Trend Analysis as Pattern Recognition

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Introduction

Of the principal categories of forecasting methods, trend analysis remains the most prevalent. (1) After all, trend information from the past and the present is the only empirical evidence that we have to use in thinking about the future – nobody has data from the future. In many day-to-day applications, forecasts are linear extrapolations of the past. Although it is inadequate as our only method for forecasting, trend analysis will likely continue as the most popular method of forecasting in the future, so we would be well served by developing more reliable approaches to doing it.

This paper has the following three objectives:

- To assert that trends may be viewed as patterns
- To identify three types of pattern recognition as three types of trend analysis with historical examples
- To offer some suggestions for further exploration based on pattern recognition for better trend analysis as a method of futuring and forecasting.

Terms and Concepts

In the hope of avoiding confusion, I need to begin with definitions of key words and concepts that I will be frequently using in this paper.

I use the term "futuring" to embrace all methods, both qualitative and quantitative, of thinking about the future. In contrast, too often the word "forecasting" is narrowly interpreted to mean just quantitative methods, especially time series and historical trend projection. I think "forecasting" and its product, a forecast, is always a combination of qualitative and quantitative methods, but I will use the word "futuring" in the broad meaning and "forecasting" in the narrow meaning of preparing points of view of the future.

"Trends" are repetitions in phenomena and data that display an inclination, or bias, toward a certain direction over time. "Trend analysis" is the disciplined and systematic way of extracting meaning and

recognizing patterns in trends. The phenomena of trend analysis, however, are not so-called "laws of nature" or Newtonian mechanics. Rather, trend analysis is the study of patterns in human behavior, often set in a context of a time period in the past.

Historically, trends in the social sciences have borrowed liberally from the physical sciences. Philosophers, historians, and futurists have searched for natural forces in such things as economics, politics, and social structures as though such things moved according to immutable laws of nature and Newtonian mechanics. For example, Adam Smith in his *Wealth of Nations* (1776) described the market forces in the capitalist system as moving according to an "invisible hand," much like gravity. Since Smith, economists have worked from the premise of equilibrium with concepts and equations rivaling those of physics. They wished that economic behavior could be as predictable as F=ma or even $E=mc^2$. Karl Marx, to cite a famous example, saw a linear natural determinism in history leading to inevitable results in the future. In addition, both economists (like Joseph Schumpeter) and historians (like Ibn Khaldun) have looked for cycles in trends that may be predictive of the future. None of these efforts, while prescient in some regards, has hardly proven to be predictive. (2)

Trends in human affairs are patterns of behavior according to our own nature. Our species, which is some 200,000 years old in its present biological particulars, has probably further evolved little or not at all in the very recent period of the last 10,000 years, or roughly the span of human civilization. Charles Darwin asserted that behaviors evolve as well as bodies, and that humans have long-term behavioral characteristics of their own and similar to those displayed by many other kinds of animals. (3) Carl Jung developed the concept of psychological archetypes, whereby certain mental images, thoughts, and perhaps even patterns of behavior have been hardwired into our brains through evolution. (4) History tells us, based on the surviving evidence, what people have been doing with their lives within the time period that we call civilization. These would be long-term (maybe very long-term) trends. We recognize many other types of mid-range patterns in human economic, political, social, technological, and military trends. For example, we are still studying military treatises that date back to ancient Greece and China. We also examine short-term trends as indicators of potential future developments.

An emerging approach to trend analysis is to view it from the perspective of pattern recognition, which is very broadly defined as the classification of data to achieve a purpose. It consists of sensors, data, and data classifications to provide useful information. We typically think of pattern recognition as machine learning, or the programming of computer software of known and useful patterns of data in order to apply such "learning" for extracting information from other data showing the same or similar patterns. We use pattern recognition with computer systems for many everyday applications, such as optical scanning, voice recognition, identification for security purposes, automated medical diagnostics, etc. In a more general sense, pattern recognition is a way to identify and anticipate behavior in many different aspects. For example, we are increasingly seeing the use of pattern recognition as a futuring method for consumer behavior in new product development. Pattern recognition is becoming increasingly popular in tracking trends in technologies, economics, and politics; it is also the stuff of surveillance and intelligence. (5)

Let me use a simple, everyday example of pattern recognition. The credit card companies store huge quantities of data from our frequent use of their cards. The companies know our individual patterns of card use, so when a card is used, by us or by an impersonator, for a seemingly atypically large purchase, red lights go off and the company will suspend the validity of a card's use until there is an explanation. Although this may be a temporary annoyance to the consumer, it is a prudent risk-management measure to protect credit card fraud. This example of pattern recognition might be called "profiling,"

but it is a type of profiling based on individual behavior, historical data, and pattern recognition for a practical and responsible outcome.

