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Improving charting decision making for stock market investors using collaborative agents

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إهداء:

إلى روح والدي الغالي الذي فارقنا بجسده فقط

إلى أمي الحنونة الرائعة التي طالما حثتني على النجاح

إلى زوجي العزيز وأحبتي الصغار بيسان وسعيد

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Abstract

The aim of research work is to demonstrate the power of using intelligent agents in the stock market domain. In the stock market, traders, whether experienced or naïve, are increasingly relying on software tools hoping to get some help in making profitable financial decisions. Some of these software tools are based on fundamental analysis; others apply technical analysis, while the more sophisticated tools use both techniques in addition to providing a large category of data graphs. However, these tools are not always sufficient for stock market analysts to make the correct buy and sell decisions. The stock market is a very complicated medium which is affected by many factors such as news, weather, and politics which all affect our perception of the market. The stock market is also affected by human behavior; when investors trade under pressure they trend to take decisions based on their fears or greed thus making incompetent, costly decisions.

In this research work, we take stock market analysis tools one-step further by using collaborative agents to help bringing more objectivity to the process of buying and selling shares. The aim of the thesis is to illustrate the power of using agents in these tools and the advantage of modeling investors' characteristics. An industry standard software application is beyond the scope of this tool, we introduce in the research work an agent-based prototype that contains group of agents designed to perform certain tasks with a meta agent capable and issuing the correct buy and sell signals. The first group models traders with different characters, personalities and motivations. The second group represents the decision-making process depending on technical analysis signals, some basic companies' ratios, and human personalities. The third group of agents represents data gathering, newsgathering and detailed analysis.

Chapter One

Introduction

Approximately a decade ago, the Internet and the World Wide Web became an integral part of our world. The Web has grown from a theoretical concept to an integral part of our lives, and most companies, non-profit organizations, government agencies and academic institutions either already have a websites or are in the processes of creating one. As result of the Internet revolution, the world has become a global village where people, organizations, and businesses exchange a wealth of information and resources. Taking into account the effect of e-commerce on traditional business practices by providing direct international access to information and products, the Internet has provided a venue for the stock market in which many investors from all over the world can join the market and exchange information through the Internet. Today, investors come from different social, economical and educational backgrounds. There are the professional traders who manage large portfolios, face fierce competitors, and work day and night to gain money and avoid losses. Then there are the average employees who have jobs, families and a fixed income who would always like to have an additional source of income. There are also the Moms and Dads (many of whom are retired) who have a limited income and would like to improve their standards of living and guarantee a better future for their kids. The majority of the people who belong to this segment have little experience in the field, and perhaps the only thing they know about the market is that it is a place to gain extra money. Unfortunately, when the majority of those people enter the stock market they are overwhelmed and become alarmed when they realize that they are not prepared to making trades. As a result, a lot of these investors lose their life savings and end up with a bad experience. On the other hand; there

are those individuals who enter the stock market for adventurous purposes and may be even thing of the market as a place for gambling. Regardless to which segment the investors belong, or their level of experience, they all have one thing in common and that is to make profit and avoid losses.

According to Alexander Elder, "Trading is the information game." (1)To help traders make profit and avoid losses, many commercial software tools are available in the market. They analyze the market data in depth and provide meaningful information to the traders. The information generated from these tools allows the traders to avoid boring calculations and the graphing process, and enables them to see the market situation from a wider view and make well informed decision.

The stock market analysis software tools could be classified according to different factors and the type of analysis used in the tool. In the market there are two broad types of analysis: fundamental analysis, which focuses on calculated ratios; and technical analysis in which financial indicators are used and the analyst looks for trends, bottoms and patterns in the charts (both types will be discussed in more detail in the next chapter). There are three types of traders: target traders, short-term traders, and long-term traders. Target traders, also known as day traders, include traders who buy and sell several stocks in the same day. Short term traders are traders who hold stocks from several days to a few weeks before trading these stocks. Long term traders are traders who hold stocks for a year or more before selling them. Each type of these traders needs different techniques when assessing which stocks to purchase and sell, thus each needs a specific suitable software for his/her business.

In his book, **Trading for a Living**, Alexander Elder divides the stock market software systems according to the way they introduce the results. These systems fall into three groups. The first group is the *black box software*, only those believing in magic boxes and have a very limited experience in the stock market would buy this type because this kind of software

generates end results (buy, sell, hold, wait, etc.) without giving any reasons as to why any of these recommendations is issued. This approach works only for a limited period of time because the nature of the market is continuously changing; yet the software always remains the same.

The second group is called the *toolboxes* that enable the investors to display different charts, generate a voluminous amount of data, and use a large number of technical indicators. Furthermore, they give trades the option to design their own indicators, modify existing indicators, or search the stock market for companies with certain characteristics. Tracking this large number of data and indicators is very hard for the investors because it requires good experience and a lot of time - which many people in the market do not have. On the other hand, using the technical indicators to conduct technical analysis requires proficient experience, and many investors fail to objectively read the charts and tend to impose their views on them.

Short-term investors, in particular, perform technical analysis under a lot of pressure and most of the time the picture is clouded by their fear or greed. According to Alexander Elder, Trading for a Living (1 p. 69), "The biggest problem in charting is wishful thinking. Traders often convince themselves that the pattern is bullish or bearish on whether they want to buy or sell." The outside environment is also another factor that cannot be ignored and can very much affect our perception of the market. The stock market is a very sensitive place. Any news - be it correct or just rumor - could spread quickly and affect the stock prices. Most of the available toolboxes do not take news into consideration.

The third group of stock market systems is known as *gray boxes,* which is in between the first two categories. This tool provides more functionality than the *black box* software (such as illustrating why a "buy" or "sell" recommendation is issued) but their functionality is very limited when compared to the second class of systems. The aim of this research work is

to utilize the power of agent technology and develop a prototype tool that represents a new generation of intelligent stock market tools. The prototype tool will use groups of collaborative intelligent agents to perform technical analysis, model the personality and financial conditions of the traders, model company news, and issue "buy" or "sell" recommendations.

We believe that agents will be able to perform technical and fundamental analysis faster and more accurately. And by bringing investor characteristics and company characteristics to the equation, our decision maker agent will be able to issue accurate Buy, Hold or sell signals without allowing greed and fear emotions to cloud the scene which should bring more objectively to the process of selecting stock market shares.

Developing a fully-fledged tool up to industry standards requires tremendous effort and beyond the scope of this thesis. The main contribution to this thesis to illustrate the advantage of using the latest software techniques, such as collaborative agents in the stock market domain to analyze technical and fundamental data and to model investors characteristics.

In this thesis, we explore the advantages of incorporating collaborative agents to the stock market tools. We illustrate the advantage to using agents to perform technical analysis, the advantage to utilizing agents to model the characteristics of the different types of investors and to model fundamentals of different companies.

The thesis is organized as follows: chapter two will discuss definitions and basic techniques of the two schools of thoughts in the stock market, fundamental and technical analysis; chapter three will discuss intelligent agent technology, its history definitions, types, classifications and applications. Chapter four will discuss stock market traders and factors which may affect their decisions; chapter five will introduce system requirements and design.

Chapter six will present the implementation of the prototype and introduce simple scenario while chapter seven will presents our conclusions and future research directions.

Chapter Two

Share Trading

To trade effectively on any stock market, we should know first how to pick winning stocks, and then learn when to buy and when to sell. Traders in general follow two schools of analysis to help them manage their portfolios successfully. The first of these is known as fundamental analysis, which is the classical approach. The second approach is technical analysis and has been gaining in popularity recently. In this chapter, we introduce both schools of thought and compare the two.

2.1 Fundamental analysis vs. technical analysis

Fundamental analysis is a stock valuation method that analyzes the intrinsic value of a given stock. The intrinsic value of a stock is "the value of a company or an asset based on an underlying perception of the value" (2). Fundamental analysts believe that the current value of a stock, whether above or below its intrinsic value, should always move toward the intrinsic value. Therefore, to get the precise intrinsic value of a stock, analysts focus on many factors related to the firm and the market sector it belongs to. Analysts analyze all the information related to the firm including its size, name, industry conditions, financial condition (revenues, earnings, assets, debts), in addition to the management of the firm and its competitors. Analysts also study the market sector - that is, the industry in general to which the company belongs, where they analyze the supply and demand forces for the products of the firm. They also go to a deeper level of analysis where they evaluate the national economy and its effect on the sector in general and the specific firm in order to predict the company's growth.

Technical analysis, on the other hand, attempts to analyze the "past price movement of the stock in order to forecast the future price movements." Charles H. Dow (1851 - 1902), the father of technical analysis, established modern technical analysis in his famous stock market theory, the Dow Theory. Dow was the formal editor of Wall Street Journal. He never wrote any books to identify his philosophy and concepts. Rather, all of his ideas are collected from his editorials by many writers. The first of which was his friend Samuel A. Nelson who published **The ABC of Stock Speculation**, which contains many of Dow's editorials. One year after the death of Dow, William P. Hamilton discussed his version of Dow's Theory in his book, **The Stock Market Barometer.** Hamilton's student, Robert Rhea continued the work of Dow and Hamilton and presented it as assumptions and theorems in **The Dow Theory.** After Rhea's death, a series of writers continued working on the famous theory (3). The Dow Theory highlights the following premises:

1. *"Averages discount everything."* Technical analysts believe that the prices reflect upon everything happening in the market, such as the forces of supply and demand, the knowledge of stock market participants, the feelings - fear and greed - of those participants, and the fundamental analysis.

2. *"Prices movements are not totally random."* Technical analysts believe that the price of a particular equity moves reflecting supply and demand, and there exist many indicators, which could follow and analyze the movement of the price in different periods (long, medium, and short) in the market. If stock prices move in a completely random way, technical analysis will be tool of wasting time.

3. *"What is more important than why."* Technical analysts are interested in studying the charts, which represent old data. They check the open, close, high, and low prices, convergence and divergence patterns, and other historical information that appear in the charts, because, as mentioned in the first premise, the price reflects all the

information in the stock market about a particular share, and represents the balance between the supply and demand forces. While fundamental analysts are able to answer why the price equals 'x' today and why it was equal to 'y' yesterday, the reasons are not important to technical analysts who prefer to focus on the chart trends; i.e., "what" will happen in the future based on "what" has happened in the past.

As we can see from the definitions of the two schools of thought, they are nearly opposites. In fundamental analysis, the investor should have full knowledge about the stocks. For example, if he/she is interested in the coffee market he/she should know everything about the coffee, how it is grown, what the planting cycles are, who the big buyers of coffee are, what are their plans for the future and how would that affect the demand for coffee, in addition to the financial situation of the coffee companies, and studying the national economy. To get all this information, the investor needs time and experience in the field. On the other hand, technical analysts who are also known as chartists in some books, do not have to know too much about the coffee or what the business of the firm is. They just study the charts and apply different indicators with different time intervals. They only focus on the price and volume trends of the stock.

If we look to these schools of thought from a different perspective, we can see that they can be complementary to each other. Each one gives us a unique view of the stock situation. Fund managers and individual investors will feel more confident if fundamental analysis and technical analysis confirm each other for a particular company; i.e., they will feel more confident to "Buy" if fundamental analysis shows the price to be under-valued while the charts is showing an up-trend, and more confident to "Sell" if fundamental analysis shows a company to be over-valued while the chart is showing a down-trend.

2.2 More on Fundamental Analysis

Fundamental analysis could be divided into two types: quantitative analysis, which analyses the financial statements of the company (its income statement, balance sheet and cash flow statement); and qualitative analysis, which concentrates on the intangible factors those affect the status of the company. In this section, we briefly define some of the widely used quantitative terms and qualitative factors, and conclude the section with famous stock picking strategies based on the two types (4).

2.2.1 Quantitative Analysis (5)

1. Earnings

Earnings are defined as profit (or loss) a company has made after subtracting all expenses during a limited period of time. It could be found on the 10-Q Report of the company – most companies publish their reports on their websites - this amount gives the investors an indicator of the company's expected dividends and its potential for growth. Negative or low earning does not always mean a bad sign for the company stocks. Some companies during their beginning years of business have negative earnings, but they grow quickly and capture the market later. Concentrating on earnings alone is not enough; other ratios are required to be taken into consideration.

2. Earnings per Share

The Earnings per Share (EPS) ratio is the result of dividing net earnings over the number of outstanding shares. It gives a better view than earnings alone because it takes the number of shares into consideration.

3. Price per Earning (P/E) Ratio

The Price per earnings ratio shows the investor the value of the stock or how much the market is willing to pay for the earnings of the company. It could be

calculated by dividing the price per share over EPS. Analysts look at three types of P/E ratios, the "trailing P/E" is the P/E ratio for the previous year and it is an actual number. The "current P/E" is the P/E ratio for the current year and the "forward P/E" is the forecasted P/E ratio for the upcoming year. Current and forward ratios are not actual numbers, they are estimates. A higher P/E ratio gives sign that the market is willing to pay for company's earnings which is a positive sign.

4. Percentage Earning Growth (PEG)

The PEG ratio is calculated by dividing a stock's P/E ratio over the stock's expected percentage earnings growth for the coming year. Some investors pay for overvalued stocks when they see only the P/E ratio, but by taking the PEG ratio into consideration, investors can evaluate the stock value in better way because it takes stock's projected earnings growth into deliberation. A smaller PEG value is a good sign because it means that the investor will pay less for each unit of earnings growth.

5. Dividend Yield

Dividend yield could be calculated by dividing the annual dividend per share over price per share. Large and established companies have a high dividend yield where growing companies have a lower dividend yield. Small companies do not have dividend yield because they do not pay out dividend.

6. Book Value

The book value is how much a company is worth. It is calculated by the summation of assets minus the liabilities. If we divide the last quarterly book value by number of outstanding shares, it will have *book value per share.*

7. Price/Book (P/B)

This ratio is calculated by dividing the price of the share over the book value per share. A higher ratio gives a positive sign where it means that the market is willing to pay for the company above its assets.

