Human vs. Machine:

How Technology Is Revolutionizing the Investment Industry

by | **Jennifer Drake** and **Peter Muldowney**

People have often viewed a divide between *fundamental investing* (managers performing deep analyses of individual firms to identify which stocks to buy and sell) and *systematic investing* (using computer-driven research models to predict risks and returns). The authors examine how human judgment and machine learning are part of both approaches and how the combined efforts of humans and machines will be critical to the future success of investment management.

Humans have had complex relationships with machines over the years, and perhaps for good reason. For more than two centuries, machines have eliminated human jobs. It started with the first industrial revolution and has continued through the fourth and current revolution with artificial intelligence and the use of robots replacing human roles. Not all technology advances are bad. This article discusses how machines and technology have revolutionized the investment management industry and impacted the ways in which retirement savings are managed today.

Embracing Technology

Historically, technological advances have eliminated jobs and changed the role of humans in the workforce, particularly on production lines. Conversely, these same advances have introduced new products and services that have increased efficiency and satisfaction in our personal lives. For example, many of us would not have found the transition to working from home during the COVID-19 pandemic so seamless if not for technological advances.

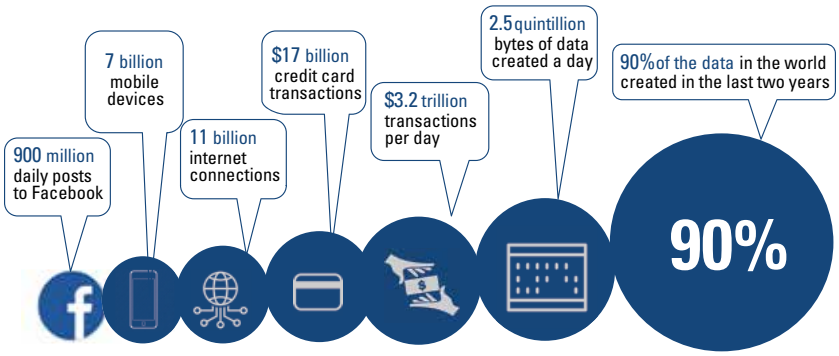
Today, it is easy to take for granted how technology influences our activities (Figure 1). Social media such as Facebook attracts millions of postings each day, aided by seven billion mobile phones in circulation that provide incredible convenience in our day-to-day lives. There are over US$3 trillion of digital transactions every day. But perhaps the most startling statistic is that 90% of the data in the world was created in the last two years.

Less apparent to the general population are the ways in which technology and analytical advances have influenced the investment management industry. In the 1950s, Harry Markowitz's seminal work on portfolio theory, linking risk and return, introduced a quantitative and analytical perspective of portfolio returns. During the 1970s, researchers identified how general factors—such as whether a company was large or small in value—influenced its risk-and-return profile; these findings were a precursor to the broader, more sophisticated considerations today.

Increases in computing power and greater availability of electronic financial data further advanced the analytical possibilities for quantitative investment managers. Recognizing these

FIGURE 1

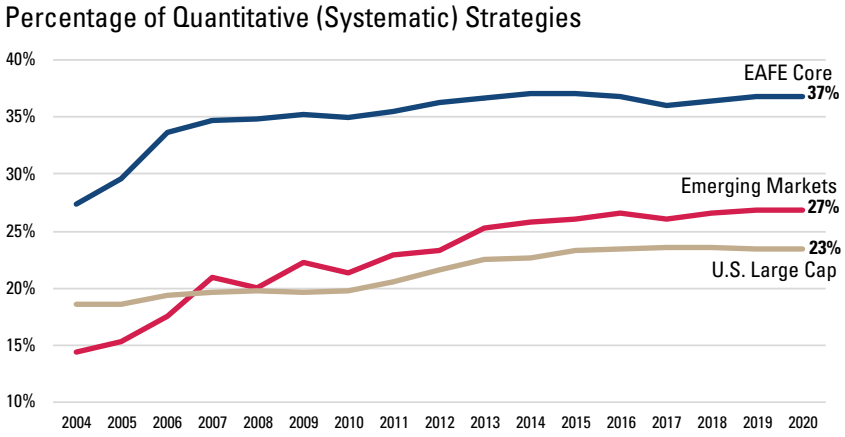
Big Data, Big Influence



Source: Big Data to Big Impact, Chen et al.

FIGURE 2

Growth, but Not Inheriting the Earth



Source: eVestment.

