The 90’s marked a period of monumental change in the way the brokerage industry transacts its day-to-day business. As trading technology continued to advance, the founders of Quantitative Science Technologies LLC (QST) observed two major shifts in the investment community. First, the transaction process had been automated to the point where revenues resulting from transactions had dropped dramatically. Next, the retail brokerage community found an increasingly greater portion of its long-held market share eroded by discount brokerage firms serving customers via the Internet.

Based upon QST’s theory that the next process to be automated would be the investment management process, the concept of the Virtual Portfolio Manager was born. When looking at the industry as a whole, it became obvious that successfully managed funds such as those found within the Fidelity Group had developed a systematic approach to money management. Their ‘winning strategy’ was being implemented predominantly by new hires only recently out of graduate school. These market rookies were being placed in front of a computer monitor and suddenly, they were successful fund managers. Was it possible that these individuals were actually seasoned traders or ‘born fund managers? The answer is “no!” Their success hinged totally upon the structured process they employed in trading these funds.

It was clear that Fidelity and other market leaders had developed the proprietary in-houses processes necessary to carry out objective and disciplined trading strategies. Because of the resulting success of such systematic approaches, these industry giants have watched as their combined assets grew from billions to trillions over the past decade.

But where did the success of these industry magnates leave the independent broker? And what could be done to ensure that an equally viable…if not superior…process was available to them? That was the question QST set out to answer in the development of its proprietary Virtual Portfolio Manager. Following years of testing and design, this original concept took its shape and form in the VPM product offered today.

The Virtual Portfolio Manager

The Virtual Portfolio Manager (VPM) concept differs markedly from other systematic approaches currently in use in the industry. The VPM’s modeling process is attached to each stock within a given portfolio. The set of rules which comprise the models within VPM are applied to each stock in the portfolio, yielding a recommended market position for each issue. The results of the model logic are then forwarded to the proprietary allocation methodology which adjusts the necessary mix of assets to diversify and provide the potential for better-than-average, risk-adjusted returns.

The virtual portfolio modeling process will only hold stocks in the portfolio which are showing positive cash flow. Therefore, it is conceivable that at a given point in time, a 100% cash position could occur. Because of its dynamic nature, this process provides the environment for risk-adjusted returns that consistently outperform the market indices. Such returns are achieved by combining the decision-making process accorded each individual stock in its universe with a linear portfolio concept. The VPM balances cash with equity diversification to manage risk exposure within the equity markets.
Market Dynamics

Stock market patterns evolve through several cycles during a trending phase. There are several known characteristics of trends in the stock market. The Advance/Decline Line will be the basis for this discussion in determining the different cycles of a trend.

The beginning cycle follows a declining period and is considered the bottoming phase. During a market decline, the declining issues well outnumber the advancing issues. However, once the market finds relative value, the Advance/Decline statistics begin to flatten out. The prices in the market then begin a basing or bottoming phase. During this phase, several emerging ‘bargain’ issues will pique buying interest and begin to appreciate, causing a shift in market psychology. As the bottom forms, more and more issues will begin to advance causing the indices to initiate an upward move.

The next phase of trend development occurs when the original leaders ‘off the bottom’ begin to accelerate and ignite even more interest by market participants. This phenomenon triggers an expansion of the list of stocks emerging as market leaders.

As participants become more positive about the prospects of the market and cash flows expand further, causing the advancing issues to outpace the declining issues, prices begin to accelerate. This phase usually builds into a frenzy, resulting in a ratio of three-to-one or more in favor of advancing versus declining issues, triggering prices into a sharp rise. Once the frenzy has continued much longer than expected, a change in psychology occurs.

At this stage, market participants become concerned about the levels of the market and begin to debate the relative value of stocks in general. As this shift in market psychology takes hold, market participants focus on real earnings and economic considerations as the market approaches the strongest phase of the trend. This stepped-back, realistic review of the situation typically causes the market to peak and/or experience a downward reversal. As a contra-trend movement or correctional phase unfolds, a rotation of assets begins. This becomes the basis for the final phase of the trend in which a very selective rally comprised of only a few stocks leading the way.

Because this phase represents the ‘top’ or the completion of the trend movement, the next phase will begin a broader-based decline or correctional phase. Once the market participants are convinced the top of the trend has been reached, a downward pattern or declining phase will emerge, unfolding in direct contrast to the uptrend as the number of advancing issues contracts while the declining issues expand. The market will decline to find its relative value and embark upon a basing stage or bottoming phase. This cycle then repeats itself again and again, with some cycles exhibiting both bullish and bearish runs extending for various periods of time.