In both pattern recognition and trend analysis cases, which can be extremely complex, we typically face both ambiguous and incomplete data even in situations of dire need, like saving a life. Information about the past is sometimes seemingly contradictory and frequently incomplete; we often have to use judgment to weigh the evidence and use speculation to fill in the gaps of information to form a complete mental picture. As mentioned above, nobody has data from the future, so our expectations for the future may be largely speculative. Yet the uncertainties of the future are bound by the precedents of the past as well as present conditions. To manage inherent uncertainty, we must use pattern recognition with Bayesian probabilities, at least qualitatively in the concept of dynamic uncertainty if not mathematically. We use *a priori* probabilities to reflect judgment based on past and present information along with disciplined expectations for the future and then we continuously adjust them to *a posteriori* probabilities as we acquire new information as events unfold over time.(6)

Building upon the basic concept of uncertainty and the use of Bayesian probabilities, I assert that the future always has been and always will be a combination of continuity and change. Trends are examples of continuity. But trend analysis as nothing more than time series projections fails when the time period is extended (more time allowing for more variability, or risk), the data are incomplete, we have imperfect knowledge of trend relationships, and disruptive, and typically unpredictable, events occur. The future, on the other hand, is not all change. Rarely is a change so dramatic that is unsettles everything that went before it. In addition, no change occurs with total randomness. You tell me what happened, and I can reconstruct, basically, how it happened. Looking backward, an event may seem inevitable, because we screen out all the "irrelevant" information (things that did not happen), but looking forward we cannot see a clear outcome buried in so many distractions and false leads.

Figuring out all the possible, let alone likely, combinations of continuities and changes in the future is the very core of the difficulty of trying to predict the future. The use of the concepts and technologies of pattern recognition, however, may provide a new and potentially fruitful way of looking forward as well as backward.

There are fundamentally three types of pattern recognition, and by analogy, three types of trend analysis, as follows:

1. Type I (Background): where we know the background and we seek to identify continuities and potential changes of any kind from the norm
2. Type II (Signals): where we are looking for specific, known signals, signatures, or trends (typically changes), but know little or care less about the background, which is just so much "noise"
3. Type III (Scatters): where we detect apparently random signals without context and require interpretation inductively through emerging pattern recognition or trend analysis.

I will examine each in further detail.

Type I Pattern Recognition and Trend Analysis (Backgrounds)

Type I, or "Backgrounds," tell us what is normal for a place, a time, and a society. We understand the background and we are continuously monitoring it to detect any kind of deviation or any kind of signal

or signature (or change). We typically use camera and other types of surveillance to do Type I pattern recognition for security and intelligence. In trend analysis, we use long and mid-range trends that may be either static (a portrait of a particular place at a particular time) or dynamic over time. Many long-term trends will change in minor ways, but will remain fundamentally stable for extended periods of time. Excellent examples of Type I trend analysis were authored by the great French historian Fernand Braudel. (7).

Backgrounds can be static, meaning that they show us conditions at a particular point in time, or they can be dynamic in that they may show the continuity of many trends. Type I pattern recognition can be thought of as multiple trends, even interacting with each other to produce a net future. It can also be used to establish a baseline condition or forecast that provides context for interpreting possible changes from the norm, either small or great.

Let me present just two examples of Type I pattern recognition and trend analysis. One is the case of the Cuban Missile Crisis in October 1962, when repeated U-2 flights and satellite surveillance over Cuba established a background of what was norm and then tracked a series of changes, which turned out to be the construction sites for Russian medium range ballistic missiles to be pointed at the U.S. One example of the aerial photograph, taken after the crisis to track the dismantling of the same missiles appears as Figure 1. Satellite surveillance is a particularly powerful method to establish Type I background patterns. In qualitative intelligence, area studies and the periodic National Intelligence Estimates are also examples of Type I pattern recognition.

A simple historical example of Type I trend analysis is Rembrandt's acclaimed "The Night Watch," as seen in Figure 2. It is a painting from 1642 showing a company of guards on their way to their nightly tour of the city. It is an example of Type I pattern recognition and trend analysis at two levels: what they are doing is an example of security surveillance in 17th century urban Holland, whereby they knew the normal state of affairs and were searching during the night for any deviations (crimes) from the norm. It is also an excellent example of the attire, weapons, and customs of Amsterdam in Rembrandt's times. Today the soldiers would look like policemen, who still patrol the streets of Amsterdam at night.

