MANAGER SKILL ANALYSIS

An important metric of success in the manager selection process is to ascertain whether target portfolio managers outperform their peers who exhibit a similar combination of factor exposures (or investment style), after they have been selected. Since performance of fundamental factors are subject to market cycles we posit that managers' peer group rankings are also subject to such cycles. This cyclicality of return of different market factors coupled with the performance impact of a manager's factor exposures along with their security selection skill (or lack there-of), often leads to disappointing results. This leads to lack of persistence in manager rankings with high ranking first-quartile managers falling below their peer medians over the three-year market cycle period post selection.

Aapryl believes that, by accurately identifying factor exposures and disaggregating a manager's excess return into the inherent effects of such factor influences from their skill in stock selection, one can forecast managers who have a non-random probability of out-performing the median peer-manager universe over a three-year market cycle time frame, post-selection. Accordingly, Aapryl models that above-median managers will have a higher probability of being top quartile managers with similar investment style while helping identify managers who will underperform their peer group.

The core tenet of Aapryl's process is to build passive replications or clones for every product using Returns-based analysis (RBSA) – where factor models are created to explain the asset's returns. A manager-specific clone portfolio is the more relevant benchmark against which the manager's performance should be compared to assess true "excess return". The process of identifying manager factor exposures yields a "beta" profile that can be assessed cross-sectionally across a universe of managers to determine their relative exposure. This application could be used as a starting point for segmenting the manager universe prior to the implementation of Aapryl's methodologies for forecasting peer-group ranking and relative return attribution.

Using proprietary regression techniques on the time series of portfolio returns, a manager's "style" is replicated as explained by various factors such as Value, Growth, Core, and Dividend yield. In addition to the Value/Growth style dimension, manager returns are also regressed along the Quality axis. Factors such as Economic sensitivity

(or Dynamic), Low-Volatility, Quality, Defensiveness, and Momentum are used. In summary, the clone portfolio is an investable long-only passive factor replication strategy that is easy to implement.

The Static Clone captures the average exposures of the manager's full return history since 2001. All available data series is utilized in the regression process to ascertain its dominant style exposure. Dynamic Clone, on the other hand, captures a rolling short-term (36-month window) exposure to understand the manager's recent style creep or evolution. In short, this is how the manager's style is today.

The research framework can be summarized by the following overview charts (Charts 1 thru 3). Construction of proprietary parameters and modelling of their efficacy is discussed in sections below.

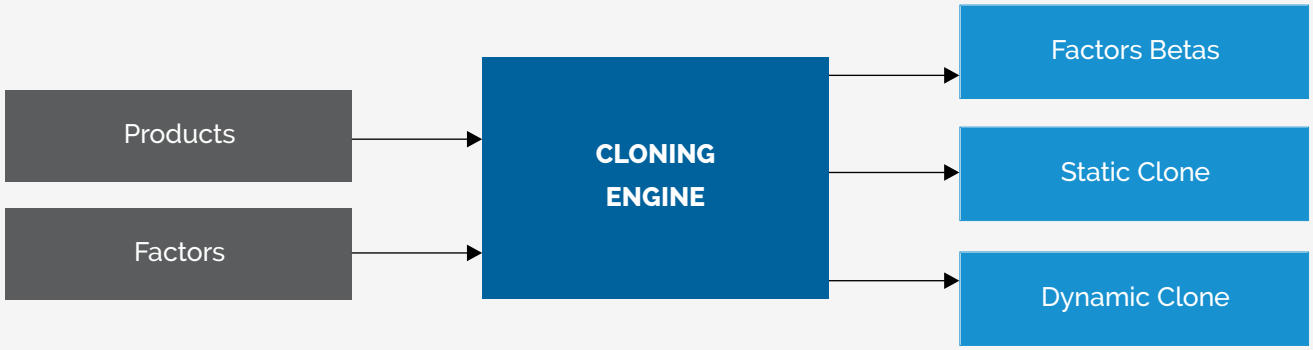

Chart 1: Overview of Aapryl's Cloning and Clustering Methodology

Chart 2: Aapryl Excess Return Model

Aapryl posits that the measure of a manager's true excess return is the difference between its returns and that of the static clone, which is created with the manager's passive factor exposures. This style-adjusted excess return is attributable to the manager's active decisions and hence is the true alpha.