The above overview of market-trend mechanics forms the groundwork for the systematic trend-following analysis incorporated into the VPM process.
The development of the models used by the VPM was based upon the real-time trading experience of the developer and cofounder of Quantitative Science Technologies, LLC, Robert L. Kendall. With experience and expertise drawn from over fifteen years of successful trading, his trading philosophies have been tested, validated, and shown to stand the test of time. The basis of Mr. Kendall’s trading process emerged from an in-depth understanding of market mechanics including intricate market pattern and technical analysis. Currently, a similar process also developed by Mr. Kendall produces the quantitative projections as reported in “The Daily ‘Quant’ Fixed-Income Report.” It is estimated that this institutional research product influences over ten billion dollars of trading assets in the U.S. Government Bond market.

As with this original process, the VPM was developed based upon quantitative modeling rules and procedures. The trading models analyzes time-series data for patterns and momentum characteristics. The models then calculate a probability factor for a new trend to develop or an existing trend to continue or end. More than forty variables are considered at different phases of each individual trend development and ultimately determine the buy, hold, or sell (exit) strategies.

Most quantitative models used in this industry have been formulated by mathematicians who believe some ‘magic formula’ will yield successful trading results. While it is feasible that a valid and profitable process could emerge from such an effort, it has been our experience that a thorough understanding of market mechanics and patterns along with a solid statistical approach will stand the test of time. The process utilized by the VPM has been in use in an out-of-sample environment for six years. It has also been tested across a large spectrum of stocks and financial instruments, aiding in the high level of confidence currently enjoyed by the process.

As a reflection of human thought and emotion, the market possesses pattern and structure. Although not always easily discernible, the structure of the market becomes clearer when it is broken down into parts. Each part can then be analyzed individually as well as with respect to the whole. Market patterns have been compared to such things as ‘stairs’ and ‘waves.’ Each of these comparisons shares a common denominator: The premise that the market does not advance or decline in a straight movement.

Market movement occurs in increments, each with its own unique components which together form the whole. Each of the larger components consists of smaller components…similar, but on a smaller scale…and each of the perceived ‘wholes’ are actually components of a larger whole.

The critical challenge of quantitative modeling arises in determining when each of these steps or waves ends and a new one begins. Because each component contains several smaller components, it is often difficult to distinguish which is part of the preceding structure and which is part of the ensuing structure. Although 20/20 hindsight provides the only 100% validation of a correct assumption, the modeling process employed by the VPM has proven highly successful in making accurate determinations regarding the beginnings and endings of major market cycles.

The software routines utilized by the VPM are designed to identify the pattern and phase of individual stocks. This is accomplished by engaging a proprietary pattern-recognition
algorithm. Prior to launching the algorithm, four ‘Price Pressure Momentum Indicators’ (PPM’s) are examined. PPM’s #1, #2, #3, and #4 are linked to the patterns of four different phases of trend development. These indicators identify multiple time-frame momentum patterns associated with underlying price series data and thus aid in the identification of emerging trends.

Many trend-following approaches use moving averages in some way. What differentiates the VPM approach is that these averages only represent the beginning of the process and are used to determine trend strength and market phase in accordance with pattern structure. The VPM process then examines the configuration of the PPM’s to determine whether the market is in a trending or corrective wave sequence.

The objective of the VPM rule base is to determine the current direction of price movement; the PPM’s are the foundation of this process. Such movement is limited to three possibilities: upward, downward, or sideways. This determination of movement provides the basis for which the integration of pattern rules assists in the trading process. By employing the moving-average rules, the phase of a particular market sequence can be determined by examining the market structure, momentum levels, and price objectives.

Crucial predictor incorporated into the trading models philosophy is the Fibonacci Price Objectives. Geometry and Fibonacci ratios play an important role in technical analysis. Most market advances and declines are proportional to other moves, and are therefore predictable to some extent.

Because several potential price targets can be generated from each preceding move, other tools which employ timing as well as price must be integrated to eliminate low-probability objectives. Price objectives which are attained during a convergence of cycles or when other indicators signal an extreme price target are more reliable than those which occur on their own. The philosophy trading models consider these factors when arriving at a decision to buy, sell, or hold a given instrument.

In conclusion, the VPM process represents an infinitely dynamic operation in which the logic is provided the ability to cover a large sampling of prices and economic cycles, thus lending to the model a solid, statistical basis for continued success. We believe the combination of an innovative, robust trading system with a sound methodology for allocating risk across a diverse portfolio of products creates a process capable of generating excellent risk-adjusted returns.
The logic begins its process by recognizing there are no current positions (market positions equal zero.) Once this has been determined, the analysis begins. In this section, we will review some basic ‘buy’ criteria and patterns which the models recognize as viable for entering long positions.

The VPM logic monitors the progress of emerging trends. In portfolios modeled for ‘long-only’ positions, the following process unfolds:

1) The logic looks for positive position entry conditions.
2) If the conditions to ‘buy’ are recognized, an order is issued.
3) Once a position is entered, a secondary task of monitoring the trade begins.
4) The models test each new data point for ‘exit’ and ‘stop-loss’ criteria.
5) If exit rules or stops are selected, a liquidation order is issued.