Type I patterns and trends are predictive of future conditions in the absence of critical changes. While small changes may occur continuously, the "background" remains remarkably stable. The stability of Type I trends emerge from the basic repetitions of human behavior expressed as culture, customs, traditions, routines, and habits. As Henry David Thoreau generalized from a path that he had worn at Walden Pond in 1847: "The surface of the earth is soft and impressible by the feet of men; and so with the paths which the mind travels. How worn and dusty, then, must be the highways of the world, how deep the ruts of tradition and conformity!" (8)

Generally, case studies in business, medicine, law, economics, and intelligence are examples of Type I pattern recognition.

In Type I trends analysis, there may be, as said previously, a spectrum from long-term to short-term trends over time. There may also be strong trends, which are not only long lasting and remarkably stable but also impacting many other trends. Conversely, there are weak trends that are highly volatile and subject to impacts from other trends. Beyond the first challenge of even identifying Type I patterns and trends, sorting out all of the impacts of trends on each other and combining them into a prescient mixture of continuities and changes, working with data only from the past and present, without letting

Figure 1. Example of Type I pattern recognition. Soviet missile sites under construction in Cuba during the Cuban Missile Crisis. NASA photograph, November 1, 1962. www.images.google.com from www.classbrain.com.../cuban-missles.jpg.

Figure 2. Example of Type I trend analysis. Rembrandt's "The Night Watch," depicting styles and behavior of 17th century Amsterdam. www.rembrandtpainting.net/rembrandt's_night_watch.html.

our wishful thinking or fanciful imaginations run away from us, are exactly the formidable challenges of futuring.

Type II Pattern Recognition and Trend Analysis (Signals and Changes)

Type II pattern recognition occurs when we are interested in particular known signals, or signatures, and we are looking for them regardless of the background, which may be just so much "noise." There may be overlaps between Type I and Type II in as much as Type I may also involve surveillance using many of the same technologies as Type II. The important difference between Type I and Type II is that in Type I we may be looking for changes of any kind, whether known or not, while in Type II we know what signal we are looking for and typically may know little or nothing, or care less, about the background.

Type II might also occur as a variation on monitoring a particular trend rather than an event or significant change. Monitoring just economic political trends, for example, without taking into account demographic, social, political, and technological trends would be a variation of Type II pattern recognition because it would focus on a particular signal to the detriment of considering the whole context (Type I pattern recognition).

Radar and sonar are famous examples of Type II pattern recognition. Using electronic technologies and experience, we know the image of a Russian missile, the radar signature of a Russian bomber, or the sonar signal of a Chinese submarine, and, because we fear them, we are always trying to detect and track them. Optical and infrared technologies are also used for Type II pattern recognition. There is also the qualitative variations of Type II, such as the Customs and Immigration agents who process thousands, if not millions, of people coming into the U.S. and who have developed remarkable cognitive skills and intuition spotting "funny" behavior patterns likely reflecting anxiety and illegal behavior. New types of both qualitative and quantitative methods of pattern recognition are emerging in the fields of safety, security, and law enforcement.

In trend analysis, Type II pattern recognition focuses on particular signals, isolated trends, and dramatic changes rather than the baseline conditions and continuities of Type I. Since early times, scribes and chroniclers recorded important events that departed from the norm. This set the trend for historians to emphasize famous people and major events while largely ignoring the background of boring details of everyday life. Advocates of Type II trend analysis have gone so far as to argue that long-term trends count for little or nothing and that only the major surprises, called "Black Swans" or "wild cards" are significant. They claim that you cannot predict, let alone prevent "Black Swans" and that the most you can do is to prepare to respond to dramatic events when they occur. (9)

Certainly dramatic events occur, and they may change previous trends and create new ones. Let me use two very famous historical examples of shocking Type II changes that have obsessed both historians and intelligence officials. The first was the Japanese surprise attack on the U.S. naval base at Pearl Harbor on Sunday morning, December 7, 1941 (see Figure 3). The possibility that the Japanese might attack the American presence in the Pacific, even Pearl Harbor itself, was recognized but largely discounted by American military intelligence in the 1930s. When the attack actually happened, it came as a huge surprise to the Americans, and represented a Type II change qualifying as a disastrous "Black Swan." The Japanese strike could have been predicted and detected, maybe even prevented, had we had a better awareness of an historical pattern of Japanese surprise attacks prior to declarations of war and better information about Japanese ambitions, plans, and war preparations. We apparently missed the approaching Japanese aircraft carriers, let alone the Japanese planes in flight.

Figure 3. Burning American battleships after the Japanese surprise attack on Pearl Harbor on December 7, 1941. From www.history1900s.about.com/library/photos/blyph48.htm.