8. Price/Sales (P/S) Ratio

The price per sales ratio could be calculated by dividing the stock's current price over the company's total sales per share for the previous year. If the ratio is less than one, it is a positive indicator for investors because it means the stock is priced cheaply.

9. Return on Equity (ROE)

ROE shows investors the net profit the company gains with the money shareholders invested in the company, so a high ROE ratio attracts them because it means more profits. It is calculated by dividing net income over shareholders equity (total assets minus total liabilities).

2.2.2 Qualitative Analysis (6)

1. Company management system

Strong management is one of the most important factors that could guarantee the success of the company. It is a good idea for the trader if he\she researches and attempts to answer the following questions before purchasing a stock; who is the manager of the company? Is it managed by a Chief Executive Officer (CEO), a Chief Financial Officer (CFO) and a Chief Operating Officer (COO)? What is their professional and academic background? What type of experience do they have? Did they become managers because they are qualified and have succeeded in their field or because they simply inherited the company? Are they qualified to run the company successfully? What is the management philosophy? (Is it transparent, flexible or

rigid?   At times, if the investors believe that changing company mangers and management philosophies often indicate bad signs so they do not buy or invest in stocks of the company.

2. Analyzing the business of the company

Some investors buy stocks based on rumors or false perception – just because a friend or a magazine article predicts that a company will have a brilliant future. Unfortunately; there are many examples from the history of the market of people who have made great losses. In the late 90's people had a great desire to buy shares of dot com companies without understanding their business models, and the products and services they provide. This led to buying over-valued shares with very shallow business model and consequently led to great losses.

Therefore, knowing the products and the services of the company and how it is profitable (remember that great industry will return solid profit) before buying its share is a very important factor in determining the worth of the investment.

3. Competition

Before buying company shares, traders should look at the situation of the company in the market to find out if it enjoys strong fundamentals. They should identify the competition, because small successful companies could easily become a take-over target.

4. Brand Name

It is good to look for a company with a brand name, because the brand name reflects the power of the company and the years of products development and marketing. Companies with a big brand name most of time have solid returns because of their positive image. On the other hand, some investors are conservative about buying stocks of companies tied closely to well known individuals, if they happen to

be infamous because of legal or personal issues, the reputation of such individuals can potentially have a negative effect on the way the company is perceived, which might lead to a lower stock price.

2.2.3 Trading Strategies (6)

1. Value investing

Value investing is aimed at "finding companies trading below their inherent worth" (7). This concept became one of the best picking stock methodologies established by two finance professors, David Dodd and Benjamin Graham in the thirties of the last century (7). By using value investing, traders will know that the decline in stock prices is not always a good opportunity to buy. They must ensure first that the decline is not due to problems in the company's fundamentals. Therefore, to be successful value investors, they must compare the current value of the stock with its intrinsic value. For example, if a stock of company A was $30 last year and has dropped to $12, some investors would look at this drop as a great chance to buy; but they must be more conservative to ensure that this drop is not a reflection of a series of problems in the company where the intrinsic value is at most $12.

2. Growth Investing

Growth investing is an opposite strategy to value investing. It aims at finding growth investing by identifying a rising economic sector such as emerging technology companies. This strategy is more suitable for people who like to take risks.

Growth investing is buying shares higher than their intrinsic value with the belief that the intrinsic value will grow and exceed the amount of its current valuation.

Growth investors constrain their investments in young and new technology companies. They usually watch the earnings and revenues of these companies because

they believe that an increase in the earnings of the company will lead to an immediate increase in the value of the stock.

This type of investing is risky. Growth investors must be careful because this type of strategy does not depend only on mathematical ratios, but they also need to study the performance of the company and its industry very well. Therefore; to be successful using this type of strategy, an investor also needs correct and realistic interpretation and wise judgment.

3. GARP Investing

GARP investing combines both, value and growth investing. It "looks for companies that are somewhat undervalued and have solid sustainable growth potential." Merging two opposite concepts is not easy work, but in GARP strategy it can be successfully done. GARPers share some characteristics with growth investors and other characteristics with value investors. GARPers are similar to growth investors in concentrating on the growth and growth potential of the companies but the GARPers are more conservative when it comes to taking risk based on these indicators. Both look to the ROE figure (defined earlier) to identify superior companies, which could be found if ROE is over the industry average. This is in addition to the fact that GARP and growth investors depend on individual interpretation and judgment. GARPers share the value investors approach in looking for low P/B ratio and a P/E ratio below industry average (these ratios are defined in the previous section).

4. Income Investing

Income investing is for people who wish to be long term trading without too much efforts and minimum risk. This strategy which depends on picking companies with a steady income, it usually targets companies that are large, well-known, and already

have an accomplished level of growth so they can provide solid dividend yield to their shareholders.

5. CAN SLIM (8)

CANSLISM is one of the best stock picking strategies introduced by William O'Neil in his famous book **How to Make Money in Stocks** (8). CAN SLIM define seven factors and implements combination between value, growth, fundamental and technical analysis all together.   Therefore the investors should know about the company by analyzing these seven factors which are represented in each of the letters CAN SLIM; and these factors are:

1. C: Current quarterly EPS

The current quarterly earnings per share (EPS) should increase sharply from the EPS in the same quarter of the previous year.

2. A: Annual Earnings

The annual earnings figure is important in CANSLISM so the company should have solid annual earning at least in the past five years.

3. N: New

New issues such as products, market, management philosophy, a new high in stock price… etc. is a very positive sign about the company according to O'Neil because it means that the company is alive and is moving forward.

4. S: Shares Out-Standing

CANSALISM looks for firms with a small number of out-standing shares because it is easier for them than large companies to show their gains.

5. L: Leaders

CANSALISM tells investors to follow the market leaders because most of them guarantee big returns to shareholders.

6. I: Institutional Sponsorship

Investors should own stocks for companies that have at least a few numbers of institutional Sponsors (from 5 to10). It is important that these sponsors should have good performance records.

7. M: Market Direction

Investors should follow the trend of the market whether it is a bull market (prices of stocks are rising or expected to rise) or a bear market (prices of the stocks are falling). Trading against the general direction of the market is risky and most of the time ends with big losses.

2.3 Technical Analysis (9)

2.3.1 Charts

Technical analysts represent price and volume movements in different ways. Each representation has its own advantages and gives a different perspective to the analysts. Bar

Charts and Candlesticks are the two most widely used representations, and they are briefly explained in the next two subsections.

1. Bar Charts

The most basic types of charts are bar charts and line charts. Line charts are most basic type of charts builds in finance by connecting series of historical prices together in a line. Each single bar represents information about prices in one trading day, week or month of the stock. The information shown in figure 2.1 represents the opening price (shown on the left of the bar), the closing price (shown on the right side of the bar), the top of the bar shows the highest price reached during the day/week/month where the bottom represents the lowest price reached during the day/week/month. Bar charts have an advantage over the simple line graph that it provides us with all this information about the prices of the stock and for the same reason it used for showing many indicators.

Figure 2.1-Bar Chart

From (10)

2. Candlestick Charts (11)

The term Candlestick refers to Japanese candles which were used by Japanese rice traders hundreds of years ago to analyze the prices of rice. Candlestick charts as shown in figure 2.2 represent information about the daily/weekly/monthly price

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movements. Figure 2.2 shows how the opening, closing, highest and lowest price of the day/week/month are represented, and extra information about the movement of the price is represented by the color of the body. It the color used is white or green, the stock closed higher than its opening price, if the body is black or red the stock closed lower than its opening price.
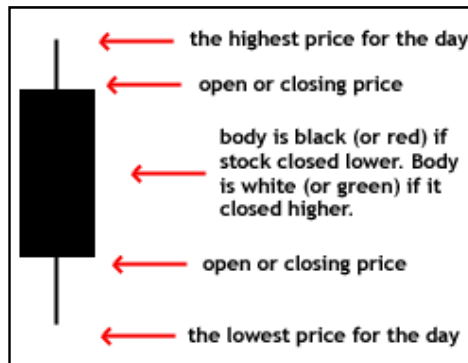
Figure2.2-Candlestick Chart

From (12)

2.3.2 Indicators

According to Arthur Hill (13), "An indicator is a series of data points that are derived by applying a formula to the price data of a security". Data such as opening, closing, high, low and volume are usually used in different mathematical formulas and the result is also represented on the price chart or below it. Technical analysts represent these series of data points (indicators) in graphical forms and compare them with prices graphs in order to make decisions.

These days, hundreds of technical indicators are available. A lot of them measure the same thing but in different ways, so the beginner in the field may be overwhelmed by this large number of indicators. Another problem that may face the trader is that some indicators produce conflicting results leaving the traders confused as to what to do. Tony Compton and Eric Kendall in their book **Trading with a Plan**, classified technical indicators into six

groups and advice traders to select indicators from those different groups in order to take different views of the market (14) .The six types of indicators are briefly mentioned below:

1. Trend indicators

Trend indicators help traders determine the direction of the market. The market may move in three directions, up so we can say that the market is on an uptrend or is bullish, or down so we can say the market is on a downtrend or bearish, or the market is going nowhere (sideways). Moving averages, MACD, DEMA, Price Oscillators, Trend lines and many others are examples of this group of indicators.

2. Volatility

According to Tony Compton and Eric Kendall **Trading with a Plan**, "Volatility refers to the size of day-to-day fluctuation in share prices." In general, high volatility gives a good sign to having a high profit but it will be risky. Variable Moving Average, Standard Deviation, Average True Range, and Standard Error Band are examples of volatility indicators.

3. Momentum

This type of indicator focuses on the speed at which prices change. By following this type of indicator, we can know if shares are overbought or oversold, identify weakening or strengthening in trend and also predict when the trend will reverse.

MACD, Relative Strength Index, Momentum Indicator, Change Momentum Indicator, Range Indicator, Williams" % R and many others could be used as momentum indicators.

4. Cycles

Cyclic indicators help predict if the trend will continue in its direction or it will reverse .Cycle Lines, Fourier Transform and Fibonacci Time Zones are examples of this group.

5. Market Strength

Market strength could be considered as measure tool of the degree of participants in the market, therefore, it can give us warning about the strength of the market or industrial shares. Examples of this group of indicators are: Demand Index, Ease of Movement, Moving Average (volume adjusted), and On Balance Volume.

6. Support and Resistance

Support and resistance are price levels that when stock price movement reaches one of these levels, it would stop and reverse its direction. Envelope, Projection Band, and Trend lines are examples of support and resistance indicators.

Traders use indicators for different purposes: some indicators are used to predict the direction of future prices; some traders used different indicators to confirm the same signal, because many indicators confirm each other, while other indicators act as alerts for traders to study price action closely.

2.3.2.1 Moving Averages (MA) (15)

The Moving Average is one of the oldest and most popular indicators in technical analysis which is built on a very simple formula. The Moving Average smooth data series makes it easier to define the market trend especially in a volatile market, and it is also the building block for a large number of indicators so many expert traders believe in it and rely upon it in their analysis. There are different types of moving averages, here in this section we will briefly discuss three of them starting with the basic one; a simple moving average.

1. Simple Moving Average (SMA)

A simple moving average is arrived at by dividing the average price over a specific number of periods (15). In calculating the average price, one can use the opening price, closing price, high, or low price of the day could be used but most analysts use the closing price.

The mathematical formula for the Simple Moving Average is:

$$SMA = \frac{\sum_{j=1}^{n} Close_j}{n}$$

Where close is the closing price and n is number of days.

The following is an example of the calculation of a simple moving average:

If we have the following closing prices for five days

$10+11+12+13+14 = 60$

Average $= 60/5 = 12$

Point 12 –the first average- is the first point in the series. If the next closing price in the average is (15) then the oldest closing price (10) in our example will be dropped from the formula and (15) will be added as illustrated in the following:

$11+12+13+14+\mathbf{15} = 65$

Average $= 65/5 = 13$

By repeating the calculations with every new closing price, we will have a series of averages. A simple moving average line will be composed by joining those averages together.

Popular Trading Methods:

    1. Simple Moving Average Price crossover:

A. The trend is bullish if the price is above the simple moving average. If the price is below the simple moving average and then it crosses the moving average line the trend become bullish and a buy signal is generated.

B. The trend is bearish if the price is below the simple moving average. Therefore, if the price is above the simple moving average and then it cross the moving average line the trend become bearish and a sell signal is generated.

Figure2.3-Buy Sell Signals

From (15)

2. Dual SMA crossover:

The Dual Simple Moving Average is done by using two simple MA lines with two time periods; the line with the shorter period is called the faster moving average where the slower moving average represents the longer time period.

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A. When a faster moving average (being below the slower one) moves and crosses over the slower moving average then a buy signal is generated.

B. When a faster moving average (being above the slower one) moves and crosses below the slower moving average then a sell signal is generated.
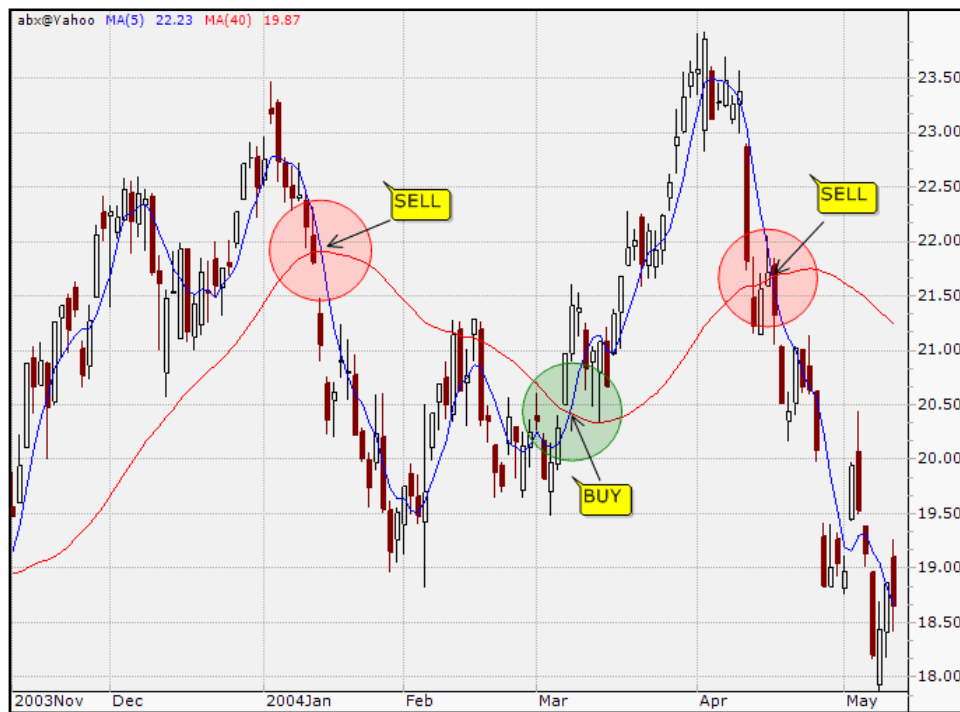
Figure2.4-Dual MA Crossover

From (15)

3. Triple SMA crossover

As the name suggests, a triple SMA is based on using three lines of SMA with different periods, if we take a 7-21-90 days SMA as an example; 7 days is the fastest SMA, 21 days is a medium speed SMA, and 90 days is the slowest SMA. As a result, we will have the following signals:

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A. When a medium speed SMA (being below the slowest one) moves and crosses over the slowest moving average then buy signal is generated.

