# Enhancing Kairos: A Quantitative Strategy Enhancement Blueprint

From a ~1.0 Active Sharpe baseline, systematic enhancements across six dimensions can reasonably target **1.5-2.0 Active Sharpe** within 12-18 months. The highest-impact opportunities are transitioning to long-short (20-50% Sharpe improvement), adding gross profitability and protected momentum factors (+0.15-0.3 Sharpe each), implementing ML-based factor combination (potentially doubling Sharpe vs. linear methods per Gu-Kelly-Xiu 2020), and applying volatility targeting (+0.1-0.2 Sharpe). This report provides specific academic evidence, implementation guidance, and data source recommendations for each enhancement area.

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## Long-short construction unlocks full alpha expression

**The 130/30 structure represents the optimal balance** of alpha expression and implementation complexity for benchmark-aware strategies. Academic research from Clarke, de Silva, Thorley, and Sapra establishes 130/30 as mathematically optimal, Meketa Investment Group while Lo & Patel (2008) in the *Journal of Portfolio Management* demonstrated significant advantages over long-only with manageable complexity. Regulation T caps the short side at 50%, making 150/50 the practical maximum.

Expected improvements are substantial but require realistic expectations. Picton Mahoney's 130/30 backtest showed **570 bps annual outperformance** with Sharpe improvement from 0.38 to 0.72. However, the short side is structurally harder—Alpha Theory estimates a **~9% annual disadvantage** from market headwind (~5%), borrowing costs (~2%), management intensity (~1%), and return asymmetry (~1%). Stambaugh, Yu & Yuan (2015) in the *Journal of Finance* documented "arbitrage asymmetry"—the relation between idiosyncratic volatility and alpha is positive among underpriced stocks but negative and stronger among overpriced stocks. Alpha Architect

For short book construction, focus on larger-cap liquid stocks (83-84% of institutional short interest is in General Collateral stocks with 17-30 bps annual cost). Hard-to-borrow stocks underperform by **12-19% annually** per Henderson, Jostova & Philipov, but high borrow fees largely offset profits. The best use of borrow fee data may be avoiding high-fee stocks in the long book rather than shorting them.

| Configuration | Long | Short | Net | Expected Sharpe Improvement |
|---|---|---|---|---|
| Conservative Start | 115% | 15% | 100% | +10-20% |
| Standard 130/30 | 130% | 30% | 100% | +20-40% |
| Aggressive | 150% | 50% | 100% | +30-50% |

**Implementation complexity: High.** Requires prime brokerage setup, borrow cost monitoring (assume 0.75% annually for GC stocks in backtests), margin management, and compliance with Rule 201 (alternative uptick rule) and new Rule 13f-2 (monthly Form SHO filing for positions ≥$10M or ≥2.5% of shares outstanding, effective January 2, 2025). ACA Group Position sizes should be asymmetric: **1.5-2% maximum for shorts** versus 3-4% for longs due to unlimited loss potential.

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## High-value alternative factors complement existing quality and value

### Gross profitability: The single most valuable addition

Novy-Marx (2013) in the *Journal of Financial Economics* demonstrated that gross profitability (Revenue minus COGS divided by Total Assets) has "as much power as book-to-market predicting cross-sectional returns." Critically, it provides **value-like returns with growth characteristics**, offering an excellent hedge for value positions. A March 2025 Novy-Marx & Medhat paper confirms profitability explains "multiple widely-studied, seemingly disparate anomalies."

**Expected contribution: +0.15-0.2 Sharpe, IC of 0.04-0.06.** Implementation is easy—standard financial statement data, already available in Sharadar SF1. This factor distinguishes "bargain stocks" from "value traps" and combining with value increases returns while reducing volatility and drawdowns.

### Days-to-cover outperforms simple short interest

Hong, Li, Ni, Scheinkman & Yan (2016) showed days-to-cover generates **1.2% monthly return** (14.4% annualized) on long-short strategies, outperforming simple short interest ratio in 20 of 25 years tested. The signal maintains predictive power internationally and works best in less liquid stocks.

**Expected contribution: +0.1-0.15 Sharpe (short side primarily).** Implementation complexity is medium—requires bi-monthly FINRA data with 11-day delay, or ORTEX ($39/month) for daily updates. Calculate as Short Interest Ratio divided by Average Daily Turnover.