Figure 4. Burning buildings of the World Trade Center, New York City, after the terrorist attacks of September 11, 2001. From www.911research.wtc7.net/wtc/evidence/photos/fires.htm.

One consequence of Pearl Harbor was a lasting American fear of another surprise attack from an enemy. This fear became an obsession of American security during the Cold War. In parallel, the Soviets had suffered from their own "Pearl Harbor": the near catastrophic surprise attack of the Germans on Russia on June 22, 1941. The Soviets were just as paranoid about a surprise attack as the Americans became. Hence, a great deal of the tension of the Cold War centered on detecting and preventing any move of an adversary that might lead to a surprise attack – like the placing of Soviet medium range nuclear missiles in Cuba in 1962.

The second example we remember very well: the terrorist attacks on New York City and Washington, D.C., on Tuesday, September 11, 2001 (see Figure 4). Muslim terrorists had hit American targets in the Middle East, and they had previously attempted a bombing of the World Trade Center in New York City that failed. The notion that the Muslim terrorists could hijack commercial jet airplanes (done before), target the World Trade Center (done before), and fly the hijacked airplanes into buildings (not done before, exactly), causing the skyscrapers of the World Trade Center to collapse (never done before) seemed at the time absolutely incredible. Yet a few futurists had at least identified the possibility of such an attack in general if not specifically. The terrorist attack of 9-11 caused many previous trends to change and created some whole new ones, especially the American policies of retaliation, preemption, and unilateralism concerning Muslim terrorists and suspected terrorist-supporting regimes in the Middle East. It added another dimension to American concerns about that part of the world: the Arab-Israeli confrontation, oil, and the Muslim terrorist threat aimed directly at the U.S. rather than just American assets in the Middle East. The 9-11 events, like Pearl Harbor, have caused us to focus, perhaps excessively, on one particular application of Type II pattern recognition and trend analysis.

Type III Pattern Recognition and Trend Analysis (Arrays)

Type III patterns occur when we detect signals, signatures, trends, or changes that are initially unfamiliar to us. We recognize neither a known Type I background nor Type II signal. In this situation, we have to continue monitoring the phenomena for more data and find ways of arraying them in order to see a pattern. Emerging Type III patterns might conform, even roughly, to known Type I patterns – which happens, by design, in many applications of machine learning and automated pattern recognition using neural nets, fuzzy logic, and other techniques. But how much data do we need from an inductive Type III pattern to feel comfortable that we are seeing only a variation of a known Type I pattern as opposed to a relatively new Type I pattern?

Perhaps an infinite number of patterns exist, far more than any library of Type I patterns known today. Very simple examples include the following:

- 1, 2, 3, 4, 5, 6…
- 1, 2, 3, 1, 4, 5, 6, 2, 7, 8, 9, 3….
- 10011000101110011111001010100010010001010101111….
- A, B, C, D, E, F…
- LETT…RS CAN BE ARRANG…INTO …THOUS… OF DIFF…WORDS….

Cryptology is but one application of pattern recognition. In addition to numbers and letters, there is virtually an infinite number of combinations of symbols, pictograms, and illustrations that are patterns emerging from data.

A typical way of arraying data in Type III pattern recognition is a scatter diagram, as illustrated in Figure 5. It plots data as received according to two axes, the *x* axis usually being time and the *y* axis usually measuring frequency or intensity (or even location). The axes might be determined by experience

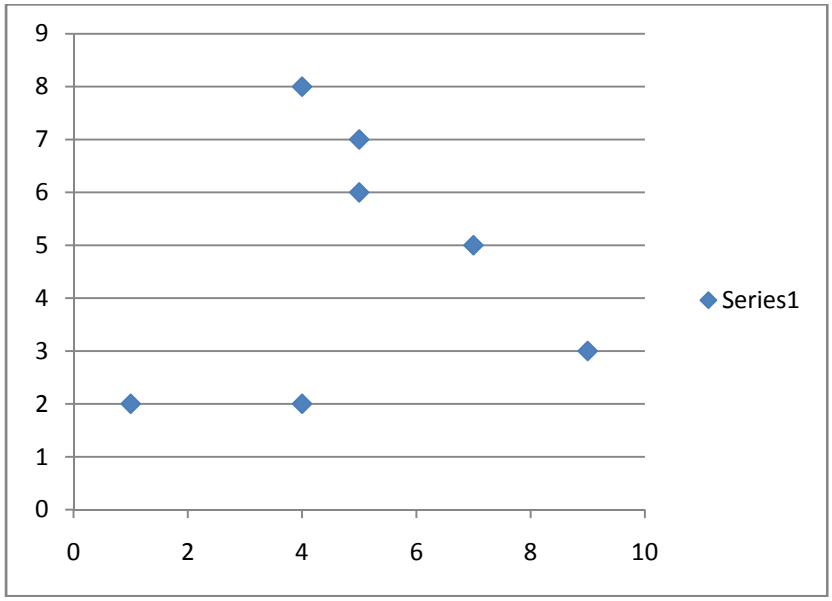

Figure 5. A typical scatter diagram, or array, of data in Type III Pattern Recognition