The following describes some of the basic signals generated by the VPM logic:

**Phase One ‘Buy’ Signal**

The chart below illustrates a Phase One ‘Buy’ Signal.

This signal locates a bottoming formation in which the PPM’s locate a trend reversal after an elongated downtrend. Notice the moving averages as the market unfolds in a low momentum uptrend. The models address this type of trend by understanding the appropriate volatility level to maintain the position as the trend unfolds. This trade was maintained for almost two years. This type of configuration typically emerges with highly liquid stocks such as IBM.
Phase Two ‘Buy’ Signal

The chart below illustrates a Phase Two ‘Buy’ Signal.

This signal is generated when a basing pattern has occurred and the logic is unable to determine a high enough probability for the stock to appreciate during the bottoming phase. Typically, this situation unfolds when a combination of a breakout above the basing pattern occurs as the PPM’s reveal a momentum surge.

In 20/20 hindsight, this trade signal often appears to be a late entry. However, VPM users must keep in mind that the basis for all trades issued by the models is signals showing a ‘high probability’ for appreciation; not the lowest entry or perceived price point. So while in retrospect, one can identify what appears to be a better entry point, VPM utilizes its pattern recognition approach in combination with several other factors to raise the probability for a successful trade.

Note: The above chart also illustrates an exit that was triggered by a ‘Trailing Stop.’
This entry signal emerges from a high-level consolidation pattern. Often, stocks will rally sharply over the course of several months and the logic will exit a previous trade entered on a Phase One or Phase Two signal. Several months of sidewise trading may then unfold. During this time, the VPM’s logic is monitoring the pattern for the potential for a rally to continue.

The Phase Three signal represents a combination of a pattern breakout and momentum along with corresponding probability factors. When this trade is issued, it is not uncommon for a small loss to be experienced as evidenced on the first trade illustrated above. This is likely to represent the most difficult trade for an individual trader to make on his own.

The criteria for this trade to be issued is often associated with a low probability factor. However, due to the sidewise pattern, it is possible for the risk of this trade to be controlled more easily than in Phase One or Phase Two trades.
Exit Rules

The VPM logic incorporates several exit rules which can cause a position to be abandoned.

The logic also considers several other conditions for issuing an exit signal on a particular position. Some of the most critical areas of monitoring concern seeking indications of downward reversal patterns, cyclic, and momentum failures.

This monitoring is accomplished through the use of the proprietary ‘Cycle Finder’ logic, Price Pressure Momentum Indicators, and Pattern Finders. Approximately forty-to-sixty percent of the exits issued are a result of this process which allows for outside reversals combined with other negative factors to launch the process to determine exits. The models monitor such events and then place a probability factor on the trend ending.

When several rules fire simultaneously, it raises the probability that the market has reached a peak value. If such an occurrence is followed by a break of the pattern or a key moving average on which the models have placed a critical value, an exit signal will be issued.
The Portfolio Allocation Module is by far the most critical component of the VPM modeling process. This module interacts with trade signals to determine how best to utilize all capital at any given time. There are two allocation modes available to VPM users: weighted and linear. For illustration purposes, the ‘linear’ process is presented below.

Naturally, the process begins with 100% cash/T-bill positions based upon the total funds available to place into the portfolio. Following the development of the individual Manager’s stock list, the VPM process launches an eight-year track record analysis of each included stock. Each calculation is then subjected to the ‘Long’ and ‘Short’ rule base.

The resulting calculations are integrated into the VPM’s Allocation Module based upon the Manager’s predetermined risk levels. At this point, the portfolio is established. As the dynamic modeling process continues throughout the life of the portfolio, exit rules are invoked to ensure risk-adjusted returns are achieved through the careful balancing of equity exposure versus cash.
When a portfolio is submitted to QST, the modeling process is set for one of three basic risk profiles: Conservative, Moderate, or Aggressive. The selected profile reflects the risk-adjusted returns desired by the end user and is achieved by stipulating a maximum allocation factor. The allocation model then interacts with several factors, including the amount of a given position held at any one time.

The linear process is unique in its attempt to maintain a balanced portfolio across all active positions with a maximum allocation factor applied within a dynamic environment. A general rule of thumb is that the maximum number of open positions held by the portfolio on a historical basis is around 70% of the total number of stocks in the portfolio. Because of market price fluctuations and the fact that each stock appreciates at differing rates, the ideal balance is never actually achieved. It is a paradox of immense significance to the stellar results of VPM that this is so. This maximum position typically occurs when the market indices are exhibiting a sharp rise with a strong advance/decline ratio profile.

**Example:** 60 stocks in a given portfolio would result in a “maximum historical position” of 42. There are several ways to set up the portfolio mix.