B. When the fastest SMA (being above the medium one) moves and crosses below the medium speed SMA then a sell signal is generated.
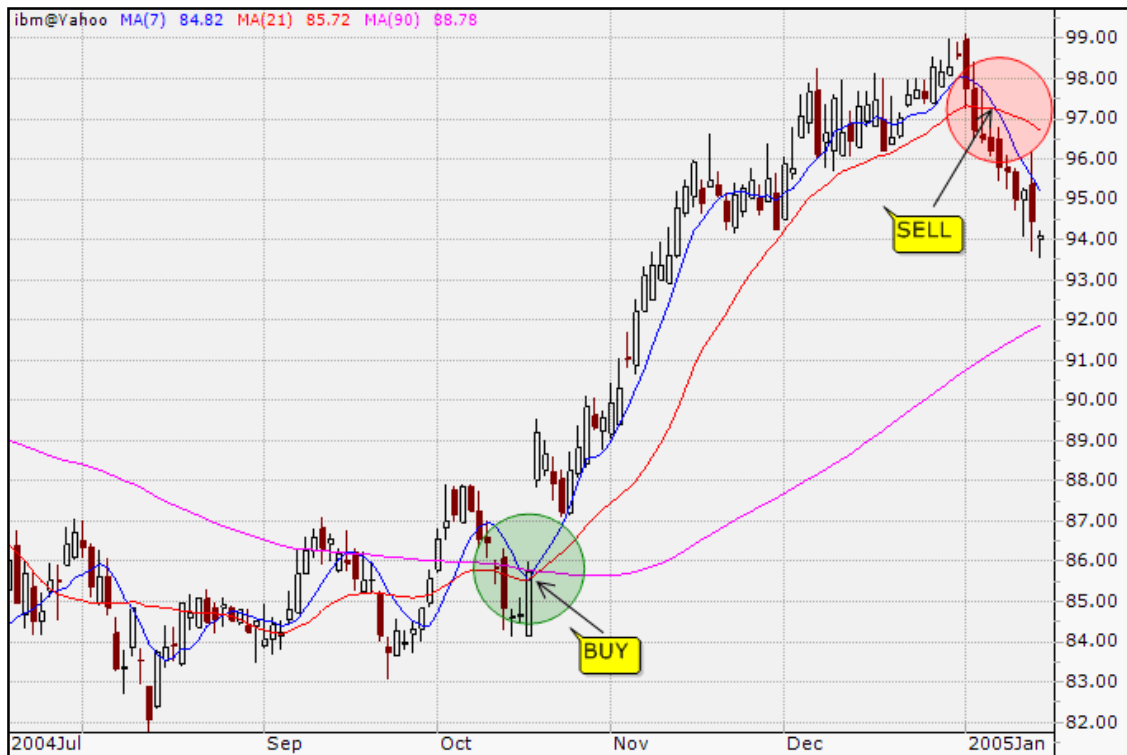
Figure2.5-Triple SMA signals

From (15)

2. Exponential Moving Average (EMA):

The exponential moving average is similar to a simple moving average but it gives more weight to the recent prices in order to reduce the lag in a simple moving average (a simple moving average is classified as a lagging indicator which give the signal of changing in price after it is already done) (16) (15).

The mathematical formula for the EMA is as follows:

$$EMA = Close \frac{2}{n+1} + \frac{\sum_{j=1}^{n} Close_j}{n}\left(100 - \frac{2}{n+1}\right)$$

Where *close* is the closing price and *n* is number of days.

Trading Methods:

1. When a stock's price is above its EMA line then a buy signal is generated.

2. When a stock's price falls below its EMA line then sell signal is generated.

Figure 2.6-EMA Line

From (16)

3. Moving Average Convergence Divergence (MACD) (17)

The Moving Average Convergence Divergence was developed by Gerald Appel and it adds new characteristics to SMA and changes it from a lagging indicator to a momentum oscillator. The standard MACD is the difference between a fast (12-day) and a slow (26-day) simple moving average. With calculations of a MACD Signal line, which is a 9-day SMA of MACD is needed to determine the convergence and divergence, which is the difference between MACD and the signal line.

The mathematical formula for a MACD is as follows:

$$MACD = SMA(n_1) - SMA(n_2)$$

$$Signal_{Line} = SMA(n_{sig}, MACD)$$

As an example, in standard MACD n1=12,n2=26 and n_sig =9

Some Trading Methods:

1. When MACD is rising above the signal line then a buy signal is generated.

2. When MACD is falling below the signal line then a sell signal is generated.
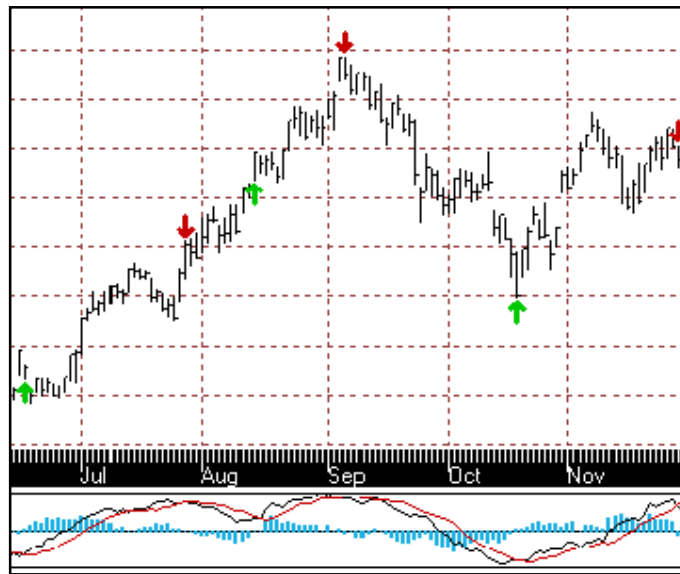
Figure 2.7-MACD signals

From (17)

In Figure (2.7): MACD is the black line below, the signal line is represented in red, and the blue histogram represents the difference between MACD and the signal line.

4. Relative Strength Index (RSI) (18)

The relative strength index is one of the most powerful indicators available in charting. This indicator was introduced by J.Welles Widler in his 1978 book: New Concepts in Technical Trading Systems. In his book, Widler describes RSI, defines its mathematical formula and discusses in details where and how it is used.

According to '*Money Words*' (19) , RSI is "A technical analysis indicator which measures the magnitude of gains over a given time period against the magnitude of losses over that same time period." Another simpler definition is RSI is an oscillator used to determine overbought or oversold market conditions.

By its math formula, RSI values lay between 0 and 100.

The following is the mathematical formula for RSI:

$$RSI = 100 - \left(\frac{100}{1 + RS} \right)$$

$$RS = \left(\frac{\bar{C}u_{[x]}}{\bar{\bar{C}}\, d_{[x]}} \right)$$

$$\bar{C}u_{[x]} = \left(\frac{Total\ 'up period'\ points}{RSI\ Lookback\ Lenght} \right)$$

$$\bar{C}d_{[x]} = \left(\frac{Total\ 'down\ period'\ points}{RSI\ Lookback\ Lenght} \right)$$

An example of the calculations using the above formula is listed below:

Assume the following:

Chart Interval = 1day

RSI Look back Length = 9 days

Total up period points = 20

Total down period points= 51

To calculate RSI:

      1. Down Period average=51/10 = 5.1

2. Up Period average = 20/10 = 2

3. RS = 2/5.1 = 0.3921568

4. RSI = 100-(100/1+. 3921568) = 28.169

Some Trading Methods:

1. When RSI value is around 70 the stock is considered overbought so traders are advised to sell because reversal in the trend is expected.

2. When RSI value is around 30 the stock is considered oversold so traders are advised to buy because reversal in the trend is expected.

Figure 2.8-RSI signals

(18)

5. Directional Movement Index (DMI) (20)

The Directional Movement Index (DMI) was also developed and introduced by J.Welles Widler in his 1978 book, **New Concepts in Technical Trading Systems**. DMI indicates the trend of the market and is composed of three lines: +DI, -DI and the ADX Line which is the average between the two lines.

The mathematical formula for the DMI according to AKMOS Trade is as follows (21):

A. First the positive and the negative directional movement is

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calculated

- $+DM_j$ and $-DM_j$ if $High_j > High_{j-1}$, then $+DM_j = High_j - High_{j-1}$, otherwise $+DM_j = 0$

if $Low_j < Low_{j-1}$, then $-DM_j = Low_{j-1} - Low_j$, otherwise $-DM_j = 0$

The lesser of $+DM_j$ and $-DM_j$ is set to zero; if they are equal, both are set to zero.

B. True range is calculated – TR_j

$$TR_j = max(|Low_j - Close_{j-1}|, |High_j - Close_{j-1}|, |High_j - Low_j|)$$

C. A positive and negative directional index is calculated - $+$ and $-DI_j$

if $TR_j = 0$, then $+SDI_j = 0$, $-SDI_j = 0$,

if $TR_j \neq 0$, then $+SDI_j = +DM_j / TR_j$; $-SDI_j = -DM_j / TR_j$

By smoothing $+SDI$ and $-SDI$ with exponential moving average (EMAve), we get $+DI_j$ and $-DI_j$

$$+DI_j = EMAve_j(+SDI, N)$$

$$-DI_j = EMAve_j(-SDI, N)$$

N - Averaging period

D. Calculating average directional movement - ADX_j. First calculate directional movement DX_j:

$$DX_j = (|+DI_j - -DI_j| / |+DI_j + -DI_j|) \times 100$$

By averaging DX, one can find ADX:

$$ADX_j = EMAve_j(DX, N)$$

Trading Methods:

1. A buy Signal is generated when +DI cross above –DI.

2. A sell signal is generated when –DI cross below +DI.

3. The ADX Line should be between +DI and –DI.

4. The ADX values should be between 0-100

5. Increasing in ADX value means that the market is trending upwards so it is a good idea to look to the other lines [+DI and –DI] and to examine the following indicators.

6. If the ADX is less than 25, it is a strong signal to avoiding trading.
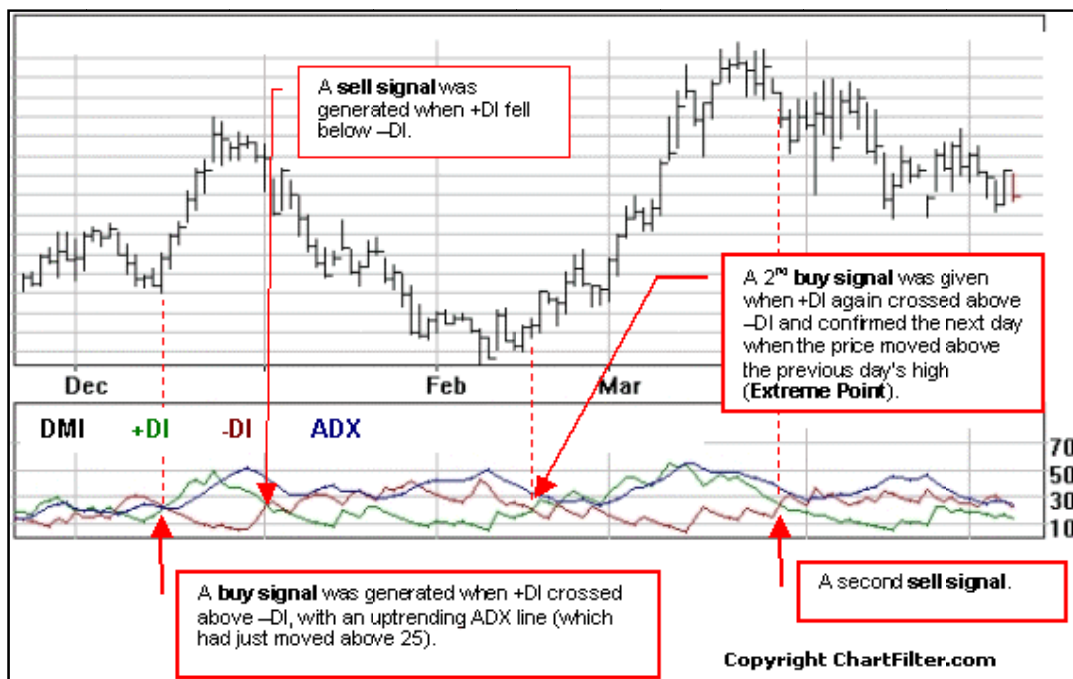
Figure 2.9-DMI signals

From (20)

2.4 Review of existing stock market software tools:

Now a day's many stock market software tools are available for all types of investors. If we referred to Elder classification of stock market software (1) –mentioned in the first chapter- we can find the AHL system which appeared in the beginning of last decade and could be considered as oldest black box systems. This software a black box systems that issues buy/sell recommendations for traders. Many people who like to work in the market, yet has no trading experience, prefer to buy a similar type of software (22).