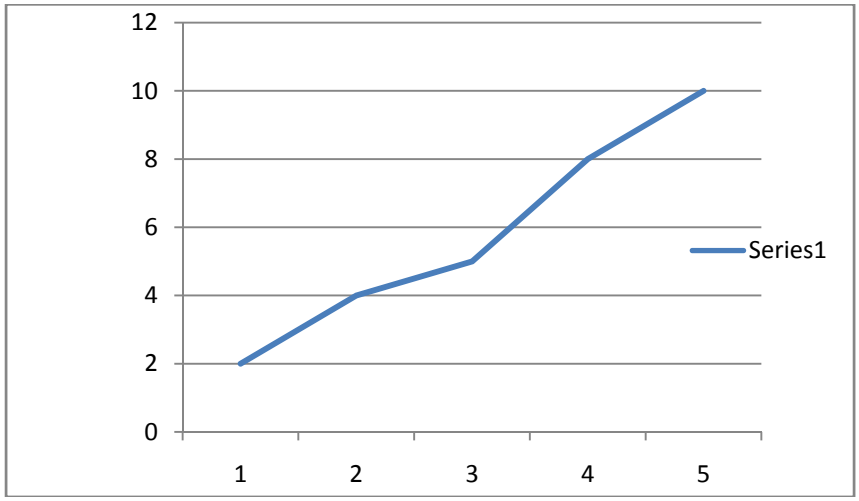

Figure 6. A typical time series or linear trend projection graph that may be Type I or Type III pattern recognition

(Type I patterns) or by expert judgment. There exists a strong bias, maybe resulting from our education in mathematics and statistics, to reduce scatter diagrams into lines by averaging, regression analysis, and Box-Jenkins econometrics. We end up with another Type I trend analysis, a linear projection, as shown in Figure 6, which may appear very neat but may be neither perceptive nor prescient.

Trend projection, as a variation of Type III pattern recognition and trend analysis, is inductive in that the data are gathered and organized into patterns based on an assumption that future data will be consistent with past and present data. Yet, as the Scottish philosopher David Hume observed as early as 1739, just because a trend has occurred consistently in the past does not mean that you can logically assume that it will do so in the future. He further asserted that psychologically we often perceive cause-and-effect relationship based on past custom that may not be empirically justified. (10)
In addition, what Karl Popper warned us about the inductive method in science applies equally to futuring from trend analysis: no line of investigation can ever 100% prove a theory, model, or hypothesis, but one conclusive refutation can kill it. (11) I recall a technical colleague who once complained that the experimental data had destroyed a perfectly beautiful theory. The same may be said of forecasts, which is why trends have to be continuously monitored and forecasts have to be continuously updated and revised. There is no such thing as an immutable forecast of an immutable future.

Yet repeatedly, as though we did not know better, we make linear historical trend projections, often with implicit conditions and in a vacuum without considering other trends, when alternative futures (scenarios) based on multiple trends interacting with each other with Bayesian probabilities would make more sense. The best that we can do with a trend projection is to say that there is a high probability that the future will look much like the past under certain boundary conditions (such as a relatively short time frame, known variables and relationships among them, and the absence of disruptive events). Furthermore, there may be an important story in the distribution of the data in an array that may get totally lost when reduced to a time series Type I trend.

When we go back to the definition of a trend, which is a repeating pattern of behavior with a directional bias, or data inclination, over time, I wonder whether the bias is the result of push or pull. If I believed in predestination, that there is a future out there that has already been created (spiritually or materially), then I would accept the idea that trends are pulled toward a target with a force somewhat like gravity. Or if I believed in a future that was predetermined, at least to a large extent, by what was done in the past, then I would conclude that trends are largely pushed. If I also believed in a literal and rigid kind of genetic evolution, then I might also believe that we are products of our own biology modified by culture. I might even go so far as to embrace the ancient Greek ideal, as expressed in so many dramatic tragedies, that a person's character is his or her fate.

Leaving aside the philosophical questions, a familiar mechanical problem with historical trend and time series forecasts as a line is the question of how many data points constitute a trend that can be projected into the future with any confidence at all? I was visiting a major international corporation when a technology forecaster asked me how many data points did I require to draw a technology trend? I thought he was joking with me, so I said "at least two." With a perfectly straight face, he responded "That's funny – we use only one." This anecdote illustrates the point that we too often rush to a projection with historical data and assume too much that the future will mirror the past. When the challenge, however, involves the very survival of a society, then rushing to patterns and trends as the basis for effective counter-actions seems understandable.