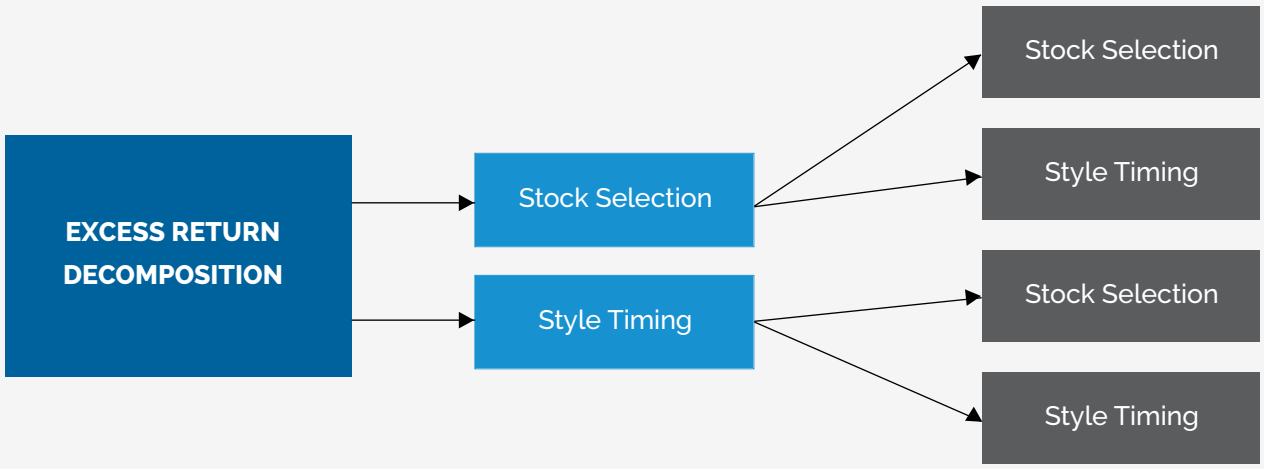

Chart 3: Aapryl Decomposition of Excess Return

The two streams of excess returns - Stock selection and Style Timing – measure a manager's drivers of alpha generation.

Style timing alpha embodies the excess return that is attributable to the dynamic changes in the manager's factor exposures. In other words, it captures short term style versus long term style and is measured as the difference between the manager's dynamic and static clone portfolio returns.

Stock selection alpha, which is the dominant driver of equity returns, is the difference between total excess return and the style timing excess return. This is the portion of alpha that cannot be explained by the dynamic factor exposures of the manager and it is the "true" alpha generated by active security decisions.

Methodology:

1. As described above, a clone portfolio for each manager is developed to capture the manager's style driven performance. We believe that the manager's specific clone portfolio is a more appropriate and accurate benchmark to measure against the manager's true excess return. Quadratic Programming (QP) constrained regression technical is applied to nine fundamental factors, which include Value, Growth, Core, Dividend Yield, Quality, Volatility, Defensive, Economic Sensitivity (Dynamic), and Momentum, to construct the clone portfolio. The definition of each of the factors is provided in Appendix 1. The regression methodology adds realistic constrains to the outcomes where each factor exposure is positive (within the range of 0% to 100%) while the sum of all factor exposures adds up to a total of 100%. This in turn avoids betas that are unrealistic to replicate for the clone portfolio. In another words, the clone portfolio is a transparent and investable long-only factor replication strategy that is straightforward for investors to implement in practical scenarios.

2. The data series is utilized differently to perform the dynamic QP constrained regression (rolling 36-month data series) and the static QP constrained regression (all available data series) to capture the manager's short-term style evolvement and long-term dominant style influence. For the dynamic QP constrained regression, a (24,12) central weighting scheme is employed where past 24 months and forward 12 months of data series is taken for the rolling 36-month time window.