The MESA software is a good example of the gray box systems. According to Elder, it is best program for identifying market cycles (1).The third group is Tool box software which is widely available now a day. It is designed for the new generation of traders, those who are familiar with technical analysis. They look for these tools because they allow the traders to down load end-of-day data, apply different indicators and visualize the row data in meaningful ways. Meta stock and Omni trader are famous examples of this group.

Alexander Helleboogh and Pierre Lefebvre **(23)** introduced prototype system by using agent-based software approach in their master thesis, titled "A configurable electronic stock market agent: Framework and prototype." However, we are not aware of any commercial tool that uses intelligent agents to date. Their proposed agent architecture is composed of several subsystems which perform technical analysis, gather data from different resources and manage data with different format. The information available about this thesis is limited because it is written in Dutch and not available in English.

None of the above mentioned systems use collaborative agents- Helleboogh and Lefebvre prototype used agents but in different architecture. Furthermore, none of the above systems model personality characteristics or take human behaviors into considerations. Our prototype which an exploratory research in the field and need further work and development to be

strong and usable tool, introduces architecture based on collaborative agents and explores the dimension of modeling the investors' personality characteristics in order to bring more objectivity to the Buy/sell decision making.

Chapter Three

Intelligent Agents

The main purpose of this chapter is to introduce software agents. In the first section the history of software agents will be discussed, and then a review of some definitions will be highlighted. The second section will discuss the classification of agents. And the last section will talk about some agents' applications.

3.1 Brief History and definitions

People have past and constant dreams of having non-human agencies that can perform the work on their behalf. Development in computing and communications has made some of these dreams turn into reality. While working in the robotic field is still in development, we find that many software agents are very popular now. In fact, working in the agents' field is not relatively new. It was started back in the middle of the last century - with the beginning of computers. Alan Kay, a long time researcher in agent technology traces the roots of software agents. "The idea of an agent originated with John McCarthy in the mid-1950, and the term was coined by Oliver G. Selfridge a few years later, when they were both at the Massachusetts Institute of Technology. They had in view a system that, when given a goal, could carry out the details of the appropriate computer operations and could ask for and receive advice, offered in human terms, when it was stuck. An agent would be a 'soft robot' living and doing its business within the computer's world." (24)

There is a type of ambiguity in understanding the definition of an agent. This term is used in a general sense. For example, some programs are called agents because they can be scheduled to perform tasks on a remote machine, or their capability of speaking agent communication language, or because they are capable of introducing themselves to users as

believable characters.

In language; an agent is derived from the present participle Latin word 'agere' which means to drive, act, lead or do. An agents is defined in the American Heritage Dictionary as "One that acts or has the power or authority to act ... or represent another" or "the means by which something is done or caused; instrument." (25)

Researches gave different definitions of agents depending on their applications and research areas where they employ the agency in. Here, we will try to list some of them, concerning the software agencies:

If you want to see movie on your weekend, however you do not have time to check movie reviews and schedules it would be ideal to have a computer program that knows your taste, what you will like, and what you will enjoy. This program will have the capacity to check the movies and select the best one for you. From this view, Ted Selker of the IBM Almaden Research Center defines an agent as *"a software that knows how to do things that you could probably do yourself if you had the time*". (26) (27)

David Wallace Croft (28), a senior intelligent systems engineer, gives a more comprehensive definition to agent, software agent and intelligent software agents. Croft starts with defining an agent as *"One that is authorized to act for another"* he then defines a software agent as *"an artificial agents which operates in a software environment."* .This software environment includes operating systems, databases, networking and other computer applications. Croft then defined intelligent software agents as *"A software agent that uses artificial intelligence (AI) in the pursuit of goals of its clients."*

In other words, and according to Croft artificial intelligence is*" the imitation of human intelligence by mechanical means".* Russell and Norvig also defined agents with embodying AI techniques according to them *"An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors"* (29). A

similar definition of agents, but with different words was published in IBM's Intelligent Agent Strategy white paper *"Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some knowledge or representation of the user's goals or desires"* (30)

3.2 Agents Classification

According to Hyacinth Nwana (31), there are different dimensions to classifying software agents. This section will attempt to define some of them:

1. According to their mobility: mobility is the ability to move from one host platform to another in the network. In this manner agents may be static or mobile.

2. According to their architecture: agents are either

    a. Deliberative - According to Hyacinth S. Nwana, "*possess an internal symbolic, reasoning model and they engage in planning and negotiation in order to achieve coordination with other agents*" (31).

    b. Reactive – According to Wooldridge and Jennings, "*agents perceive their environment, (which may be the physical world, a user via a graphical user interface, a collection of other agents, the INTERNET, or perhaps all of these combined), and respond in a timely fashion to changes that occur in it*" (32)

    c. Social agents - According to Wooldridge and Jennings, "*agents interact with other agents (and possibly humans) via some kind of agent-communication language*". (32)

3. According to their attributes: agents may have primary and secondary attributes (31):

    a. Autonomy: - According to Wooldridge and Jennings, "*agents operate without the direct intervention of humans or others, and have some kind of control*

over their actions and internal state" (32). We can see from these definitions that the key element of agents' autonomy is their pro-activeness which is the ability to take the initiative in order to reach the goal instead of simply acting in response to the environment.

b. Cooperation: to cooperate there must be more than one agent in the system and the agents should be social – by interacting with each other or with humans, by using specific language.

c. Learning: The ability to increase the performance with time when interacting with the environment. We can consider learning as the key attribute of intelligence.

From those basic attributes Nwana (31)derived four types of agents and they are, as shown in Figure 3.1: Interface agents, Collaborative agents, Collaborative Learning agents, and Smart agents.
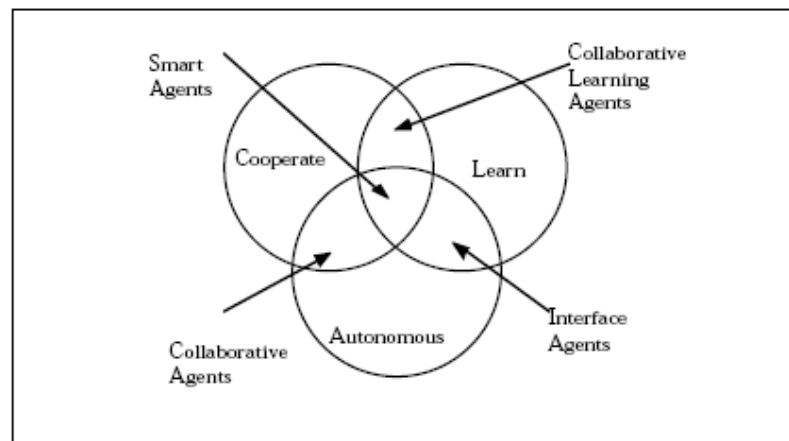
Figure 3.1-Nawana basic attributes

From (31)

Agents may also have secondary attributes. For example versatility - does the agent have several tasks to perform, or it is only limited to performing one task? Is the agent's work temporary or continuous? Is it benevolent or non-helpful? Could agents

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have beliefs and desires? If yes can they achieve their tasks driven by beliefs and desires?

4. According to their roles: Agents may be classified according to their roles in different fields. We can take the information gathering from the Internet as an example. Information agents travel through the web in an intelligent manner in order to gather the information for the user (i.e. Lycos and Spider agents). I will talk in more details about agents' applications in the coming section. (31)

Hybrid Agents: According to Nwana "*agents which combine two or more agent philosophies in a single agent*" (31)

3.3 Agents Types

Depending in Nwanas' typology in the previous section we may have eight types of agents and they are shown in the diagram below:
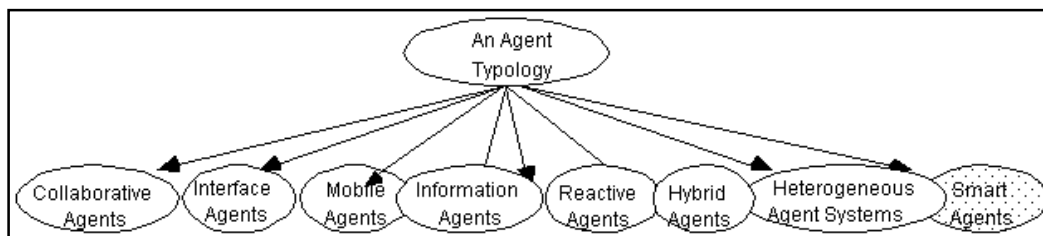
Figure 3.2-Nawanas' Typology

From (31)

3.3.1 Collaborative Agents:

- Collaborative agents are autonomous agents that have the social ability through which they cooperate with one another in order to perform tasks for their users. Collaborative agents may learn but this is not a basic attribute, however most implemented collaborative agents do not perform complex learning.

- Collaborative agents may be used to solve several problems such as:

    1. Solving problems which are too large to be solved by using single agents due to resource limitations or because it is safer to divide tasks between several agents than only one.

    2. Collaborative agents provide good solutions for distributed problems by their nature, as in the case of air traffic control systems.

    3. It is good to use collaborative agents in problems that need to collect information from distributed resources.

    4. Provide solutions for problem where system users are distributed as health care provisioning.

    5. Collaborative agents are used as solution for complex systems because they enhance modularity, speed (many agents' works together) and flexibility.

- Collaborative agents add new value to systems in different domains as electronic commerce, medical care systems, work flow management, telecommunication network and business process engineering, network management and control…Etc.

- As example of systems with collaborative agents: Pleiades project which was directed by Tom Mitchell and Katia Sycara, applied collaborative agents in the organizational decision making field, and 'DVMT', a distributed vehicle monitoring system (31).

3.3.2 Interface Agents:

- Current computer user interface is passive, that is they wait for direct commands initiated by the user. With time the importance of computers in our life is increasing but on other hand the numbers of untrained users is increasing exponentially (31). Therefore, users need more intelligent interfaces which learn from the user and can do different tasks instead of them – and this is where the idea of intelligent interface agents comes from.

- In order to perform their tasks interface agents emphasize autonomy and learning (Figure3.1).

- Interface agents learn from the users by observing, receiving feedback and instructions from them. Interface agents can also learn by taking advice from other interface agents since interface agents may also collaborate.

- Calendar Agents, described by Kozierok and Maes (33)are interface agents that help users in scheduling their meetings. Other example of interface agents called "Letizia" described by Lieberman (34), assist users in web browsing.

3.3.3 Mobile Agents

- Mobile agents are "*computational software processes capable of roaming wide areas network interacting foreign hosts, gathering information on behalf of its owner and coming back home having performed the duties set by users*". (31)

- If we want to perform an airline reservation task, we may run a program that checks airline companies' databases. This may need transferring huge data through networks in order to handle it locally in our machine. But with using mobile agents, small programs can roam through a network to a different host

and access the airline databases then return with results to our machine.

- PIC personal intelligent communicator is an example of mobile agent which assists in managing users email, fax, phones and also link users to communication services such as America Online.

3.3.4 Information Agents:

- Information agents manage, manipulate and collect information from different internet resources.

- Collaborative and interface agents gather information from the internet but with the explosion of the World Wide Web, we need agents that know *what they collect*, and understand users needs and users personalities as information agents.

- 'Softbot' system which is described by Etzioni & Weld (35) is an example of information agent which allows user to make high level requests then searches the internet to satisfy this request.

3.3.5 Reactive Agents

- Reactive agents were defined in the previous section.

- Until now, there are only a few reactive software agent base applications available.

- As example of using reactive agents' concepts; Feber (36) describes how he simulates ant societies where each ant modeled an agent. In this manner reactive agents could be used to make a computer as virtual laboratory where researcher could modify their experimental parameters and validate their model using qualitative and quantitative data.

3.3.6 Hybrid Agents

- We also defined hybrid agents in the preceding section, and as reactive agents tell now, there are a limited number of applications that use them.

- Fergusonis Touring machines system (31) is an example of hybrid architecture of dynamic and mobile agents.

3.3.7 Heterogeneous Agents

- Heterogeneous agents systems refer to integrating two or more agents that belong to two or more different agent classes.

- Intelligent and Cooperative Information Systems (ICIS) is an example of heterogeneous agents. ICIS seeks to integrate information systems, software engineering, databases, and AI by using information agents. (31)

3.3.7 Smart Agents

- Smart agents that emphasize autonomy learning and collaboration [figure 3.1] are a dream and have not been implemented yet.

3.4 Agent Applications

Agents' technology has already been implemented in several domains and with time it will become not only familiar but also necessary. According to Janca (37),*"Agents are the next major computing paradigm and will be pervasive in every market by the year 2000*." This optimistic vision from Janca has somewhat become a reality, multi agents systems have already been implemented in the following domains:

3.4.1 Industrial Applications

Industrial applications of agent technology were amongst the first to be

developed. As early as 1987, Parunak (38) reports experience with employing the contract net task allocation protocol in a manufacturing setting. Now-a-days, agents are being applied in a vast range of industrial applications.

Process control is a natural application for intelligent agents and multi-agent systems. One of the best known agent based process control applications is ARCHON – one of the earliest field tested multi-agent systems in the world is a software platform for building multi-agent systems, and has an associated methodology for building applications with this platform (39).

3.4.2 Commercial Applications

A simple click of the mouse connects us to a sea of information available to us through the Internet and the World Wide Web. The voluminous amount of information creates an information overload experience for the users leaving them with overwhelming material to browse through, which could become very problematic for the users leaving them bored and very distracted. The information overload could be characterized in two ways:

Information filtering – sorting through the large amount of information such as emails, articles, and news that we receive and keeping the most relevant to us and most useful; Information gathering: The large volume of information available hinders users from finding information to answer specific queries. Users need to be able to obtain information that meets their specifications, even if that means they have to obtain it from external sites.

An example of directing the management process is Maxims (40)– an email filtering agent program that 'learns to prioritize, delete, forward, sort and archive mail

messages on behalf of a user' (p.35). Maxim operates by constantly making internal predictions about what a user will do with a message.