I suppose, just to go off on a tangential thought, that if a trend could be created by a single point, the point might be considered a singularity, or an event when known paradigms collapse and new phenomena begin. It is a metaphor from physics, more specifically the theory of general relativity. A singularity in technology, economics, or politics would theoretically fall under Type II pattern recognition and trend analysis. If a low probability but high consequence event might be called a "black swan," then a singularity might be a "Big Bird." Although terribly dramatic, they are very, very rare.

A variation of, and second only in popularity to, the line is the oscillating cycle. As early as 1377 the imminent Muslim scholar Ibn Khaldun identified repeating patterns of trends in the form of historical cycles in *The Muqaddimah*. In recent times, Arnold J. Toynbee, writing in parallel to Joseph Schumpeter's economic theory of business cycles, claimed to have identified historical cycles in the rise and fall of civilizations. Similar attempts were made by both Professors Arthur Schlesinger Senior and Junior to identify cycles in American political history. They both concluded that the cycles were more metaphorical than literal. This is likely due to the fact that time moves in only one direction and that historical conditions and specific situations vary over time even if basic human behavior does not.(12)

Having said this, in the void of empirical knowledge, the use of analogies may give us at least a preliminary meaning to a Type III pattern or trend based on past Type I patterns and trends. But the analogies of Type III with Type I patterns and trends must follow tight lines of logic and be subjected to peer review and collaboration by future data.

Another type of Type III pattern recognition as applied to trend analysis is the employment of modeling and simulation. A model is both a simplification and a speculation. In a scientific way, it is also a working hypothesis for inductive investigation. Models reduce great complexity to their most simple (but hopefully not simplistic) forms. They provide a powerful tool for organizing data and extracting insights and foresights from them. Models can be heuristic, diagnostic, and prognostic. They can be examples of Type I when properly validate, but they may also serve as emerging Type III pattern recognition.

One example of a model appears as Figure 7. It is a prototype model of terrorist behavior. It is based largely on historical information and present publicly available intelligence. The model presents a progression of actions from the individual terrorist to a target. We are trying to understand all the most important elements of the terrorist paradigm and the intertwining relationships among them. If the model proves valid, then one can use it to identify how to best anticipate and perhaps prevent terrorists from achieving their goals. It must be emphasized that the model does not necessarily have to produce just one outcome, as models can generate alternative scenarios with Bayesian probabilities of occurrence to reflect the inherent uncertainties of an emerging Type III pattern or trend. As with all models, this one has to be continuously updated, revised, and improved as new information becomes available.(13)

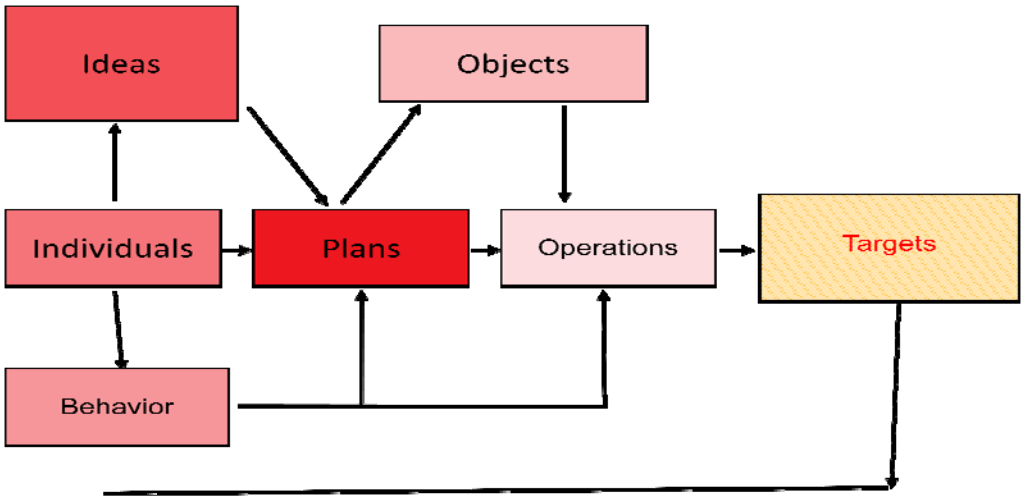

Figure 7. A simple model of Muslim terrorist behavior. Adapted from "The Top 10 Innovations in the War on Terrorism by 2014," a presentation by Stephen M. Millett for Social Technologies LLC at the Department of Defense, 13 November 2006.

