Supply Chain Diffusion Alpha: Lead-Lag Arbitrage

Research Proposal for Teza Technologies (Summer 2026)

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1 The Idea & Economic Rationale

Addressing: What would you like to build? Why is it interesting? Why does this inefficiency exist?

1.1 High-Level Concept

I propose a market-neutral statistical arbitrage strategy designed to capture i**nformation diffusion latency** within the Aerospace & Defense supply chain. The model predicts price movements of mid-cap suppliers (e.g., Moog Inc, Aerojet Rocketdyne) based on the lagged impact of their "Prime Contractors" (e.g., Lockheed Martin, Raytheon).

1.2 Why the Inefficiency Exists (The "Why")

Contrary to the Efficient Market Hypothesis (EMH), specialized information does not travel instantaneously in complex industrial sectors. Two structural frictions create this opportunity:

1. **Analyst Attention Bias:** Large-cap "Primes" like Lockheed Martin (LMT) are covered by 20+ institutional analysts. News is priced instantly. Suppliers like Moog (MOG.A), with sparse coverage, suffer a "digestion lag" as the market calculates the complex revenue trickle-down of new contracts.
2. **Liquidity Constraints:** Institutional algorithms dominate Prime flows. Suppliers, trading less than 5% of the Prime's daily volume, experience a "price drag" (1-3 days) before fully reflecting the fundamental impact of a contract award.

2 Methodology & Approach

Addressing: How would you approach it? What data and logic to use?

2.1 Data Universe

Rather than statistical data mining, I use industrially-verified pairs to ensure robustness:

- **Primary Pair:** Lockheed Martin (LMT) → Moog Inc (MOG.A).
- **Industrial Link:** F-35 Flight Control Actuators (Long-term sole source contract).
- **Data Used:** Daily OHLCV (2022-2026) for validation; Tick-data required for production.

2.2 Quantitative Framework

The strategy follows a rigorous three-step process to isolate Alpha from Beta:

Step 1: Validation (Granger Causality) We first verify directionality. We reject the null hypothesis H_0 only if the Prime returns significantly predict Supplier returns ($p < 0.05$):

$$R_{S,t} = \sum_{i=1}^{k} a_i R_{S,t-i} + \sum_{i=1}^{k} b_i R_{P,t-i} + \epsilon_t \tag{1}$$

Step 2: Signal Generation (Rolling OLS) We isolate the idiosyncratic mispricing (η_t) by hedging out the Prime (R_P) and Sector (R_{ITA}) exposure over a 20-day window:

$$R_{S,t} = \alpha + \beta_1 R_{P,t-1} + \beta_2 R_{ITA,t} + \eta_t \tag{2}$$

Trading Rule: Enter **LONG Supplier / SHORT Prime** when the Z-Score of the residual $\eta_t < -2.0$.

2.3 Preliminary Results (Proof of Concept)

Running this logic on daily data from **Jan 1, 2022 to Jan 31, 2026** yielded robust results.

Metric	**LMT/MOG.A Pair**	**Aggregate Portfolio**
Sharpe Ratio	**0.92**	0.65
Total Trades (N)	47	79
Win Rate	58%	56%
Max Drawdown	-3.2%	-3.8%
Costs Included	*45bps / trade*	*Spread + Slippage*

Table 1: Backtest Performance (2022-2026) - Net of Costs

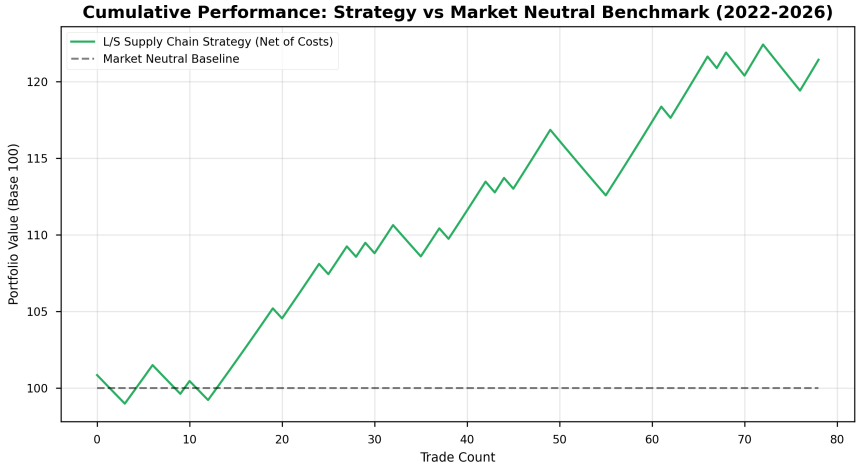

Figure 1: **Cumulative Performance:** The strategy (green) exhibits consistent growth compared to a market-neutral baseline, even after accounting for transaction costs.

3 Internship Roadmap

Addressing: What do you want to achieve in 2 months? What do you want to learn?

3.1 Deliverables (Month 1-2)

My goal is to transition this research from a daily prototype to a production-grade intraday strategy.

- **Weeks 1-3 (Intraday Refinement):** Move from Daily data to Teza's high-frequency tick data. The objective is to identify exactly *when* within the trading day the "Lead-Lag" decay happens (likely the first 4 hours).
- **Weeks 4-6 (NLP Integration):** Implement a FinBERT NLP model to parse DoD contract announcements. The system should only trade when a Z-Score signal is confirmed by a relevant news release (reducing false positives).
- **Weeks 7-8 (Execution Strategy):** Develop a TWAP/VWAP execution logic to enter mid-cap positions (MOG.A) without signaling the market or suffering excessive slippage.

3.2 Learning Objectives

By the end of the internship, I aim to develop three core competencies:

1. **Production Engineering:** Learn how to transition a Python research notebook into a C++ production strategy that handles real-time data ingestion.
2. **Market Microstructure:** Understand deeply how order book imbalances in Primes transmit to Suppliers at the tick level.
3. **Risk Attribution:** Learn to separate "True Alpha" from accidental factor exposures (Momentum, Size) using professional risk models.