3.4.3 Medical Applications

Medical informatics is a central growth area in Computer Science. New applications are being found for computers every day in the health industry. Two of the very first applications are in the areas of health care and patient monitoring. The Guardian System is a patient monitoring system intended to help manage patient care in the Surgical Intensive Care Unit (SICU) (39). The Guardian System is inspired by two concerns: that the patient care model in the SICU is that of a team, where a collection of experts with distinct areas of expertise work together to organize patient health care; and the second is the adequate sharing of information between members of the critical team unit.

The Guardian System distributes the SICU patient monitoring function amongst a number of agents of three different types:

Perception/action agents – responsible for the interface between Guardian and the SICU team, mapping raw sensor input into usable symbolic form, and translating action requests from Guardian into raw effecter control command.

Reasoning agents – responsible for organizing the system's decision making process, and *control agents* – one overall, top level control of the system (39)

3.4.3 Entertainment

The leisure industry is most often not taken as a serious component of the computer science community. Leisure applications such as games are seen as relatively peripheral to the 'serious' applications of computer (39). Yet computer

games can be very profitable. Agents have an evident role in computer games, interactive theater, and related virtual reality applications.

An example of a Computer Game is Disney Channel's The Suite Life of Zack and Codey (39) – twin boys who must survive by going around the house without getting 'busted' by their parents. The highest floor they can reach is the fourth. The agent of the game takes the part of the user, who must control where the twin boys go without getting 'busted' by their parents.

In our work, we use collaborative agents because the nature of the problem is complex and requires the collaborations of different layers, or groups of objects in order to achieve particular goals. In our stock market prototype, the first group represents different traders with different personalities and emotional characteristics. Those traders talk with each other and exchange experience. Company agents, on the other hand, are used to represent different companies from different sectors and different sizes. Another group of agents are needed to gather financial data and news from different resources then analyze them. Finally, a decision maker agent is introduced to take the final Buy/Sell decision, which is based on the information provided by the different groups of collaborating agents.

Chapter Four

To Buy or to Sell? Human Factors that Affect the Decisions of Share Traders

Stock market traders follow different investments strategies depending on their personal circumstances and level of knowledge. We can broadly classify traders into a number of segments depending on these investment strategies. We start this chapter by defining these segments. We then discuss the human factors which usually affect traders' ability to make decisions, as human perception (in section two), and human psychology (in section three). In the last section we briefly discuss how news and rumors seriously affect share prices and the decisions of traders.

4.1 Share Traders

The stock market is a wide medium that contains heterogeneous traders and companies. Traders could be classified according to different factors: the type and quantity of investment they work on; the school of thought they belong to; or the period of time at which they keep their shares. The time factor in particular is very important. Whether classified as a long-term, Medium-term, short-term or day trader, they all seek to maximize their profits, however; each category has its own characteristics and will follow a different strategy (41).

4.1.1 Day Traders

Day traders are traders who buy and sell shares after a short period of time. This time may range between a few hours to a few days.

4.1.2 Short-Term Traders

When trading extends to an extra few days giving the price more time to change as swing trader do.

4.1.3 Medium-Term Traders

These traders keep their shares extra weeks or months in order to study the prices fluctuation and follow their trends of course seeking extra profit.

4.1.4 Long-Term Traders

As the title suggests, long-term traders are traders who hold their shares for long periods of time ranging from several months to a few years. Some of them work on long term investing strategies in order to compile good wealth while other traders are busy with their works and families so that they forget that they have shares and they let stockbrokers do the trading for them. I will talk in more depth about traders' personalities and behaviors in the coming sections.

4.2 Human Perception

Human perception is a very complicated topic. According to the English dictionary (25), perception is "becoming aware of something via the senses" or "the process of perceiving" for example; perceiving information from the outside world or "knowledge gained by perceiving."

Perception is simply knowing the world through our senses, but the old question is "Does our perception allow us to experience the world as it really is?" according to many researchers the answer is "NO" because our perception is influenced by different factors, some of them are physical as activities of sense organs, others are emotional, in addition to what is stored in our memory, or previous knowledge, which have a great effect on the way

we perceive things. In other words, what we see is not an exact replica of what exists in the environments, but a picture influenced, or distorted, by these factors, and the same applies to other senses.

If we look at the picture in Figure 4.3, below, what do we see? As a simple experience that illustrates the concept of perception, we asked this question to a number of people divided into three groups. One group saw the picture of the old women first, Figure 4.1a, the second group saw the picture young woman face, Figure 4.2, and the third group saw neither the first nor the second picture. The majority of the people in the first group will see an old woman when they look at the third picture because their perception has been influenced by what they have seen in the first picture. The second group, on the other, will see a young woman when they look at the third picture because their perception is influenced by what they had seen in the second picture. The third group will see an ambiguous picture when they look at the third picture because no previous knowledge has influenced their perception.

Figure 4.1-Old Lady with cap

From (42)

Figure 4.2-Young Lady in a boat

From (43)

The same may happen in the stock market when different traders look at the same graphs and yet they take different decisions. This is because they differ in the way they perceive and understand those graphs.

In this thesis, I hypothesize that using stock market tools will reduce the effect of human perception in the decision-making process, and will bring more objectivity to the interpretation of the charts.

4.3 Traders Psychologies

Trader's psychology seriously affects the movement of the prices in the stock market. It has been said before that the "stock market is actually 75% psychological and only 25% financial" (45). The importance of traders psychologies in the decision making process leads to the 'Behavioral Finance' which attempts to explain how traders psychologies, emotions and

cognitive errors influence their decision making process and consequently all market movements.   In this section, I will shed the light on some common characteristics among trader which behavioral finance research attempts to explain (46):

1. The influence of fear and greed (47):

   - The market is driven by just two emotions: fear and greed. According to Bill Gross (48), "The Market invariably moves to undervalued and overvalued extremes because human nature falls victim to greed and/or fear."

   - Fear, according to Meir Statman is ("…an unpleasant, often strong emotion, of anticipation or awareness of danger"). Fear of regret is a behavior; people tend to feel sorrow after they make a bad trade. So their fear of more losses prevents them from making the correct decision.   These traders often make the wrong decisions by ignoring the fact that making decisions while fearful of what was may in fact lead them to extra losses.

   - Greed refers to "excessive desire".   All people wish to have much wealth in the shortest time but should this lead us to be greedy? Greed fever starts when traders hear encouraging news about a specific company so they start to buy its stock, with the increase of the demand on a stock, prices tend to rise exponentially, this will not stop greedy traders and they will keep buying even if the price of the stock become much higher than its real value. After which, stock prices start decreasing when the stock readjusts to its true value and this will lead to major losses for many traders.

   -Good traders should stay emotionally neutral in making decisions and should not follow the crowed blindly. They must know how to control their emotions.

2. According to Tversky and Kahneman (49), "people placed different weights on gains and losses and on different range of probability".   For example trader x will feel twice the pain when he loses $1when compared to the pleasure of gaining 1$.

3. Many investors, whether novice or expert, tend to buy popular and well known companies' stocks, simply because many people do that (they follow the crowed because they do not want to take responsibility of their decision alone).

4. Some traders are overconfident with their skills; they may think that patterns and signals in the graphs do not really exist. And if they accidentally succeed and gain some money they refer this to their super skills.

5. Many people tend to remember their good experiences in the market. They fall in the same mistake many times because they forget their errors and bad experiences. According to John Allen Paulos (50), "There is a strong general tendency to filter out the bad and the failed and to focus on the good and successful."

4.4 Personality Traits

According to Toni Turner In his book titled Apply **Now, Your Guide to Day Trading**, the most successful traders [short-term/long-term traders] tend to have many traits, and we will list some of them:

1. **Confidence:** this is one of the most important traits especially for short term traders who have to make their decisions quickly. Lack of self-confidence will result doubt and guessing which may lead to missing many good opportunities.

2. **Discipline:** a good trader must know what his/her objectives are and develop a trading plan and stick to it in order to reach these objectives.

3. **Ability to accept failure:** Trader's lose money sometimes; good traders learn from their mistakes and don't accept to be under fear and sorrow.

4. **Ability to accept risk:** risk is a primary element in stock market trading; all traders have to take risky decisions some times. Some of them to get extra profit and others to just avoid more losses.

5. **Patience:** successful trader must hunt the best opportunity to buy or sell or hold a stock until the right time for a trade arrives.

4.5 News and other factors

The stock market is a very sensitive medium. Share prices may rise or fall by the influence of news; be it company news, new employments, manufacturing, directors' dealings, political events, wars, earthquakes and even the weather. Therefore, successful traders must follow up with the current news events, journals, news paper or any other source of information available. And doing this may still not be enough - traders must also know news other traders look at and how the other investors will perceive this news. All of this will help traders in selecting the best moment to buy or sell.

According to (51)the following factors will influence the share prices:

1. **The Economy**

The health of the global economy has a great influence on share prices because it is responsible for driving companies' profits. If the economy is growing, companies' profits improve and shares value will become higher. On the other hand if the economy is weakening, company profits will inevitably fall and share values will go down. Traders should know that the effect of the economy will differ from one sector of companies to another. For example, a rise in interest rates is bad news for house builders as people feel less confident about taking on debt. Retailers are often badly affected too as people spend less. Pharmaceutical companies are, however, usually unaffected as people's demand for drugs is not influenced by the state of the economy. Traders may feel overwhelmed when they try to follow up the situation of global economy and its effect in different arrears because it is an expanded and complex field so it will be easier if they close their attention to employment data,

interest rates changes, and trade with other countries, retail sales and manufacturing news.

2. Company News

Company news has a major influence in stock prices whether this news is true or is just rumors. For example, if sales of the company decline this may drop a company's stock price. If a company changes its manager several times in a short period, stocks value may drop because of predicted problems in management. Other news that may positively influence and raise the value of the stock is producing new products or an increase in company sales. Traders also should look to the environment around the company and the situation of its competitors, if any exist. If a competitor produces new products it will probably affect the sales of other companies the stock value will most likely decline.

Now a- days, companies' financial situations and news could be easily known from the companies' official websites and financial news found on TV and in newspapers. Information and data are available in large amounts but traders should know how to analyze this news and this is not an easy task especially for novice traders.

3. Press Recommendation

Most popular newspapers or investment magazines contain and share tips to traders. If a journalist recommended a share its value will increase quickly and it will drop also quickly if any bad story about the company or one of its managers is published. Therefore, traders must always try to catch those tips quickly.

4. Analyst Report

Independent analyst reports affect the value of the stock as much as press recommendations do. If the reports issue a "Buy" recommendations for any company

stocks, its value will increase quickly, but the affect of the recommendation will not stay for a long time, and maybe for only the few hours after the reports are published, so traders must be careful and be sure that the reports recommendation is not out of time. Actually, even if the report recommendations are out of date they are still worth reading, because they contain useful information about the company, its development and how it rates against its competitors.

Analysts' reports may be produce by investment banks for big investors, and sometimes they publish them free for the public in their websites. Stockbrokers also do research for their private investors and publish summaries in financial magazines, websites and newspapers.

Chapter Five

Requirements and Design

This chapter will introduce our agent-base tool design. In the first section we will discuss why we need multiple agents in stock market case, next section we will talk briefly about the nature of the problem and how using intelligent agent may offer a solution. In the third section, the high level design concept of the agent-base stock market tool will be introduced, and the requirements of each component in the tool will be discussed. The fourth section discusses how decision is taken in our prototype, where the fifth section about the general requirements of the tool. The chapter will end by highlighting the scope of the prototype tool.

5.1 Why we need multiple agents in our design?

The Stock market is a very complicated medium. Using one agent will not help model the whole case because it is complicated and distributed by nature; hence we need different agents. Some of these agents will model hundreds of financial indicators (some of them may give conflicting results), and others will collect and analyze news which may affect stock market trends. Many people may enter to trade so personal agents will model different trader personalities; other agents will represent companies with different fundamental values. All those agents represent stock market society and need to communicate easily. Using multi-agents framework will help in building such design.

5.2 Characteristic of Agent-Based tool

Today, hundreds of commercial stock market tools are widely available; some of them - from earlier generations- are simple tools that analyze stock market data and apply some basic indicators on the data. Newer versions apply more complex indicators, allow traders to

design their own indicators, implement more graph capabilities such as 3D graphs, apply fundamental analysis and also apply expert advices, take news into consideration before produce the recommendation and much more.

In the previous chapter, we discussed in detail many factors which may affect traders' decisions that were neglected in previous tools. By use intelligent agents and take trader's personality characteristics and trading circumstances into consideration compared to the traditional stock market tools. Now, we list the basic characteristics of our agent-based tool and discuss what this option may offer to investors.

1. As most traditional tools, these agent-based tools should retrieve financial data and update it consistently from the Internet.

2. It should be able to collect information and news about companies and perform fundamental analysis.

3. It should be able to apply a large number of technical indicators and give traders options if they want to design their own technical indicators.

4. It should be able to communicate with different news agents; retrieve external as well as internal company news from the internet then analyze how that news may affect trader's decisions.

5. It should provide different personality and psychology tests to be performed by every trader who logs on to the system, since the decision to buy or sell will also depend on the trader's personality and behavior. Information about the trader is saved and extra tests will be done from time to time because human behavior may change by time and experience.

6. Personal agents, which model traders, should be able to communicate in order to exchange experience.

7. Company agents should model company fundamentals and should communicate to exchange information.

8. For a system that is composed of different agents, the agents should be able to announce their services in the yellow pages ("A yellow pages service allows agents to publish one or more services they provide so that other agents can find and successively exploit them"- (52) –JADE platform provide this facility) this make communication between agents thorough internet faster easier and dynamic.

9. The tool should go beyond the generation of buy and sell recommendations - traders should be able to generate data graphs in multiple screens with different time intervals. We believe that 3D graph visualization will add extra value to charting however this is beyond the scope of our thesis and to be left as future direction.

10. System recommendations should differ from one trader to another because these recommendation do not only depend on fundamental and technical analysis, but they also take into consideration the trader's personality, different trading strategies followed, company and world news, rumors and the like.