Let me comment again on the inherent dangers of trying to convert an emerging Type III pattern, including a model, into a known Type I pattern based on new and partial data. This is a potential drawback to the methods of pattern recognition as well as trend analysis. We might think that a new Type III pattern emerging from a data array is very similar to if not identical with a previous Type I pattern or trend when in actuality the new Type III pattern is just a metaphor or analogy without being identical to a Type I pattern or trend. While metaphors and analogies provide insights and understanding of the unknown by relating it to the known, they also break down when spread too far. What Robert Frost said of metaphors in poetry applies equally to patterns and trends: "All metaphor breaks down somewhere….It is touch and go with the metaphor, and until you have lived with it long enough you don't know when it is going. You don't know how much you can get out of it and when it will cease to yield. It is a very living thing." (14) This is also the danger of the false historical analogy that is well known to historians but perhaps not as well appreciated by the intelligence community.(15)

One recent example of a confused and overwrought metaphor and a mistaken Type III pattern for an historical Type I trend was the concept of "Islamofascism." In 2006 some people were asserting that the Type III pattern for Osama bin Laden and the Muslim terrorism organization known as Al-Qaeda was a repetition of Adolph Hitler and the Nazi movement in Germany (see Figure 8). They implied, if not claimed, that the future of radical Islam would be virtually the same as the end of Nazi Germany. The parallels allegedly were that both Hitler and bin Laden were/are messianic leaders with visions of a new world order based upon their strongly argued views of cultural traditions (if not myths) of nationality or race, religion, moral superiority, higher authority, power, and ambition. Both were outspoken in articulating their visions and both had cult-like followers. But, as Robert Frost warned us, the metaphor breaks down quickly. The Type III pattern of radical Islam and Muslim terrorism has distinctly different characteristics and implications for the future than the Type I historical pattern of fascism. Most disturbing was the implication that the U.S. would liberate Afghanistan and Iraq (and perhaps others) from Muslim fanatical and terrorist regimes, or regimes that covertly supported terrorism, in the Middle

Figure 8. An example of a Type III pattern characterized as an historical Type I pattern or trend. The picture below is of Osama bin Laden, leader of the radical Muslim terrorist organization known as Al-Qaeda. Recently he has been compared with Adolf Hitler (picture above) and the Nazi regime in Germany from 1933 to 1945. While there are certainly some gross similarities, the differences are significant, such that forecasting the future of Muslim terrorism (Type III pattern recognition) based on the fall of Nazi Germany (Type I pattern recognition and trend analysis) may be very misleading. The picture of Hitler can be found at www.images.google.com from www.bostonherald.com; the picture of bin Laden comes from www. Images.google.com from www.pettywars.com.

East like it had liberated France from the Nazis in 1944. Unfortunately, many Afghans and Iraqi have not shared the same feelings about American soldiers as the French did over 60 years ago.

Conclusions and Recommendations

This paper has argued that trend analysis as a futuring method resembles closely the three categories of pattern recognition. It also has asserted that the state of the art of historical trend analysis could be improved by extending the potential concepts, if not the exact methods, of pattern recognition technologies. While practical applications may not yet appear obvious to us, this line of thinking may lead us to new and more prescient methods for forward looking and actionable intelligence.

In the spirit of Popper, no single paper or relatively small number of historical examples can validate an assertion with 100% certainty, especially when addressing the unknowns of the future. My paper presents a theory that requires much more investigation.
I recommend the following avenues among many potential directions of further inquiry:

- Further explore the evolving concepts and technologies of pattern recognition and its applications to trend analysis as a futuring method for anticipatory and actionable intelligence
- Explore more sophisticated methods for blending Type I and Type II patterns and trends to better sort out the continuities and changes that will shape the future.
- Develop logic rules for guiding Type III pattern recognition and test such emerging patterns against Type I patterns and trends
- Build a library of historical Type I patterns that might provide a basis for future categorization of emerging Type III patterns.
- Advance the state of the art of modeling and simulation as a Type III pattern recognition and trend analysis method incorporating scenarios and Bayesian probabilities.

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3. Charles Darwin, *The Expression of the Emotions in Man and Animals*. Chicago: Chicago University Press, 1965 (1872).

4. For example, see C. G. Jung, *Psychological Reflections*. Selections edited by Jolande Jacobi. New York: Harper Torchbooks, 1961 (1953). Joseph Campbell, to cite but one famous example, leveraged the Jungian concept of archetypes to classify myths and legions, and the historical patterns behind them, in the behavior of leaders across history in *The Hero With A Thousand Faces.* Princeton, NJ: Princeton University Press, 1972 (1949).