3. Managers excess returns are then calculated relative to their static clone return, to derive their excess return relative to the manager's passive factor exposures. We believe that this style adjusted excess return represents a manager's true alpha that is attributable to their "active" decisions. This style adjusted total excess return can be further decomposed into two complementary skill streams: style timing and stock selection alpha, that in turn helps disaggregate the sources of excess returns. Style timing alpha, which is the excess return attributable to the dynamic changes in the manager's factor exposures, is defined as the difference between dynamic and static clone portfolio returns. The residual, which is the portion of excess return that cannot be explained by the long-term factor exposures of the manager, is then classified as the stock selection alpha. It then embodies all active security selection decisions made by the manager.

Excess Return	Manager Return – Static Clone Return
Style Timing Alpha	Dynamic Clone Return – Static Clone Return
Stock Selection Alpha	Excess Return - Style Timing Alpha (Manager Return - Static Clone Return) - (Dynamic Clone Return - Static Clone Return) Manager Return - Dynamic Clone Return

4. The next step is to construct the proprietary edge and consistency measurements based on style timing and stock selection alpha to provide granular insights behind the alpha drivers. The edge component intends to measures the magnitude of the manager's style timing and stock selection alpha. Philosophically, the Edge measure is designed to capture the full distribution of wins and losses, giving credit for large and infrequent returns, similar in approach to the Omega ratio. On the other hand, the Consistency component intends to capture the manager's ability to be consistently outperform their static clone.