TABLE

Differences in Investment Process

Stage of Process	Fundamental	Systematic
Research	Assess not only hard data like income statements and market prices but also "soft" information such as the experience and follow-through of the senior management team. The analysis aims for a deeper understanding for the prospects of an individual company.	Focus on the ongoing development and enhancement of investment models to enhance the overall research process. The models are applied to all the stocks in the appropriate index as well as opportunities outside the index. The research incorporates only information that can be *quantified*, which means the process implies less depth of knowledge about any one particular company and instead explores a breadth of understanding on a large universe of potential stocks.
Forecasting	When determining the expected performance of individual companies, the focus is typically with respect to a smaller subset of stocks based on intuition and the experience of the team and is inherently subjective in nature.	Forecasting is based on investment models that are developed over time by examining an extensive set of financial ratios for the whole index universe of stocks and making the process more objective in nature.
Portfolio Construction	The analysis from the previous steps is inferred in individual stock risk and return expectations to determine which stocks to include in the portfolio. It is at the discretion of each manager to respond to changes in the market environment, which can introduce emotional influences.	Provide an explicit assessment of overall risk and return expectations based on significant historical data that is consistently applied through algorithms, making the process very transparent and less likely to be subject to emotional interference.

advances, the management consultant Casey, Quirk & Associates (now part of Deloitte) predicted there would be a substantial growth in quantitative investing (or *systematic investing*, as it is also known) in a 2005 research paper titled *The Geeks Shall Inherit the Earth*.

While the popularity of systematic investing has somewhat lived up to this prediction, it did not quite live up to inheriting the Earth. The popularity also varies depending on which part of the Earth you are invested in (Figure 2). For example, the percentage of investment managers associated with a systematic approach in international, United States and emerging market equity mandates experienced growth over the past 15 years, although the percentage has levelled out more recently.

The levelling off is likely due to technology being only part of the solution. Richard Bookstaber eloquently stated, "No (hu)man is better than a machine, and no machine is better than a (hu)man with a machine."[1] This statement recognizes that both machines and humans have shortcomings but, when combined, they offer a better outcome. Humans are often too driven by emotions and susceptible to emotional influences, while machines have a blind spot of not being able to understand or simulate human thinking.

For example, humans are susceptible to decision-making biases. One example is *confirmation bias*, in which we analyse options but gather self-serving information and pay less attention to information that could reveal potential shortcomings in our preferred option.

An example of a machine's blind spot of not being able to simulate human thinking can be seen in the "Miracle on the Hudson," where Captain Chesley "Sully" Sullenberger successfully ditched US Airways Flight 1549 into the Hudson

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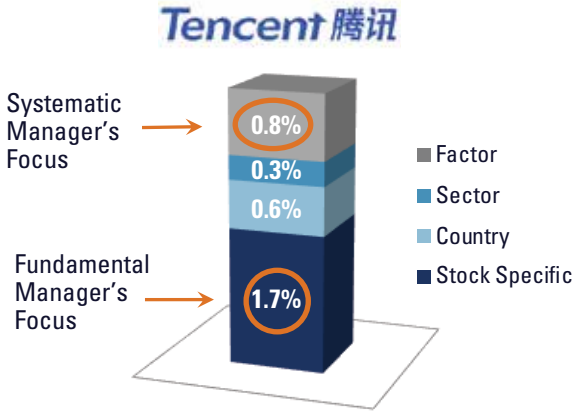
FIGURE 3

Portfolio Implications

Differences in Focus



Source: CC&L Investment Management and secondary sources. Data as of April 4, 2019.

River after an unlucky encounter with a flock of geese on takeoff. Everyone on board survived. Following an investigation of the encounter, it was concluded that the same thankful outcome would not have happened if it had been left to the autopilot.

Irrespective of the investment approach, future success in investment management will therefore require investment managers to embrace the combined benefit of human and machine power rather than getting caught up in a debate of human vs. machine.

Smaller Divide

Looking back over the decades, there has been quite a divide between fundamental and systematic investment approaches, but the divide is getting smaller. Fundamental managers tend to be characterized as rolling up their sleeves and undertaking deep research, analyzing unique aspects of individual firms to identify which stocks to buy and sell. Fundamental investing places significant reliance on instinct or "gut feelings," honed by personal experience of the portfolio managers and research analysts.

In contrast, the "mathy" systematic managers develop computer-driven research models to sift through reams and reams of data to identify metrics to predict both returns and risks.

While it is clear that a fundamental approach involves human judgment, machine or computer technology also plays an increasing role in the investment process. Undertaking company analyses, such as comparing financial ratios between companies, is more efficiently achieved through computer databases and the availability of electronic data. The efficiencies allow more time to undertake deep research and allow for a larger universe of opportunities.

Perhaps less obvious, human judgment is also present under a systematic approach. It is human judgment that determines the framework for developing analytical models and human judgment that oversees the models' application in portfolio construction.

Process Differences

Philosophically, fundamental and systematic investment approaches both seek to find and invest in businesses with characteristics they believe will enable them to outperform the relevant market index. Where they differ is in how they go about identifying investment opportunities and building portfolios. To appreciate the differences, the key stages of the investment process—research, forecasting and portfolio construction—for each approach are summarized in the table.

Figure 3 provides a practical illustration of how the fundamental and systematic approaches differ by considering how they go about assessing the outlook for the company Tencent Holdings Ltd., one of the largest publicly traded companies in China. It can be thought of as China's version of Facebook, Twitter and Google combined into a single company. Figure 3 shows a breakdown of the change in price of Tencent on a particular day.