11. As discussed in earlier chapters –specifically chapter three- collaborative agents may learn, so experienced traders should be able to adapt agents with new trading strategies.

12. The tool should be available in different platforms.

5.3 Overviews of Components and High-level Requirements

Our empirical stock market agent-based tool consists of several agents which are designed to perform different tasks such as collecting data from the Internet, analyzing data collected and implementing financial indicators, collecting news, model traders personalities and

taking decisions. Figure (5.1) clarifies those agents[1]; roles of these components will be discussed in more details in the following subsections:
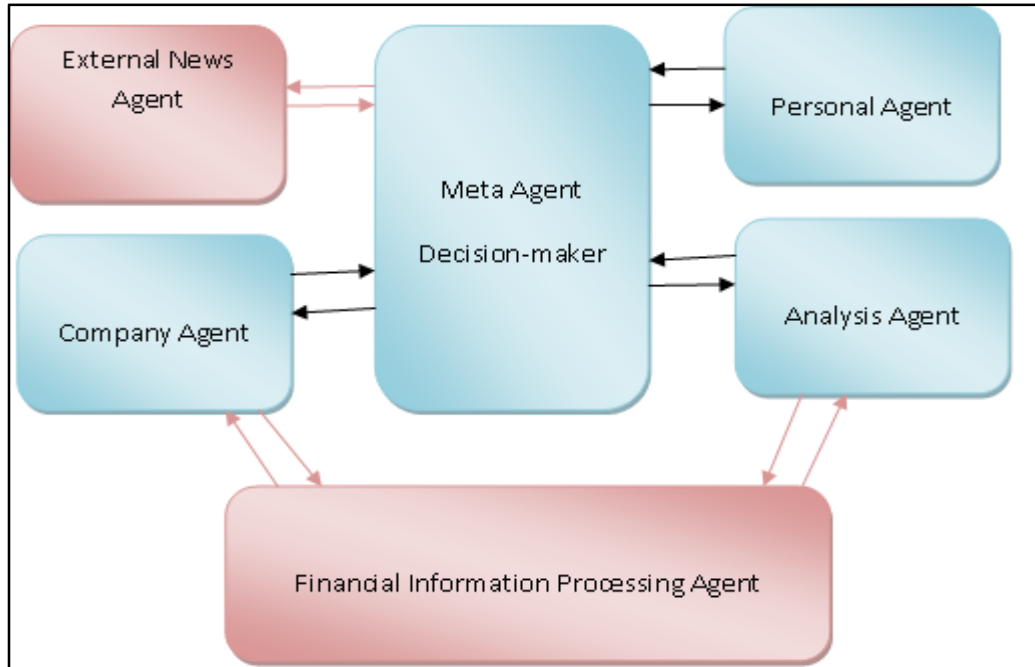
Figure 5.1-System Agents

5.3.1 Personal Agents-PA

When a trader logs on to the system for the first time; he/she should submit complete information such as name, age, job, and experience through a simple form. The trader should also perform some personality tests because the tool classifies traders according to their personalities and behaviors.

Each personal agent model is unique for that specific trader and has the following requirements:

1. It should be able to represent the personality characteristics of a trader.

---

[1] Agents in red not implemented in our prototype

2. It should be able to utilize data generated by the personality tests upon request of the system because investors' characteristics should influence the Buy and Sell decisions.

3. The Personal Agents model should behave as traders do; personal agents must communicate between each other in order to exchange news and experience.

4. Personal agents should be able to request information about a specific company from the Meta agent; therefore the Meta agent should provide/retrieve the best recommendation for the trader.

5.3.2 Analysis Agent

The Analysis agent (AA) should have the following requirements:

1. It should be able to request company prices and company news from financial information processing agents and the company agent; (but this part as will be discussed later, is outside of the scope of this work). The analysis agent will obtain financial data from the Internet directly through special classes.

2. Analysis agent should perform technical analysis on market data by running different financial indicators, and by performing fundamental analysis. This is where the previously introduced mathematical formulas are used and the calculations are performed.

3. The analysis agent should be able to retrieve and forward the results of calculations to the Meta agent.

5.3.3 Company Agent

Each Company Agent (CA) in the system models a company and has the following requirements:

1. Each Company Agent (CA) agent represents a distinct company; so it should have all information about it, such as company staff, structure, products, news, financial situation, stocks, and shareholders.

2. Company agents should be responsible for updating company information and company news continuously by communicating with Financial Information processing agents (this is also outside the scope of this work).

3. Since each company agent represents a distinct company, different company agents should have the ability to communicate with each other in order to exchange news.

4. Company agents should be able communicate with Meta agent in order to send the required information about the company.

5.3.4 Financial Information Processing Agent

The Financial Information Processing Agent (FIPA) is outside the scope of this work, but it is proposed in this prototype design because it supports the system's modularity. FIPA agent should have the following requirements:

1. Travel widely through the Internet in order to gather all the necessary information about companies from different resources such as companies' official websites, published pages, and financial reports.

2. Communicate with other foreign agents working in the same field in order to obtain maximum information.

3. Perform some processes in data before sending it to other agents in the system such as filtering to decrease redundancy, and indexing.

4. Communicate with other agents in the system and supply them with the best data.

5.3.5 External News Agent

External News Agent (ENA) is also outside the scope of this work, but they should not be overlooked. These agents should have the following requirements:

1. Travel through the Internet in order to get world news from different resource.

2. Communicate with other news agents already launched on the Internet.

3. Analyze news and summarize its effects on stock market prices.

4. The ability to communicate with Meta agent and other agents in the system.

5.3.6 Decision Maker Agent

The Decision Maker Agent (DMA) is the core agent in our tool. It is listed at the end of this section because it communicates with all agents mentioned above.

The DMA should have the following requirements:

1. It should be able to collect information from all other agents in the system, obtain information about the trader from the personal agent, receive world news from the News agent, obtain technical and fundamental analysis from the Analysis agent, and acquire company data and news from the company agent.

2. Depending on all information collected from all agents in the system, the decision maker agent should be able to make decisions and issue recommendations for the user.

5.4 Decision Making

Because of existing many factors (such as different financial indicators results, news and rumors, different traders personalities and situations...Etc) which may conflict for some cases it will not be easy to model Buy/Sell stocks decision. In our prototype we follow very simple decision making rules (we did not take news inconsideration because it's out the scope of our work):

1. If all financial indicators issue buy signal for all companies selected by user, decision will be buy from company with better fundamental values[here comparisons between fundamental ratios will occurs] ignoring the personality test result.

2. If we have conflicting financial indicators results companies with bigger number of conflicting signals will be eliminated. Then comparison between remaining companies fundamentals will be occurs, companies with weaker fundamentals will also eliminated. Then trader personality test results will be taken, traders who like to take the risk by their nature will be advised to follow buy recommendation for company with good fundamental and have buy signals more than sell. If the user very conservative the tool will issue no signal which means wait and do not trade today because of conflicting indicators.

5.5 General Requirements

The stock market agent-base tool should have the following requirements:

1. The tool is platform independent, and it should run under Microsoft Windows, UNIX, and Macos.

2. The tool's agents should be able to communicate with other agents under different platforms.

5.6 Scope of this work:

The main purpose of this work is to overcome the limitation of traditional stock market analysis tools and to propose a new generation of tools in a more intelligent manner. Agent technology is used to achieve that goal but most concepts of agent technology at present time are found in research papers and are yet to be implemented. In this work, we attempted to illustrate a tool and to partially implement it, but the scope is limited because of the complexity of the design and also the time and resource limitations. The limitations are highlighted below:

1. Personal agent will be partially implemented; only one simple, yet comprehensive personality test will be performed.

2. Company agent will be partially implemented. Only it will do so and deliver the data to decision maker agent without acquiring it from the Internet.

3. Financial Information Processing Agent will not be implemented.

4. News Agent will not be implemented.

5. Analysis agent is partially implemented where we implement RSI indicator. and we apply a small number of fundamental analysis basics.

6. Because the FIPA agent is not implemented, the analysis agent retrieves data from Internet directly.

7. 3D-Graphs are not implemented.

Chapter Six

System Implementation

In this chapter, we talk about software packages used to implement our agent base-stock market tools. The following diagram show the packages used and how they interact with each other. Detailed information about system implementations discussed in later subsections.
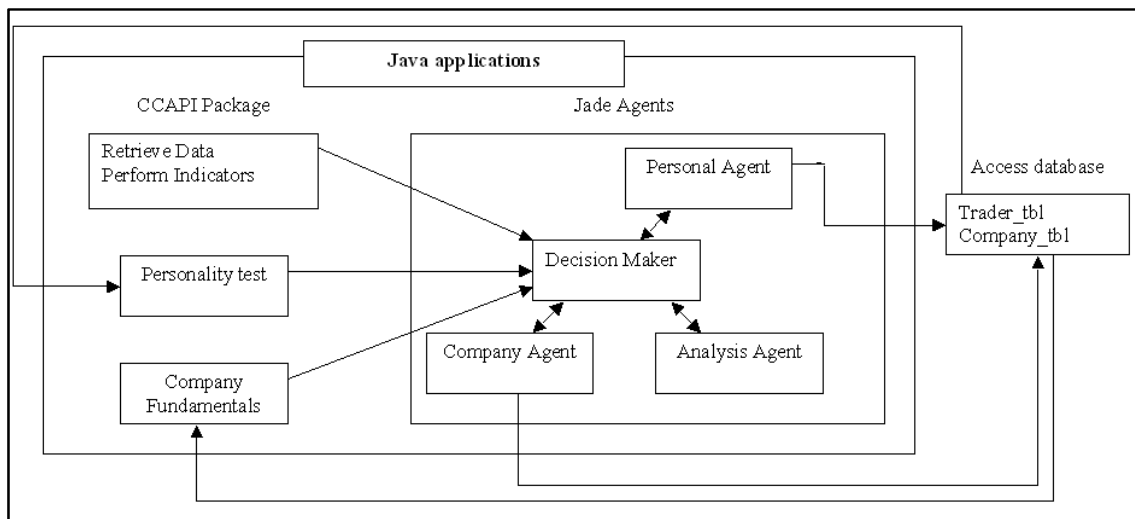
Figure 6.1-software packages

6.1 Software Required

6.1.1 JADE [v3.6]

Even though ad hoc multi-agent systems are often created from scratch by researchers and developers, some frameworks have arisen that implement common standards (such as the FIPA agent system platforms and communication languages). Having such frameworks saves developers time as well as aid in the standardization of MAS development. Some examples of those frameworks include Jack, Net Logo, Repast, Jade and many others (53) . In our work we use Jade because of its many

strong points such as Jade agents' ability to coordinate solving complex problems in distributed ways, their ability to work in proactive way according to the given rule, their ability to negotiate with each other regardless of their rules and position, and also Jade which is a java-based middleware has portability to run in different platform environments (54) .

6.1.1.1 Overview

Telecom Italia Lab (TILAB) of Italy has developed Java Agent Development Framework or JADE in compliance with the Foundation for Intelligent Physical Agents (FIPA) specifications. As a non-profit organization, FIPA is geared toward producing the standards for the interoperation of heterogeneous agents. Using several Java technologies and written entirely in Java, JADE is a middle-ware that simplifies the implementation of multi-agent systems. This is accomplished by providing a set of graphical tools that support debugging and deployment phases. Regardless of underlying operating systems, the agent platform can be distributed across multiple machines; the configuration is controlled via a remote graphical user interface. (55) (56) (57)

6.1.1.2 Jade Architecture

Jade create multiple containers (run time environment) for agents, each container may have one or more agents at the same time those containers could be in the same computing system or through the network. Set of active containers construct platform. A single main container must be active in the platform and other containers register with it when they start. The main container should hold the following agents:

3. The AMS (Agent Management System): agent which has authority to create/kill other agents in the platform, kill containers, and shout down platform.

4. The DF (Directory Facilitator): agent provides Yellow pages service which advertise the services of agents in the platform so other agents need those services can find them. (58) (59)

Figure 6.2-Jade Architecture (58)
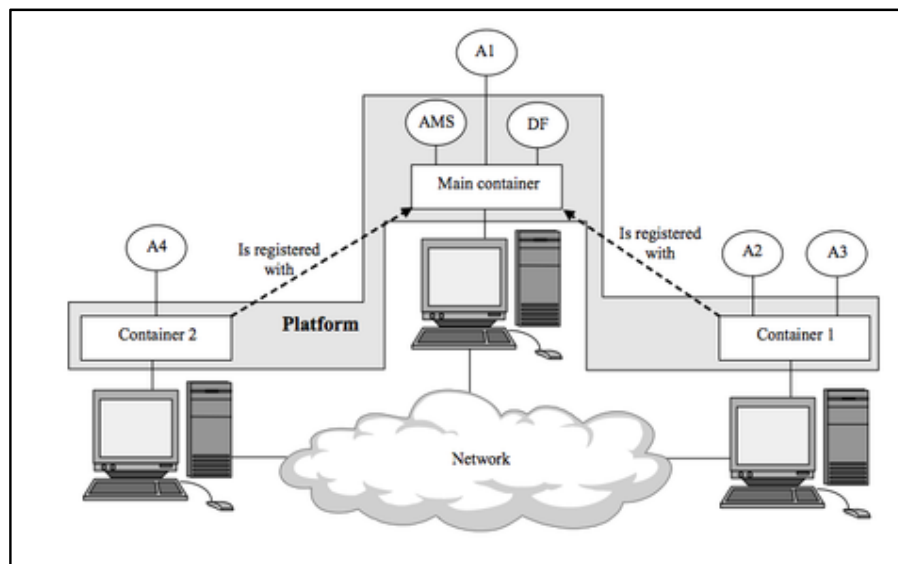
6.1.2 CCAPI [v2] (60)

CCAPI is a financial application library for Java. Using Cortal Consors, CCAPI supplies interfaces for automated stock exchange trading. CCAPI also provides various functions that are used to retrieve online quotes from various data sources, including Consors, Comdirect, EUWAX, and Yahoo!. In addition, CCAPI provides a wide-ranging library of both mathematical and

technical indicator implementations, which include MACD, SMA, EMA, RSI, Williams %R, Correlation, and others.