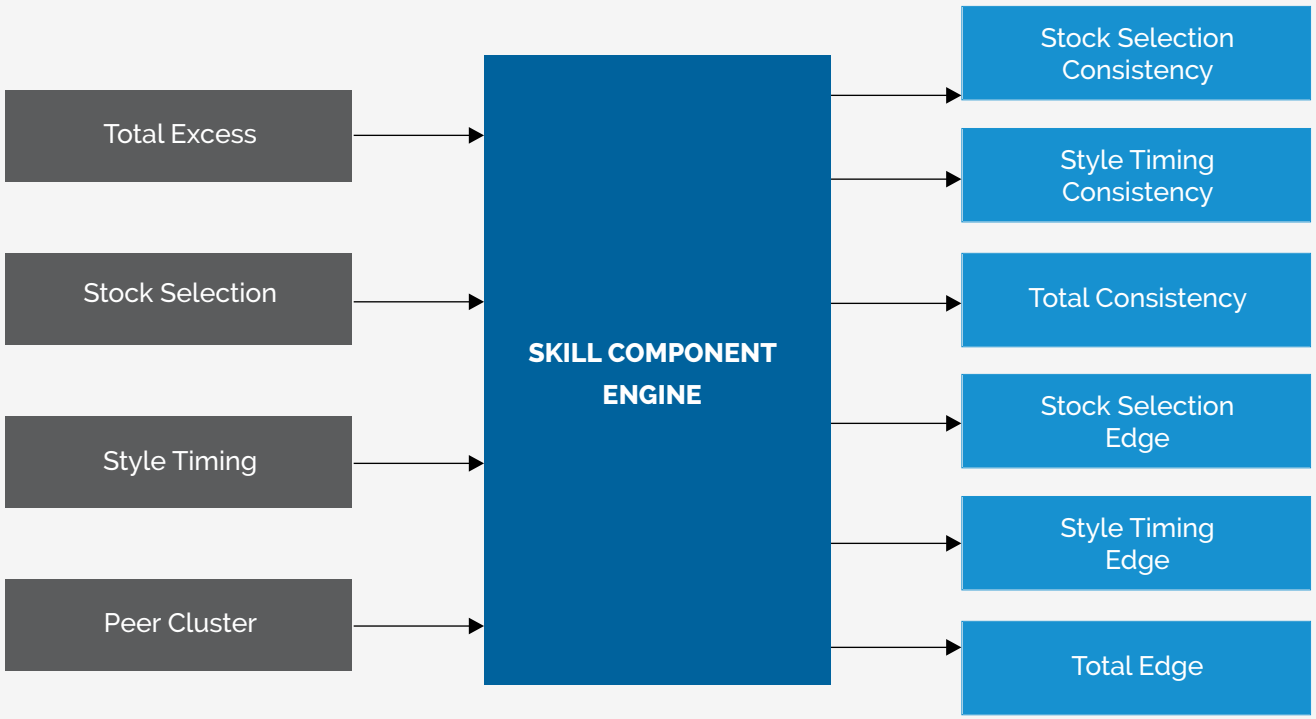

Chart 4: Aapryl Skill Components Model

5. To construct the style timing edge component, the manager's geometric compounded alpha at each quarter-end is calculated by using the monthly style timing alphas within that quarter. This is then converted into a cross-sectional z-score by using the peer group style timing alpha average and standard deviation at each quarter. Conceptually, this captures the cyclical nature of manager's alpha and rescales the performance accordingly. Note that the peer group for each manager was created by Aapryl's clustering methodology that classifies six clusters/peer groups for each universe. The detailed research framework for clustering analysis is documented in a separate paper. An average of all available quarterly z-scores is taken and an adjusting parameter is applied to account for the sample size at each quarter. This adjusted averaged z-score is stored as the manager's style timing edge metric. The manager's stock selection edge construction follows the exact same process as style timing described above except that the input is now the stock selection alpha. The metric of Total Edge is also similarly developed.

6. Aapryl's consistency measure is a proprietary batting average type statistic that quantifies the likelihood that a manager's returns are coming from a true investment edge, rather than random noise. To construct the consistency components for style timing and stock selection alpha, a binary variable is used to represent outperformance and underperformance respectively. In summary, an inverse binomial distribution probability function is calculated to measure the "batting average" based on a rolling 24-month window. Cross-sectional z-score calculation is then done and stored as the manager's style timing, stock selection, and total consistency measurement.

7. These six independent components (style timing edge, stock selection edge, total edge, style timing consistency, stock selection consistency, and total consistency) are the foundational blocks for Aapryl's forward-looking proprietary probability score calculation – which in turn are important inputs for predictive analysis, skill screening, and portfolio optimization modules.

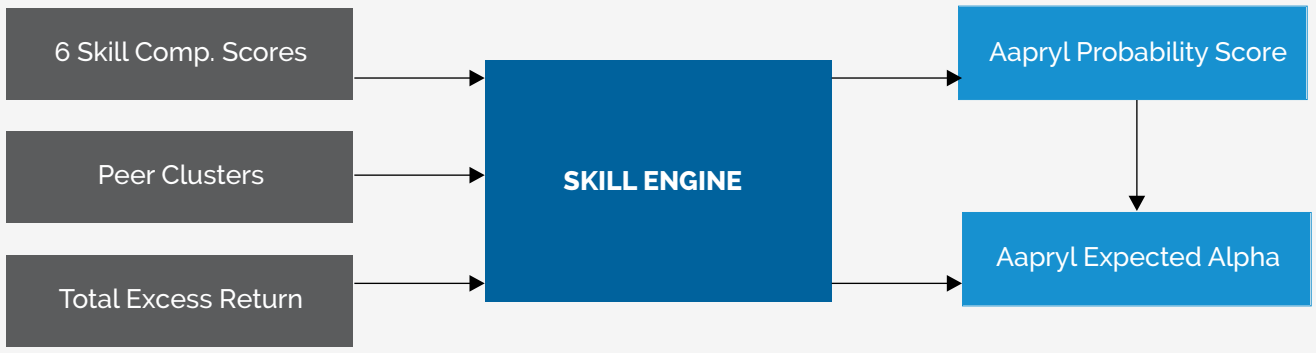

Chart 5: Aapryl Score Model

8. Compared to other quantitative assessments, the Aapryl Score goes one step forward in providing a predictive indicator. A machine learning engine (using neural network algorithm) is utilized to hone in on the accuracy of the prediction for sampled datapoints. Aapryl score attempts to answers the question, "compared to the average manager how incrementally likely is a manager to finish in the top quartile over the next 3 years?" A random likelihood of outperformance would be a 0% Aapryl Score. Any positive score can be interpreted to mean that the manager is forecasted to have a more than random chance of outperforming with a higher likelihood to finish in the top quartile (versus a random chance of 25%). The inverse is true for negative scores.