The overall 3.4% rise can be broken down into components. On this day, China and the media services sector (in which Tencent competes) increased by a combined 0.9% (0.3% sector and 0.6% country). These influences are not unique to Tencent and also apply to other companies in the same market or sector. There are other shared factors that also explain the performance of Tencent: its market capitalization, profitability and level of corporate debt, along with a whole

host of relevant factors, which collectively accounted for another 0.8% of additional performance. This leaves about 1.7% of the price move attributable to influences that are truly unique to Tencent, which represent the stock-specific component of Tencent's price move.

The fundamental manager's approach is focused on stock-specific issues, while the systematic approach focuses on the common factors and characteristics that explain price performance across the full market of companies.

The deep-dive research process of fundamental managers will typically imply more concentrated portfolios with around 30 to 100 companies and large active positions ranging from 1% to 5% deviation from the index benchmark weight. Each company in the portfolio will be well-understood, along with the downside risk associated with each company.

The systematic manager, on the other hand, typically has smaller active positions in many stocks, depending on the number of stocks in the index. For example, for a global equity mandate where the investment universe is comprised of more than 10,000 companies, a systematic manager may hold around 500 to 1,000 companies, with the largest deviation from the index weight being around 1%. There are over ten times the number of positions compared with a fundamental approach, which serves to mitigate stock-specific risk through a well-diversified portfolio.

Investors can be tempted to assess the relative merits of the different approaches to determine which is better. However, it generally is not a case of one being better than the other; rather, it is more about matching the strengths of each approach to individual goals.

For example, a high added-value target above an index return would typically imply the need for a concentrated portfolio and a willingness to incur a lot of variability relative to the index over shorter term periods. With fewer stocks in a portfolio, a fundamental approach with a deeper understanding of each stock position would be best suited to meet that goal.

If the goal was to achieve returns in excess of the index in a more consistent fashion, then having a breadth of individual stock positions associated with a systematic approach would best fit the goal.

In many cases, the added-value target of investors would apply to either approach. For instance, a common added-value target for global equities is 2%. In such a situation, it can come down to individual preferences. However, for investors who can afford multiple managers in a particular asset class, the differences between fundamental and systematic approaches offer an efficient and complementary offset of styles.

Takeaways

- Ninety percent of data in the world was created in the last two years, and technology overwhelmingly influences our day-to-day lives—including the investment management industry.
- *Fundamental investing* is marked by investment managers performing deep research and analyses of individual firms to identify which stocks to buy and sell.
- *Systematic investing* involves the use of computer-driven research models to sift through massive amounts of data to predict risks and returns.
- Both investment approaches seek to find and invest in businesses with characteristics they believe will enable them to outperform the relevant market index. Both approaches involve human judgment and machine learning, which in turn bring positive attributes and blind spots to the investment process.
- Investment management shouldn't be viewed from the lens of human vs. machine. Instead, the ability to combine the approaches to match their strengths to individual goals will be critical to the future success of investment management.

The Future

While both approaches have benefited from technological innovation and the availability of electronic data, the spotlight on future developments tends to be focused on the systematic approach because of its greater use of technology. In particular, to what extent will machine learning and artificial intelligence play a role?

Perhaps the game of chess offers a potential window on future developments. Back in 1997, an IBM supercomputer, Deep Blue, beat the world chess champion, Garry Kasparov. Deep Blue had been programmed using rules written by human players. Stockfish subsequently became the best chess-playing machine programmed with human chess tactics until, in 2017, Google introduced a machine learning computer, AlphaZero, that was given the rules of chess and taught itself how to play before going on to beat Stockfish.

The future influence of machine learning is less clear for the investment management industry. Whether future enhancements apply to the research process with respect to the

role of data, the predictive models in the forecasting component or the risk management role in portfolio construction, they are likely to be a continuation of incremental improvements experienced over the last decade rather than a major game changer.

Fourth Time a Charm?

We are in the fourth industrial revolution, which has brought about advances in technology that have improved the ways in which we go about our lives. These efficiencies are beyond what most of us would have thought a decade ago and certainly have made working from home more tolerable during the current pandemic. Within the investment management industry, the advances have created efficiencies for fundamental managers and allowed systematic managers to gain a material market share of the assets of retirement savings.

While different in their approaches to investing, fundamental and systematic approaches have the same goal, which is to deliver additional returns above a benchmark index. For investors who can accommodate multiple managers in an asset class, the differences provide an opportunity to benefit from combining their complementary approaches.

Moving forward, the combined importance of human and machine in the various stages of the investment process will be critical for future success in investment management, irrespective of the approach.

BIOS

Jennifer Drake is a director and portfolio manager at Connor Clark & Lunn Investment Management Ltd. in Vancouver, British Columbia. She was recently appointed to the firm's board of directors. Drake provides a product specialist role for the systematic (quantitative) equity team, which manages a range of domestic and global strategies as well as equity extension and hedge fund strategies. An important component of her role is supporting the institutional client service team. Drake holds a B.A. degree in physics and computer science from Columbia University.

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Endnote

1. Richard Bookstaber, *The End of Theory*. Princeton University Press. 2019.