6.1.3 JFreechart (61)

JFreechart is a free 100% Java chart library that makes it feasible for developers to display various professional quality charts in their applications. JFreechart has extensive features that include: a flexible design that is easy to scale, which targets both the client and the server applications, it also supports a wide range of chart types by using a consistent and well-documented API. JFreechart supports many output types that include, but not limited to, swing components, image files (including JPEG and PNG) and various vector graphics file formats.

6.1.4 Microsoft Access

Microsoft Access is a relational database management combine's database engine with graphical user interface and it's a member of Microsoft Office group. It's easy to use and its perfect for simple database applications. In our project we use access to create very simple access database in order to save and retrieve information about traders and companies.

Database tables:

- Trader_tbl:

  Fields: trader name, date of birth, gender, career, number of kids, education, working field, portfolio.

- Company_tbl:

  Fields: company name, date of instruction, business sector, price per earning (P/E), percentage earning growth (PEG), price per book (P/B), price per

sales(P/S),return on equity(ROE). [Return to chapter two for definitions of those ratios]

6.2 Stock market tool implementation
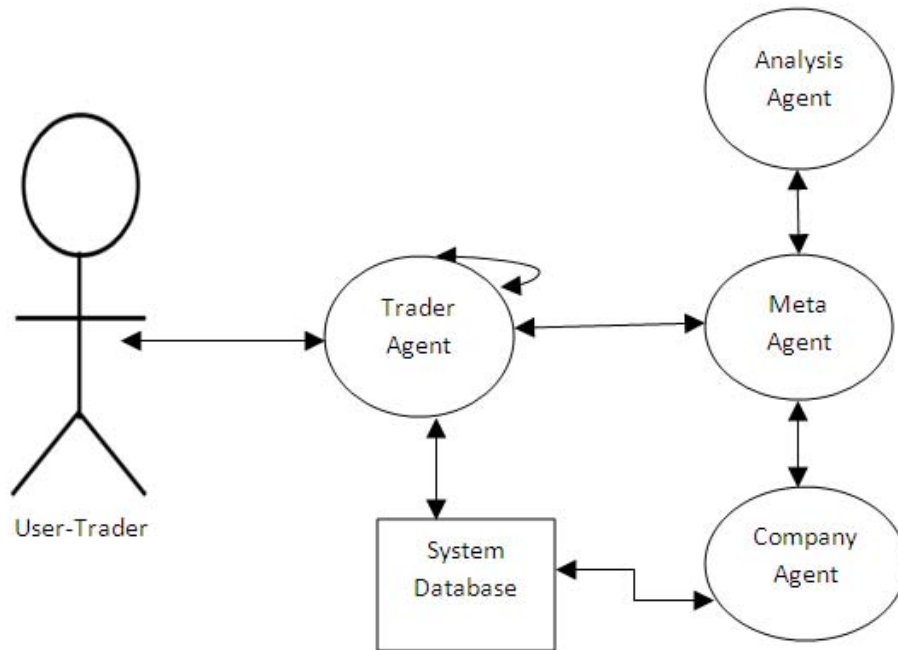
Figure 6.3-Agent Diagram

6.2.1 Agents Implementation (58)

Our agents extend the base Agent class. This implies the inheritance of features to accomplish basic interactions with the agent platform (registration, configuration, remote management…etc) and basic set of methods that can be called to implement the custom behavior of the agent like send/receive massages. Graphical user interface (GUI) is implemented for some agents in the tool in order to establish easier interaction between users and the system.

In this subsection we will talk about each agent in our empirical tool and the communication among the work

1. PA(Personal) agent:

   - Personal agent like all other agents in the tool extends base agent class.

```
import jade.core.Agent;
public class PAgent extends Agent {
protected void setup() {
// Printout a welcome message
   System.out.println("hello I am Trader"+getAID().getName()+" is
                    ready.");
}
```

   - Personal agent implemented with graphical user interface (GUI).

   - Through the GUI all trader personal information (like name, date of birth, marital status, number of kids, career) will be filled in a form and saved in simple database through *setInfo()* method. This information will help in taking the decision later.

   - Using jade will solve mismatch between autonomous nature of agents and reactive nature of GUI.

   - Trader personality will classified depending on personality test (will be discussed in coming subsection) through *getPersonality()* method.

2. AA(Analysis) agent:

   - Yahoo finance page is the main data source of our tool.

   - Analysis agent use *CCAPI.DataRetrieval* package which hold all sort of retrieves in order to read historical data.

- RSI financial indicator is performed in the retrieved data in order to generate buy or sell signal through the method *getRSISegnal()*.

3. CA(Company) agent:

   - Company agent gets some characteristics as company name, business field, and age. These information will be stored through *setCompanyInfo()* method.

   - Detailed fundamental analysis implementation is very extensive and out the scope of our work so to simplify the case and depending in some simple ratios(mentioned in 6.1.4)we assume that the company could be weak or strong fundamental and this is implemented throw *getCompanyStatus()* method.

4. Decision Maker Agent(DM):

   - Decision structure:

     1. PA sends massage to DM contains age and personality test result (PTR).

     2. AA agent gets historical data and run RSI indicator the result will be sent to DM agent.

     3. CA will also send status of company to the DM agent.

   - Making Decision Rules:

     1. If all financial indicators give buy signal, buy recommendation will issue for company with better fundamental ignoring personality test result.

2. If we have two conflict indicators we will give recommendations depending on fundamental values of the company and personality test result. if the company fundamentals good but the trader is very conscientiousness and Risk aversion wait recommendation will issued.

6.2.2 Agents Communications

Our jade agents exchange ACL massages – according to ACL language format that defined by Foundation for Intelligent Physical Agents (FIPA) for agents' massages. This format contains number of fields as:

- The **sender** of the message.
- **Receivers** list.
- **"Performative"** is what a sender wants to achieve by sending the message, "per formative" could be:

  a. REQUEST: the sender wants the receiver to perform an action.

  b. INFORM: the sender wants the receiver to know a fact.

  c. QUERY_IF: the sender wants to know whether or not a given condition holds

  d. CFP (call for proposal), PROPOSE, ACCEPT_PROPOSAL, REJECT_PROPOSAL: for sender receiver negotiation.

- The **content** of the message: real information included.
- The **content language**: syntax used to express the content (both sender and receiver must be able parse the content).

- The **ontology**: vocabulary of the symbols used in the content and their meaning.

- **Conversation-id**, **reply-with**, **in-reply-to**, **reply-by:** those fields control concurrent conversation.

An ACL message in JADE is instance of the jade.lang.acl.ACLMessage class. Get and Set methods is used to handle all fields of the message.

Our agents' communication messages listed in the following table:

	Sender	Receiver
REQUEST message	Personal Agent	Decision Maker Agent
REPLY message	Decision Maker Agent	Personal Agent
INFORMATION	Personal Agent	Decision Maker Agent
REQUEST message	Analysis Agent	Decision Maker Agent
REPLY message	Decision Maker Agent	Analysis Agent
INFORMATION	Analysis Agent	Decision Maker Agent
REQUEST message	Company Agent	Decision Maker Agent
REPLY message	Decision Maker Agent	Company Agent
INFORMATION	Company Agent	Decision Maker Agent
INFORMATION	Decision Maker Agent	Personal Agent

6.2.3 Mathematical Indicators Implementation

- Data retrieved in CSV format from yahoo finance page (62) (historical data section).

- In our system weekly data is retrieved.

- In our case we take RSI period 14 days.

- Selling when the RSI is above 70.

- Buying When RSI is below 30

```java
public class RSISystem {



        RSISystem(){
                try {

                        CSVRetriever cqr = new CSVRetriever();



                        cqr.setDelimiter(",");



                        TimeSeries data = cqr.fetch("sampledata/googleWeek.csv",
null, null, null);



                        FinancialLibrary fl = new FinancialLibrary();
                        double rsi0, rsi1;


                        rsi0 = fl.RSI(14, data, 0);
                        rsi1 = fl.RSI(14, data, 1);
                        System.out.println("\nresi0"+rsi0);
                        System.out.println("\nresi1"+rsi1);
                        if( rsi1 < 30  && rsi0 > 30 ){
                                System.out.println("BUY.");
                        }


                        if( rsi1 > 70  && rsi0 < 70 ){
                                System.out.println("SELL.");
                        }
```

73

```
        } catch (Exception e) {

              e.printStackTrace();

        }

}
```

- We take SMA as other financial indicator in the same data.

- We take period for 14 days SMA.

6.2.4 Personality test implementation

People adopt different investment strategies; we have professional investors and we have individual investors. Individual investors have different background and their knowledge of technical and fundamental analysis vary. Some people are long term investors others can be classified as traders. Traders usually follow medium to short-term investment strategies i.e. few weeks to few months investment plans. Another group of traders has emerged in the last few years referred to as day traders. Day traders play on the fluctuation of the market and analyze daily charts with short intervals, even minutes and hours. Therefore modeling the investors' characteristics and bringing this information to Decision Maker Agent can be very helpful when the Decision Maker Agent has to issue a Buy/Sell recommendation. Assume for the sake of argument that we have two companies with excellent fundamentals and the charting both seem to be favorable. By bringing the personality characteristics of the investors to the equation the Decision Maker Agent will be able consider the company that is belong to a sector that is more suitable to the investors' conditions.

Measuring personal characteristics is very complicated process. To illustrate the advantage of modeling personality characteristics, we tried to simplify it by using the three dimensional personality test developed by Dr. Brett N. Steenbarger **(63)**. This

three-dimensional personality test is best used for short-term investors. It is measure three personality traits for each trader and they are:

- Conscientiousness: "someone who has a high degree of self-control and perseverance. Conscientious traders are good rule-followers, and they often do well trading mechanical systems. Traders who are low in conscientiousness will have difficulty following explicit rules and often trade more discretionarily" (63).

- Neuroticism: "is the tendency to experience negative emotions. Often the person who is high in neuroticism is emotionally sensitive and can use this sensitivity to obtain a gut feel for market action. The trader who is low in neuroticism may experience little emotional disruption with trading, but may also be closed off to subtle, intuitive cues when a trade starts to go sour" (63).

- Risk aversion: "A risk-averse trader is one who cannot tolerate the possibility of large losses and who would prefer smaller, more frequent wins with controlled losses to larger wins with greater draw downs" (63).

Get_personality() method return the three traits for each investor high/low for every traits.

6.2.5 Decision-making

GetDecision() method based on the following structure:

❖ The system checks if the trader wants to trade stocks for distinct company or different companies.

❖ If it only one company the system checks it fundamentals values.

❖ Because of implementation consideration we check only simple fundamental ratios (those ratios discussed in detailed in chapter two) and they are:

  o Price/Earning (P/E) ratio: higher number of P/E ratio is positive sign.

  o Percentage Earning Growth (PEG): smaller PEG value is positive sign.

  o Price/Book (P/B) ratio: higher ratio is a positive sign.

  o Price/Sales (P/S) ratio: ratio <1 is a positive sign for traders.

  o Return On Equity (ROE): high ROE ratio is a positive sign.

  o Company Sector as Technology, medicine, industry...etc.

❖ Values of those ratios downloaded from yahoo finance page (62) after choosing the quotes for the company.

❖ If more than one company requested the system checks fundamentals for each company. Company with extra positive signs would be recommended.

❖ The system checks RSI indicator result either to buy or sell.

❖ Also the system checks personality test results, and trader personal information.

❖ Decision rules discussed in previous sub-section.

GetDecision() method return company fundamental result either week or strong and company name.

6.3 Testing Case One

Given the lake of experts who could perform technical analysis and the fact that our tool is a simple prototype that does not cover all conditions, our attempt to test the tool was limited. We have created the following example which included historical data related to the GOOGLE company (our source for price and volume data is yahoo finance (62)), and asked the help of one financial analysts specialized in managing stock portfolios. The same data was entered as an input to our system to be analyzed by our tool. The result recommendation issued by our Decision Maker Agent was similar to the recommendation made by the financial advisor.

In the following subsections we will clarify our test:

6.3.1 Selected Company

GOOGLE: is an American public corporation, earning revenue from advertising related to its Internet search, web-based e-mail, online mapping, office productivity, social networking, and video sharing services as well as selling advertising-free versions of the same technologies. Google was co-founded by Larry Page and Sergey Brin while they were students at Stanford University and the company was first incorporated as a privately held company on September 7, 1998 (64).

6.3.2 Trader personality

- Name: Bisan AbdelRazzaq.

- Age: 32

- Number of Kids:6

- Career: stock market trader, portfolio manager

- Companies stocks other than GOOGLE: Yahoo,

- Years of experience:10

Personality test result: High Risk-averse, high in neuroticism, conscientiousness

- Decision Issued by trader(Bisan): **BUY**

6.3.3 System Decision Elements

- Financial Analysis: BUY-this recommendation depending on RSI indicator signals.

- Fundamental Analysis:

  o Price/Earning (P/E) ratio: 32.33

  o Percentage Earning Growth (PEG): 0.86

  o Price/Book (P/B) ratio: 5.76

  o Price/Sales (P/S) ratio:7.61

  o Return On Equity (ROE): 20.8

  o Company Sector : Technology

- Personality test: High Risk-averse, high in neuroticism, conscientiousness

According to decision structure explained above the System Recommendation is:

BUY. (Was issued by our tool)

We applied the same data to our tool and similar BUY signal have been issued.