9. The dependent variable that we forecast in manager skill screening framework is the 36-month forward looking manager skill score which is defined as the Z score of manager excess return relative to their static clone return. The Z score was calculated cross-sectionally by using the manager's peer group average and standard deviation. We applied the Quadratic Programming (QP) constrained regression technique to all the independent variables and required that the respective beta coefficient to each independent variable to stay in positive territory.

To further elaborate the skill based alpha framework with an example - "Manager A – Select Large Cap Value" is the selected manager. All of the following outputs are based on results from different steps of the style analysis research framework described in this paper.

Chart 7a shows that by using traditional excess return measures, Manager A outperformed its benchmark by 0.09% (ann) since inception - primarily due to a favorable style environment (+1.71%). However, performance breakdown using Aapryl's proprietary factor analysis paints a different story. When compared to its replicated clone, the manager delivered negative excess returns of -1.62% - exemplifying negative skill. On taking the analysis one step further, we notice that the bulk of the underperformance since inception (-1.34%) came from weakness in the all-important stock selection skill metric. Style timing was also a negative contributor (-.28%).

Moreover, with a negative Aapryl score of -18.54%, this manager is 18.54% LESS likely than an average manager to finish in the top Quartile during the next 3 years. Since we know a random manager has a 25% chance, we estimate this manager has a 20.4% chance (18.54% decrease from average of 25%).

Excess Return Statistics

Manager	5.85%
Benchmark	5.75%
Static Clone	7.46%
Dynamic Clone	7.19%
Traditional	
Manager Vs Benchmark	0.09%
Excess Decomposition	
Style Environment (Static Clone - Benchmark)	1.71%
Return from Skill (Manager - Static Clone)	-1.62%
Skill Decomposition	
Style Timing (Dynamic - Static)	-0.28%
Stock Selection (Return from Skill - Style Timing)	-1.34%
Aapryl Score	-18.54%
R-squared	84.30%

**Annualized since inception*
*** Skill/Clone returns are annualized from 2001*

Chart 7a: Return Statistics (since Inception)

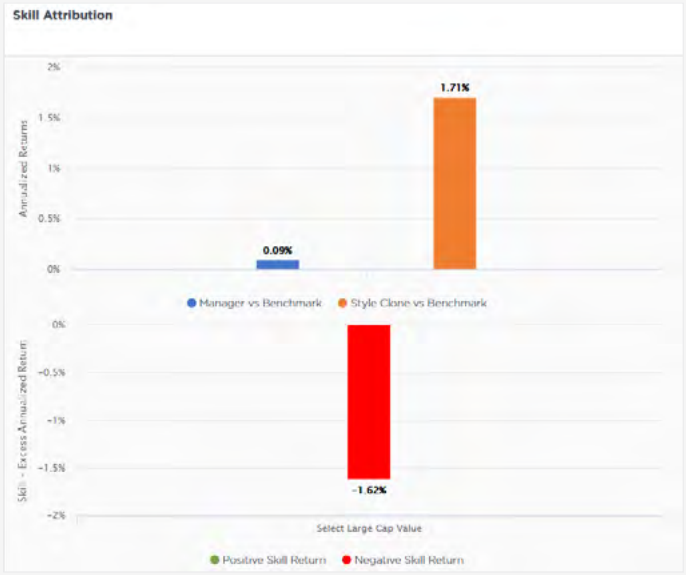

Chart 7b : Components of Excess Return

The final chart below (chart 8) shows the evolution of the proprietary Aapryl score (in yellow plotted on secondary y-axis) over time along with the manager's percentile values for all 6 skill components (style timing edge, stock selection edge, style timing consistency, stock selection consistency, total edge, and total consistency).