### Protected momentum addresses crash risk

Daniel & Moskowitz (2016) documented momentum crashes of **-49.79%** in the worst month, occurring during market reversals from bear to bull markets. Multiple protection strategies exist:

- **Constant Volatility Scaling (Barroso & Santa-Clara 2015):** 15.3% annual return, Jensen's alpha of 1.93%, reduces drawdowns by ~50%
- **Idiosyncratic Momentum (Hanauer & Windmueller):** Best performer in multi-model tests, Sharpe improvement >2x versus standard momentum
- **Stop-Loss Strategy (Han et al. 2016):** Reduces worst monthly return from -49.79% to -11.36%, doubles Sharpe for small caps

**Expected contribution: +0.2-0.3 Sharpe with protection.** Volatility scaling is now widely adopted by quant managers and essential for any momentum implementation.

### Classic factors show varied decay status

| Factor | Expected Alpha | Current Status | Complexity | Key Academic Source |
|---|---|---|---|---|
| Days-to-Cover | 14.4% ann. | Moderate decay | Medium | Hong et al. (2016) |
| SUE/PEAD | 2-9% quarterly | Significant decay in US large caps | Easy | Bernard & Thomas (1990) |
| Analyst Revisions | Similar to momentum | Resilient (MSCI 2025 confirms) | Medium | MSCI (2025) |
| Cluster Insider Buying | 2.1% monthly | Still effective | Medium-Hard | Alldredge & Blank (2019) |
| Options Signals | 40bps-11% ann. | Moderate, requires sophistication | Hard | Pan & Poteshman (2006) |

**PEAD has declined substantially** from Bernard & Thomas's original 18% to near insignificance in US large caps, per Chordia et al. (2014). It still exists in small caps, international markets, and less-covered stocks. **Analyst revisions remain resilient**—MSCI's 2025 study confirms sentiment "remained a valuable and resilient factor" through 2022-2025 market turbulence. **Cluster insider buying** (3+ insiders buying within 2-14 days) generates 0.9% premium over solitary purchases, with C-suite purchases most informative. 2iqresearch

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## Machine learning doubles Sharpe versus linear methods in academic tests

Gu, Kelly, and Xiu's 2020 *Review of Financial Studies* paper "Empirical Asset Pricing via Machine Learning" provides the foundational evidence: trees and neural networks are best-performing methods, with **out-of-sample $R^2$ unprecedented** compared to traditional approaches. Oxford Academic In some cases, ML methods doubled the Sharpe ratio of leading regression strategies. Semantic Scholar

### Gradient boosting is most practical for production

XGBoost and LightGBM offer mature, interpretable, production-ready solutions with excellent SHAP integration. Key hyperparameters for financial data:

- **Learning rate:** Start low (0.01-0.1) with early stopping
- **Max depth:** Keep shallow (3-6 leaves)—financial data has low signal-to-noise ratio
- **Subsample:** 50-80% aggressive subsampling is beneficial
- **L2 regularization:** Set high (~1)

**Expected IC improvement: 0.02-0.05 over linear methods.** Implementation complexity is low-medium. Neural networks (3 hidden layers optimal per Kelly/Xiu research) offer additional nonlinear interaction capture but require more data and tuning.

### Validation requires rigorous anti-bias measures

Harvey, Liu, and Zhu (2016) in the *Review of Financial Studies* ("...and the Cross-Section of Expected Returns") established that t-ratio thresholds should exceed **3.0** (not 2.0) for newly discovered factors. SSRN NBER Of 316 documented factors, most claimed findings are "likely false." Oxford Academic Harvey & Liu (2020) propose a **50% haircut to reported Sharpe ratios** as a rule of thumb for multiple testing adjustment. Duke University

López de Prado's *Advances in Financial Machine Learning* (2018) provides essential validation techniques:

- **Purging:** Remove training samples whose label horizon overlaps test period
- **Embargoing:** Remove samples after test fold end (typically 5% of observations)
- **Combinatorial Purged Cross-Validation (CPCV):** Generates multiple backtest paths for distribution of performance estimates

Libraries: timeseriescv, mlfinlab, shap for interpretability, evidently for drift detection.