If transactions are of concern, the portfolio will be tested first to see the position distribution and the number of current positions. The profile of a portfolio which has been mixed for minimum transactions tends to remain in fifteen to thirty percent cash positions approximately forty percent of the time. Only about ten percent of the time is the portfolio fully invested. The chart below illustrates the profile of a portfolio balanced in this manner over an eight-year test period. Notice its shape shows an even distribution of assets over the backtest period.

The above profile will offer the portfolio manager a solid, risk-adjusted return. The most fundamental task of the equity portfolio manager is the construction and maintenance of superior portfolios. For an active management process such as the VPM, this means balancing return expectations against risk projections and incorporating cost concerns to maintain the manager’s perceived ‘value-added’ position with customers.

When defining a portfolio’s variables (such as a maximum allocation factor), it is critical that the probabilities and expected volatility are examined closely to determine the real risk of a portfolio structure.
The Allocation Process Explained

The VPM model is able to generate realistic expectations of solid risk-adjusted returns though its use of a mean-variance algorithm which takes into account the interaction between volatilities of the stocks and transactions.

The primary difference between a ‘conservative mix’ and a moderate or aggressive portfolio mix is based upon the how quickly a portfolio reaches the fully invested phase. This process represents a fine balancing act between maximum positions and the efficient use of available capital.

The **VPM Allocation Module** progresses through the following four stages:

1. Cash to fully invested
2. Fully invested to fully diversified
3. Fully diversified to rotation of assets
4. Rotation of assets to final liquidation phase

The following chart represents the profile of an aggressively mixed portfolio. Notice its shape as an ascending triangle. This illustrates the VPM module maintaining a larger portion of capital working most of the time. An aggressive portfolio will remain invested in the area of the seventieth (70th) percentile of capital the majority of the time.

The aggressive portfolio mix typically returns the highest net profit due to maximized capital utilization. However, this mix raises the volatility of the process and increases the total number of trades by approximately forty percent.

If a manager seeks a high, risk-adjusted return, the aggressive profile will achieve this goal. It is understood that all equity managers are evaluated to determine ‘value-added’ capabilities for their customers. To win repeat business and ensure that customers fully appreciate this strategy, the VPM philosophy associated with this profile must be clearly stated to the customer. While the number of transactions may appear ‘heavy’ to the uninformed, a further analysis and accompanying explanation is necessary to relay the absolute value of such transactions to the VPM management process.

In reviewing the number of transactions associated with a given portfolio, it is important to understand that approximately ten-to-fifteen percent of the orders generated are rebalancing orders or reallocation of assets. The VPM is designed to allocate an equal percentage of assets to each buy signal generated by the trading models. If the profile of a given portfolio has a historical maximum position of 42 and the maximum allocation is set to 2.5%, this will result in the models reallocating assets from time to time.
The Allocation Process Explained

At the beginning of a market cycle, the VPM portfolio will be in a large cash position. As buy orders are generated for each stock in the account, the following scenario will unfold. Once all of the cash has been allocated, the models must generate sell orders to raise the necessary capital to accommodate new buy orders as issued by the trading models.

If the allocation model has been set for a maximum of three percent of total assets to be slated for any stock, the account will reach the fully invested point at around 33 positions. Actually, the portfolio can reach fully invested at some point prior to 33 positions, and in fact you hope it does, since, if the early signals have appreciated, therefore the percent invested in the portfolio will be greater than the original amount allocated.

“The VPM process is never attempting to ‘buy’ at the precise bottom or ‘sell’ at the precise top; rather it allocates capital to what is projected to be the most dynamic portion of each stocks appreciation or trend.”

Each time the trading models issue a new buy signal, the allocation module looks first to cash for the acquisition. If there is insufficient cash available, it will then evaluate all remaining positions. As the allocation module analyzes each position which has appreciated, the needed cash is raised as the models signal to liquidate portions of those positions which are at levels most above the maximum allocation factor.

The theory behind selling the most appreciated assets is twofold. The first is based upon the maturity or average-holding period which is determined for each stock at the time of purchase. Each additional week a given position is held, its trade profile suggests it is nearing its maximum holding period. It is thus perceived that those stocks which have been held the longest and appreciated the most have the highest likelihood of creating the most volatility in the portfolio. By selling such assets (or portions thereof) at this juncture of market development, the models are able to realize profits and reallocate the assets to a new position.

The second key aspect of the theory is based upon the assumption that a new position has a higher probability to appreciate than an asset which has been held for several months. Although not always the case, this is the point at which the VPM process begins to accelerate its returns. In effect, there is a pyramiding of capital based upon the theory that the new position has new (and superior) probabilities for appreciation. Such reallocations typically result in a faster multiplication of capital. It should be anticipated that an increase in transactions will occur during this portion of the allocation process.