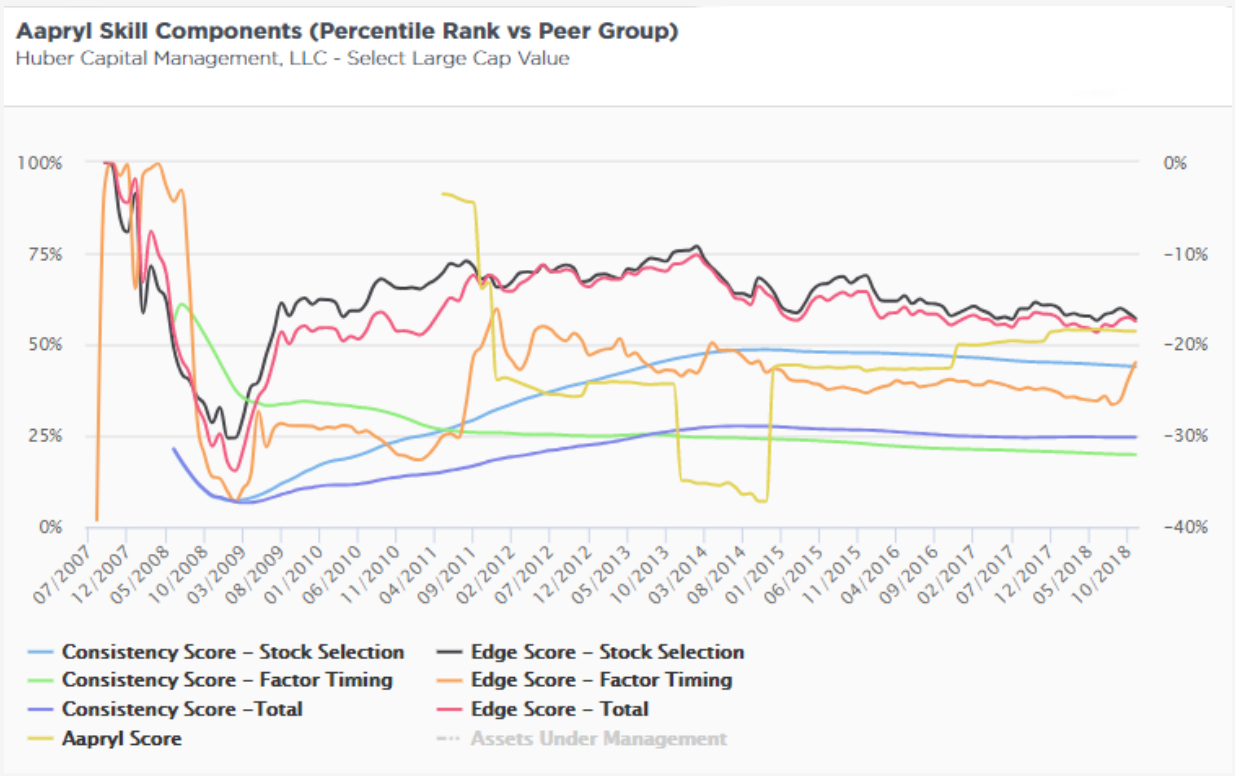

Chart 8: Aapryl Score & Skill Components over time – since inception

Appendix I: Factor Definition

Growth: measures the performance of companies that have growth characteristics such as high growth rates, price to earnings or price to book ratios.

Value: measures the performance of companies that have value characteristics such as low price to earnings or price to book ratios.

Momentum: measures the performance of companies that exhibit high price momentum relative to the market.

Quality: measures the performance of companies that exhibit high quality relative to the market based on characteristics such as ROA, leverage and earnings stability.

Yield: measures the performance of companies that have a higher dividend yields relative to the market.

Volatility: measures the performance of companies that exhibit relatively lower volatility.

Economic Sensitivity: measures the performance of companies that have relatively less stable business conditions and are more sensitive to economic cycles, credit cycles and market volatility.

Defensive: measures the performance of companies that have relatively stable business conditions which are less sensitive to economic cycles, credit cycles and market volatility.

For more information on how Aapryl's proprietary methodologies can be used please contact us at **info@aapryl.com**