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## Portfolio optimization gains come from shrinkage and volatility targeting

### Shrinkage estimators are essential with 75 positions

Raw sample covariance with 75 positions is severely ill-conditioned. PubMed Central Ledoit-Wolf (2004) shrinkage toward a single-factor model is the minimum standard; HAL Ledoit-Wolf (2017) nonlinear shrinkage provides better eigenvalue correction for larger portfolios. **Expected improvement: +0.10-0.15 Sharpe, 10-50 bps out-of-sample.**

Implementation is trivial—available in scikit-learn and PyPortfolioOpt. This should be implemented immediately.

### Black-Litterman integrates alpha signals naturally

Express your alpha signals as views in the Black-Litterman framework: arXiv absolute views ("AAPL will return 10%") or relative views ("GOOG outperforms FB by 3%"). Readthedocs Research shows Sharpe improvements of **~2.4x versus market index** when combining ML-generated views with Black-Litterman. ResearchGate The framework produces more stable portfolios with 30-50% reduction in turnover versus raw mean-variance optimization.

**Implementation complexity: Medium-high.** Use factor model residuals as views, set $\tau = 1/T$ where T = estimation period, and consider sector-relative views to avoid extreme bets.

### Volatility targeting provides reliable improvement

Moreira & Muir (2017) in the *Journal of Finance* documented significant Sharpe improvement of **0.1-0.2** for risk assets through volatility targeting. The mechanism works via the leverage effect—volatility is negatively correlated with returns—and reduces left-tail events by scaling down when volatility is high.

For a 1.0 Active Sharpe strategy, target ~10-12% annualized tracking error. Implementation: Scale exposure by target_vol / realized_vol Research Affiliates using trailing 20-30 day exponential-weighted volatility. Set reasonable leverage bounds (0.5x to 1.5x) and rebalance weekly or when volatility changes >20%.

### Position sizing via fractional Kelly

The Kelly criterion suggests $f^* = (\mu - r) / \sigma^2$ for continuous investment. Bsic With ~1.0 Active Sharpe and 16% volatility, full Kelly implies ~156% leverage—far too aggressive for real-world application. **Fractional Kelly (0.25-0.5x) is standard practice:**

| Fraction | Growth vs Full Kelly | Volatility vs Full Kelly |
|---|---|---|
| Full Kelly | 100% | 100% |
| Half Kelly | ~75% | ~50% |
| Quarter Kelly | ~44% | ~25% |

Size positions by: position_size = (alpha_i / σ²_i) × conviction × scaling_factor, with maximum single position of 3-5%.

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## Risk management priorities for strategy resilience

### Correlation breakdown during stress is the critical risk

Sandoval & Franca (2012) in *Nature Scientific Reports* documented that average correlation among DJIA stocks **increases linearly with market stress**—a universal pattern across 72 years of data. Page & Panariello (2018) in the *Financial Analysts Journal* confirmed "diversification fails when needed most," with left-tail correlations jumping 0.2-0.4 above normal levels.

**Never use full-sample correlations alone in risk models.** Build correlation regimes (normal using trailing 1-year, stress using crisis periods) and stress test monthly with crisis correlations. For a 75-position equity portfolio, assume intra-equity correlation → 0.6-0.8 in stress.

### Drawdown control via tiered deleveraging

Implement tiered deleveraging rather than binary stop-losses:

- **5% drawdown:** Monitor closely
- **10% drawdown:** Reduce gross exposure 25%
- **15% drawdown:** Reduce exposure 50%, review strategy

Use Conditional Drawdown-at-Risk (CDaR)—the average of worst α% drawdowns—in optimization. Research shows 5-15% reduction in maximum drawdown versus variance-only optimization.

### Factor hedging for long-short transition

When transitioning to long-short, always hedge market beta using E-mini S&P 500 futures (liquid, capital efficient). Rebalance hedge monthly or when beta drifts >0.1. For factor neutralization, use factor ETFs (MTUM, QUAL, VLUE) to manage unwanted exposures.

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## Data architecture for factor expansion

### Sharadar provides strong foundation with specific gaps

Sharadar via Nasdaq Data Link (~$50-150/month) provides fundamentals (SF1, 16,000+ companies since 1990), prices (SEP, 20,000+ tickers since 1998), insiders (SF2, Form 4 since 2005), and institutional ownership (SF3, 13F since 2013). Critical gaps require supplementation:

| Data Type | Recommended Source | Monthly Cost | Priority |
|---|---|---|---|
| Short Interest | ORTEX Basic | $39 | High |
| Earnings Estimates | Zacks via Nasdaq Data Link | ~$20-40 | High |
| Alternative/Sentiment | Quiver Quant | $25 | Medium |
| Options Data | Cboe DataShop | Pay-per-use | Medium |
| ESG | Free web lookups | $0 | Low |

**Estimated total: $150-300/month** for comprehensive factor coverage.

### ORTEX for short interest signals

ORTEX Basic ($39/month) provides daily short interest updates versus FINRA's twice-monthly with 11-day delay. Data includes shares on loan, utilization rate, days-to-cover, and cost-to-borrow metrics essential for both long-short construction and days-to-cover factor calculation.