6.4 Testing Case Two

In this section we will introduce other example following different strategy. By taking two competitor companies Ford Motor C and General Motors Co (62) historical data for

limited period will be obtained from yahoo finance for both companies and this data will be input to our system. Our system result will be compared with future prices (prices in weeks after our historical data limit) in order to see if the prediction of our system was correct. We will clarify the case in the following subsections:

6.4.1 Selected Companies

Ford Motor Co: Ford Company was established at 1903 in Dearborn, Michigan, this company designs, develops, manufactures and services cars and vans in all over the world. Ford operates in two sectors. The Automotive sector sells vehicles under Ford, Mercury, Lincoln and Volvo brand names in all over the world for different kind of customers as companies and individuals. The second sector is financial services which offer different financing products to and through dealers in all over the world. (62)

General Motors C: General Motors cooperation was established at 1908 in Detroit, Michigan. This company also designs, develops manufactures and services cars, trucks and related parts all over the world. This company sells vehicles under Chevrolet, Buick, Saab, GMC, Pontiac, Cadillac, Hummer, Saturn, Opel, Isuzu and other brand names. General Motors also provide financial services and after sale services for her customers. (62)

6.4.2 Trader personality

After applying 3d personality on ordinary person who does not have any market experience we got the following result:

Risk seeking, low in conscientiousness and high in neuroticism .this result show us that the person is poorly suited to trading.

6.4.3 System Decision Elements

Input data to our system range from 1/1/2007 to 30/11/2008 to each company. The user wants to know which better buying stocks from Ford or General Motors next week.

Ford Motor:

- Financial Analysis: BUY-this recommendation depending on RSI indicator signal, while hold issued from SMA indicator.

- Fundamental Analysis:

  o Price/Earning (P/E) ratio: N/A

  o Percentage Earning Growth (PEG): N/A

  o Price/Book (P/B) ratio: N/A

  o Price/Sales (P/S) ratio:0.01

  o Return On Equity (ROE): N/A.

  o Company Sector : Consumer Goods

- Personality test: Risk seeking, low in conscientiousness and high in neuroticism

General Motors:

- Financial Analysis: hold -this recommendation depending on RSI indicator and SMA indicator.

- Fundamental Analysis:

  o Price/Earning (P/E) ratio: N/A

  o Percentage Earning Growth (PEG): N/A

  o Price/Book (P/B) ratio: N/A

  o Price/Sales (P/S) ratio:0.05

- o Return On Equity (ROE): N/A.

- o Company Sector : Consumer Goods

- Personality test: Risk seeking, low in conscientiousness and high in neuroticism

6.4.5 Decision-making

- Financial indicators not conflicting for each company, no signal not conflict to buy in FORD Company.

- The two companies' fundamentals are nearly similar.

- Trader personality test show that he like to do risk.

- Depending of technical indicator and personality test system recommends buying from FORD Company.

- Comparing with future data it was good recommendation.

6.4.4 Results

- System recommends buying from Ford Company.

- When we returned to Ford historical data from 1/12/2008 to 15/12/2008 we see that prices start rising at the beginning of December and continue rising so buying was good recommendation.

- When we returned to General Motors historical data from 1/12/2008 to 15/12/2008 we see prices declining.

Chapter Seven

Conclusion and Future work

7.1 Conclusion

In this work we demonstrate by a working prototype the need for a new generation of a stock market tool that utilizes collaborative agents technology in order to perform technical and fundamental analysis in a more efficient manner.

Although many traders exhibit similar characteristics and ways of assessing the marketplace, many come from different backgrounds and environments, have personal circumstances and traits that play a critical role in the Buy / Sell decision process. So that these differences are taken into account, this tool attempts to model and utilize these varying human characteristics to bring more objectivity to the Buy/Sell decision making process.

Our work is multidisciplinary and incorporates the latest agents and human-computer interaction research concepts, but it is only a prototype partially implemented to illustrate the advantage of incorporating such concepts in a new generation of tools.

Given the limited scope of our implementation, we tested a very simple case - introduced in previous chapter- based on historical data. Introducing a fully implemented and a comprehensive tool is beyond the scope of our research work. With the advent of technology and smart agents development, this tool can be further implemented and used for its intended purpose so that the marketplace is a safer environment for investment and financial growth.

7.2 Future Work

1. Trader personality may change over time and experience. In our work we use simple personality test. More complex methods (suggested by psychologists) could be used to model different traders' characteristics in more realistic manner.

2. Exploiting the third dimension, 3D graph visualization, will add extra value to the tool.

3. More complex financial indicators should be added to issue more powerful decisions.

4. Modifying data retrieving process by using extra methods to retrieve data in different formats from all available resources as websites and documents.

5. Adding extra fundamental ratios to model companies in realistic manner will improve the tool.

6. Modeling external and company news and implementing news agent will enhance the tool.

7. Enhancing the communication between agents by defining stock market ontology will improve the model proposed in our research.

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APPENDIX I

Three Dimensions (3D) Trader Personality Quiz

Brett N. Steenbarger, Ph.D.

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Note: A version of this questionnaire will appear in Toni Turner's upcoming book, "Short-Term Trading in the New Stock Market"

When traders run into emotional difficulties with their trading, they often assume that they have deep, dark, underlying personality conflicts that require therapy. Sometimes this is true, but very often the source of the problems is different. Often there is a mismatch between the method or system that a trader is trading and the trader's needs and personality. Instead of berating themselves for a lack of "discipline", traders need to ask whether their challenges in following a methodology might be because the methods aren't right for them. Finding the proper fit between who you are and how you trade is a big part of finding success in trading.

The following questions are designed to help you assess facets of your personality that are related to the kinds of trading approaches that are likely to work for you. There are no right or wrong answers, and none of the questions are designed to evaluate your emotional stability or mental health. Rather, we are trying to find out your personal style, so that you can match

it to your trading style. Each item consists of two statements. Please choose the statement that best describes you:

1a) I often arrive early for appointments and events to make sure I'm not late.

1b) I'm not very time-oriented and often show up late to appointments and events.

2a) When a problem occurs in my trading, I first feel frustrated and vent my feelings either outwardly or at myself.

2b) When a problem occurs in my trading, I first try to focus on what went wrong and what I can do to fix it.

3a) When I go out to eat, I generally go to my favorite restaurants and order my favorite foods.

3b) When I go out to eat, I like to try new and unfamiliar restaurants and foods.

4a) I tend to be detail-oriented and try to get each aspect of a job done as well as I can.

4b) I focus on the big picture instead of details and don't sweat the small aspects of a job.

5a) If you could hear the thoughts in my head as I'm trading, you'd hear worried or negative thoughts.

5b) If you could hear the thoughts in my head as I'm trading, you'd hear me analyzing the market action.

6a) If I had a choice of car to drive, I would choose one that is comfortable and quiet.

6b) If I had a choice of car to drive, I would choose one that is fast and that handles well.

7a) I would be good at following a diet or exercise program.

7b) I would often cheat on a diet or exercise program.

8a) It is hard for me to shake off setbacks in the market.

8b) I take market setbacks as a cost of doing business.

9a) I like vacations that are peaceful and relaxing.

9b) I like vacations where you see and do a lot of different things.

10a) I get routine maintenance done on my car when it is scheduled.

10b) I don't follow deadlines for routine maintenance on my car.

11a) Sometimes I feel on top of the world in the market; other times, I'm down or down on myself.

11b) I don't have many emotional ups or downs in the market.

12a) I would like a job with a stable company that pays a guaranteed salary and benefits, even if I might not get rich.

12b) I would like a job with a startup company that offers me a chance to get rich, even if I might get laid off if things don't work out.

13a) I try to eat healthy foods and get a good amount of exercise and rest.

13b) I'm very busy and don't always eat, exercise, and sleep as I should.

14a) I trade by my gut.

14b) I trade with my head.

15a) I avoid arguments and conflict.

15b) I like to argue and hash things out.

Scoring

Items 1, 4, 7, 10, and 13 measure a personality trait called "conscientiousness". A conscientious person is someone who has a high degree of self-control and perseverance. If you scored mostly a) responses for these items, you are high in conscientiousness. Conscientious traders are good rule-followers, and they often do well trading mechanical systems. Traders who are low in conscientiousness will have difficulty following explicit rules and often trade more discretionarily. Ideally, you want a style of trading that is more structured and detail-oriented if you are more conscientious. Trying to trade in a highly structured manner will only frustrate a trader who is low in conscientiousness. Such a trader would do better with big picture trades that do not require detailed rules and analysis. Similarly, very active trading with rigid loss control will come easier to the conscientious trader; less frequent trades with wider risk parameters will come easier to the trader lower in conscientiousness.

Items 2, 5, 8, 11, and 14 measure a personality trait called "neuroticism". Neuroticism is the tendency to experience negative emotions. If you scored mostly a) responses for these items,

you are relative high in neuroticism. The trader prone to neuroticism tends to experience more emotional interference in his or her trading. Wins can create overconfidence; losses can create fear and hesitation. The trader who is low in neuroticism is more likely to react to trading problems with efforts at problem solving and analysis. He or she will not take wins or losses particularly personally. Neuroticism is a mixed bag when it comes to trading. Often the person who is high in neuroticism is emotionally sensitive and can use this sensitivity to obtain a gut feel for market action. The trader who is low in neuroticism may experience little emotional disruption with trading, but may also be closed off to subtle, intuitive cues when a trade starts to go sour. In my recent experience, I have been surprised at how successful gut traders are often relatively neurotic traders. Very active trading methods are particularly challenging for such traders, as they don't allow much time for regaining emotional equilibrium after losses. This can lead to cascades of losses and significant drawdowns of equity. It is much easier for the non-neurotic trader to turn losses around, since these are less likely to be tied to self-esteem.

Items 3, 6, 9, 12, and 15 measure a trader's risk aversion. A risk-averse trader is one who cannot tolerate the possibility of large losses and who would prefer smaller, more frequent wins with controlled losses to larger wins with greater drawdowns. If you scored mostly a) responses for these items, you are a relatively risk-averse trader. Trading with careful stops and money management, and trading smaller time-frames where risk can be controlled with the holding period will come most naturally for the risk-averse trader. The risk-seeking trader is one who enjoys stimulation and challenge. Larger positions and longer holding periods are easier to tolerate for the risk-seeking trader. Very often, the risk-seeking trader will be impulsive in entering trades and will have difficulty trading during periods of boredom (low volatility). The risk-averse trader often experiences difficulty hanging onto

winning trades and will cut profits short to avoid reversals. This trader will be challenged during periods of high market volatility. Position sizing is key and often overlooked as a trading variable. Trading too small will bore the risk-seeking trader, who will then lose focus. Trading too large will overwhelm the risk-averse trader, who will also then lose focus.

Ultimately it is the blending of these three dimensions of trader personality and not any one in isolation that is most important in shaping trading outcomes. In my experience, the traders who are most poorly suited to trading are those that are risk seeking and who are low in conscientiousness and high in neuroticism. Such traders often take large gambles on impulse, and very often those impulses are driven by emotional frustrations. An example would be a trader who gets frustrated after a loss and doubles his position size on the next trade just to make the money back quickly.

Conversely, I have seen very few successful traders who were highly risk-averse. The risk-averse trader, particularly who is high in neuroticism, is motivated more by a fear of loss than a desire for gain. This makes it difficult to sustain meaningful position sizes during promising trades. Often such traders berate themselves for being self-defeating or sabotaging, but the reality is that they might be better suited for investing than trading.

If I had to identify an ideal personality pattern for traders, I would say that such a person would be risk-tolerant, low in neuroticism, and high in conscientiousness. Such traders are generally good at following trading rules (entries, exits, money management) and disciplined in their preparation. They don't take losses personally, which gives them the perseverance to weather losing periods. When they see a good trade, they are comfortable trading in size, so that the average size of their wins exceeds that of their losses.

Finally, let me mention one other important dimension that is related to neuroticism and emotionality. I strongly suspect that cognitive style is just as important as personality style in trading. Some people process information intuitively, relying on gut cues and subtle, non-verbal information. Others process information explicitly, through reasoning and analysis. Both cognitive styles can make traders money in the markets, but it is essential that one's cognitive style match one's trading methodology. As one trades shorter and shorter time frames, moving from swinging to scalping, it is less practical to expect explicit analytical routines to guide trading. Very short-term trading is more about pattern recognition than historical research. Conversely, longer-term trades often benefit from modeling and statistical analysis that inform traders where the edge might lie. How traders process information most effectively is a neglected variable in selecting proper time frames to trade.

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ملخــــــــص

تتجه أنظار الناس بشكل متزايد نحو السوق المالي وتجارة الأسهم حيث يرى الكثيرون في تجارة الأسهم والعملات فرصة جيدة للربح السهل والوفير ولكن الكثيرون وخصوصاً الذين يتجهون لهذا المجال دون خبرة جيدة ينتهون بخسائر تطال توفيرات حياتهم.

القرارات السليمة للبيع والشراء لا تتخذ بطريقة عشوائية هنالك الكثير من البرمجيات المتوفرة بالأسواق تساعد المستثمرين على اتخاذ القرارات. بعضها يعتمد على المعادلات الحسابية في احتساب الأرباح والخسائر وتقدير الوضع المالي للشركات , البعض الاخر من تلك البرمجيات يعتمد على الأسعار بشكل تاريخي وعلى الرسومات البيانية الممثلة لها.

ولكننا من خلال هذه الأطروحة نحاول طرح جيل جديد من البرمجيات نتجاوز به مساوئ البرمجيات السابقة من محدودية التعامل مع مصادر البيانات الضخمة المنشورة على الشبكة العنكبوتية وتجاهل شخصية المستثمر وقدرته على المخاطرة وتقبل الخسائر باستخدام تقنية العاملات الذكية حيث تقوم هذه العاملات بجمع معلومات عن عدد كبير جدا من الشركات وبجمع وتحليل عدد ضخم من الأسعار التاريخية من مصادر مختلفة عن طريق شبكة المعلومات. وبعد أن تحلل تلك العاملات البيانات المالية للشركات والبيانات التاريخية لأسعار الأسهم تقوم بإعطاء المستثمر توصية للبيع ,الشراء أو الانتظار بما يتناسب مع شخصيته حيث تحلل العاملات الذكية شخصية المستثمر بشكل دوري اعتمادا على اختبارات عالمية لتحليل الشخصية.

جامعــــــــــــــــة بيرزيت

كلية تكنلوجيا المعلومات

تحسين اتخاذ القرارات الاستثمارية اعتمادا على الرسوم البيانية
باستخدام البرامج الذكية

2008

اعداد

أمال صالح خصيب