5. I thank my former colleagues at the resident School of Engineering, Air Force Institute of Technology (AFIT) and the Battelle Memorial Institute for instructing me in the technical basics of pattern recognition. Much has published in this field. For example, see Richard O. Duda, Peter E. Hart, and David G. Stock, *Pattern Classification*. Second edition. New York: John Wiley & Sons, 2001. Also check out the Web site of the International Association for Pattern Recognition, www.iapr.org. An example of trends analysis used for pattern recognition in consumer behavior may be found in Stephen M. Millett, "Futuring: Anticipating the Emerging Voice of the Customer," in Deborah L. Owens and Douglas R. Hausknecht, eds., *Integrated Marketing Communication*. Volume 4 of *Marketing in the 21st Century* (Bruce D. Keillor, General Editor). Westport, CN: Praeger, 2007, pp. 62-81.

6. David Malakoff, "Bayes Offers a 'New' Way to Make Sense of Numbers," *Science,* Vol. 286, 19, November 1999, pp. 1460-1464; Hillary L. Seal, "Thomas Bayes" and Harry V. Roberts, "Bayesian Inference" in David L. Sills, *International Encyclopedia of the Social Sciences*. New York: Macmillan and The Free Press, 1968, Vol. 2, pp. 26-33. For discussions on human perceptions of time by two different Harvard University psychologists, see Daniel Gilbert, *Stumbling on Happiness*. New York: Vintage Books, 2006; and Steven Pinker, *The Stuff of Thought. Language as a Window into Human Nature.* New York: Viking, 2007.

7. Fernand Braudel, *The Structures of Everyday Life*. *The Limits of the Possible*. Berkeley, CA: University of California Press, 1992 (1979). For his philosophy of long-term historical trends and the basic stability of human life in civilization, see his *A History of Civilizations*. New York: Penguin Books, 1995 (1963).

8. Henry David Thoreau, *Walden and Other Writings*. Edited by Brooks Atkinson. New York: The Modern Library, 2000, p. 303.

9. For example, see Nassim Nicholas Taleb, *The Black Swan. The Impact of the Highly Improbable*. New York: Random House, 2007.

10. David Hume, *A Treatise of Human Nature*. Edited by Ernest C. Mossner. London: Penguin Classics, 1985 (1739-1740), pp. 135-142, 152, 179, 183, 184, 189, and 192. Hume's 18th century philosophical observations on the human perceptions of cause-and effect relations and trend projections over time were largely confirmed by a 21st century evolutionary psychologist. See Pinker, *The Stuff of Thought,* pp. 157, 208-225.

11. Karl Popper, *The Logic of Scientific Discovery*. London: Routledge Classics, 2003 (1935).

12. For the citation for *The Muqaddimah*, see Reference 5 above. Arnold J. Toynbee's *magnus opus* was *A Study of History* in three volumes published by the Oxford University Press in 1934. Joseph Schumpeter lectured and wrote widely on business cycles prior to the publication of his book *Business Cycles* in 1939. For the work of the Schlesingers, see Arthur M. Schlesinger, Jr., *The Cycles of American History*. Boston: Mariner Books, 1999 (1986), pp. 22-48.

13. What I say here sounds a lot like the systems dynamics of Jay Forrester and the work of Peter Senge at MIT. For example, see Peter M. Senge, *The Fifth Discipline. The Art & Practice of the Learning Organization*. New York: Currency/Doubleday, 2006 (1990). It also sounds like the intuitive scenario method as developed by Shell, SRI International, and GBN. See Stephen M. Millett, "The future of scenarios: challenges and opportunities," *Strategy & Leadership*, Vol. 31, No. 2 (2003), pp. 16-24, and Bill Ralston and Ian Wilson, *The Scenario Planning Handbook*. Mason, OH: Thomson South-Western,

2006. What I am specifically referring to is a scenario method developed by the Battelle Memorial Institute called BASICS and Interactive Future Simulations (IFS)™. It is a method with a supporting software program that incorporates expert judgment for selecting the most important descriptors, cross-impact analysis and modeling, Bayesian probabilities, and simulation.

14. Robert Frost, "Education by Poetry. A Meditative Monologue" November 15, 1930, in *Robert Frost. Collected Poems, Prose, & Plays*. New York: Library Classics of America, 1995, p. 723.

15. Ernest R. May, *"Lessons" of the Past. The Use and Misuse of History in American Foreign Policy*. New York: Oxford University Press, 1973; and Richard E. Neustadt and Ernest R. May, *Thinking in Time*. *The Uses of History for Decision Makers*. New York: The Free Press, 1988 (1986).

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