### Zacks for earnings estimates

Zacks via Nasdaq Data Link (~$200-500/year) provides professional-grade earnings estimates with history since 1979, covering 4,500 US/Canadian companies. Includes consensus EPS estimates, revenue estimates, analyst ratings, and earnings surprises—sufficient for SUE construction and analyst revision momentum.

### Quiver Quant for unique alternative data

Quiver Quant ($25/month) provides uniquely valuable datasets: congressional trading (highly accurate versus SEC records), WallStreetBets sentiment, government contracts, and insider trading with predictive scores. The congressional trading dataset in particular offers **alpha unavailable from institutional data vendors**.

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## Implementation roadmap and priority matrix

### Phase 1 (Months 1-3): Foundation enhancements

| Enhancement | Expected Improvement | Complexity | Priority |
|---|---|---|---|
| Ledoit-Wolf shrinkage for covariance | +0.10-0.15 Sharpe | Low | **Immediate** |
| Gross profitability factor | +0.15-0.2 Sharpe | Easy | **Immediate** |
| Volatility targeting | +0.10-0.20 Sharpe | Low | **Week 1** |
| Asset growth factor | +0.10-0.15 Sharpe | Easy | **Week 2** |
| ORTEX + Zacks data integration | Enables new factors | Medium | **Week 2** |

### Phase 2 (Months 4-6): Factor expansion

| Enhancement | Expected Improvement | Complexity | Priority |
|---|---|---|---|
| Protected momentum (vol-scaled) | +0.2-0.3 Sharpe | Medium | High |
| Days-to-cover factor | +0.1-0.15 Sharpe | Medium | High |
| Analyst revision momentum | Similar to momentum | Medium | Medium |
| XGBoost factor combination | +0.1-0.2 Sharpe vs linear | Medium | Medium |

| Enhancement | Expected Improvement | Complexity | Priority |
|---|---|---|---|
| Black-Litterman integration | +0.1-0.2 Sharpe | Medium-High | Medium |

**Phase 3 (Months 7-12): Long-short transition**

| Enhancement | Expected Improvement | Complexity | Priority |
|---|---|---|---|
| 115/15 conservative long-short | +10-20% Sharpe | High | Phased |
| 130/30 full implementation | +20-40% Sharpe | High | After validation |
| Beta hedging via futures | Risk reduction | Medium | Required |
| Drawdown control system | Risk reduction | Medium | Required |

### Critical warnings

- **Short-side alpha is lower:** Expect shorts to generate 50-70% of long-side alpha due to structural disadvantages
- **ML Sharpe degradation:** Apply 50% haircut to backtested Sharpe (Harvey & Liu 2020) Duke University
- **Factor decay:** PEAD has declined substantially; focus on resilient factors (profitability, analyst revisions)
- **Correlation breakdown:** Stress test with 0.6-0.8 intra-equity correlation assumptions
- **Borrowing costs:** 75 bps baseline for GC stocks can erode 50%+ of theoretical short alpha
- **Multiple testing:** Require t-statistic >3.0 for new factor significance NBER

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## Conclusion

The path from 1.0 to 1.5-2.0 Active Sharpe is achievable through systematic enhancement across portfolio construction, factor expansion, and risk management. **Immediate priorities** are implementing shrinkage estimators and volatility targeting (low complexity, reliable improvement), adding gross profitability (easy implementation, robust evidence), and integrating ORTEX/Zacks data to enable new factors. The long-short transition offers the largest potential improvement (+20-50% Sharpe) but requires significant infrastructure and realistic expectations about short-side alpha generation. Machine learning factor combination can potentially double Sharpe versus linear methods, but requires rigorous validation with purging, embargoing, and t>3.0 thresholds. Throughout implementation, maintain stress correlation assumptions and tiered drawdown controls—diversification fails precisely when needed most.