Chapter 2
Cognitive Computing: Impacts on Financial Advice in Wealth Management

Russ Kliman and Bay Arinze

Abstract Cognitive computing is a form of problem-solving that incorporates machine learning, big data, data mining, natural language processing, machine vision, robotics, and other strands of artificial intelligence. Cognitive computing solutions can be used as sole or partial solutions to augment decision-making. The financial services industry is in a state of transformation, driven by the convergence of rapid changes in financial service technologies (fintech) – including cognitive computing, the digitization of the consumer, the emergence of younger investors (millennials), increased regulatory scrutiny (DOL regulation), and continued fee compression for products and services. Cognitive computing offers a disruptive opportunity in the financial services industry by not only empowering the financial intermediary but also by delivering increased engagement and value to the consumer.

This study examines how the use of cognitive computing to improve financial advice can provide value for the financial intermediary and the end consumer. For the intermediary, the study will assess how cognitive computing can augment and supercharge the expertise of the financial advisor, enabling the advisor to deliver improved advice. For the consumer, the study will assess how cognitive computing can deliver high-quality, accurate advice comparable to that of a human advisor.

Keywords Cognitive computing · Analytics · Big data · Robo-advisors · Wealth management · Financial advisers

R. Kliman
SEI Investments Company, Oaks, PA, USA
e-mail: rkliman@seic.com

B. Arinze (✉)
Drexel University, Philadelphia, PA, USA
e-mail: arinzeob@drexel.edu

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Introduction to Cognitive Computing

Cognitive computing is a form of computer-based problem-solving that has already begun to transform companies and industries in profound ways. It incorporates four major strands, namely: machine learning, big data, data mining, and artificial intelligence. This new form of computing involves computer systems that can add to their own knowledge, utilize both structured and unstructured data, "reason" and infer, and frequently interact with their users in natural language.

The International Data Corporation (IDC) has identified cognitive computing as a major factor driving digital transformations in companies and changing the ways they function. IDC forecasts spending on cognitive systems to reach $31.3 billion by 2019, with a compound annual growth rate of 55%. Over 40% of the spending will be on software, with the second largest category being consulting and business services (IDC, 2016).

In regard to big data, cognitive systems typically leverage not only structured data but also unstructured data, such as free-form speech, email, click streams, government reports, research articles, social media, and opinion pieces and process the data to solve problems, reach conclusions, and assist workers in making decisions.

Cognitive computing also incorporates data mining, namely, the ability to identify patterns, causality, correlations, and actionable hypotheses in data. Such functions include descriptive, predictive, and prescriptive capabilities that help users gain insights into deep patterns in data and take more data-driven actions.

The road to cognitive computing, once traveled on by a few innovators and risk takers, is now crowded with small and large companies alike seeking to take advantage of the power and opportunities offered by these new systems. Why then have organizations begun to adopt cognitive computing systems? Here are a few reasons:

- They allow deeper and more fine-grained engagement with customers by leveraging structured and unstructured data. Organizations gain deeper insights into their customers' (or employees') behavior and mindsets through the use of such systems.
- Cognitive systems can also supercharge the expertise of workers in the breadth, depth, and quality of generated insights. Various cognitive computing "assistants" can collect and use vast knowledge from a wide variety of fields to assist human decision-makers.
- Next, cognitive computing enables organizations to radically transform their business processes, goods, and services by cognitively enabling them. This form of product differentiation serves not only to differentiate products but also to present customers with powerful new capabilities and services.
- The knowledge discovery and learning that are possible with cognitive systems are beyond both the reach of traditional modeling and programming and human cognitive abilities. Cognitive systems continually learn and increase their knowledge in ways that are well beyond the capabilities of human experts.

Cognitive computing is bringing value to financial management, and in particular, wealth management. The focus of a financial advisor, and thus the delivery of financial advice, is about the relationship with the client. It is through this relationship that the human advisor delivers value. In order for cognitive computing to deliver true value, it must enrich the relationship both economically and psychologically for client, the advisor, and the intermediary for which the advisor works.

Williams (2016) underlines that insisting that people "… tend not to trust things we don't understand or that threaten our jobs. Full adoption of cognitive-enabled DSS will have to overcome both of those hurdles to fulfill its true promise." When IBM's Watson described Toronto, Canada, as an American city (Reynolds, 2016), it showed the paradox of humans simultaneously being able to trust self-driving cars but being wary of systems that can make mistakes no human would make. Accenture's study (Shanks, Sinha, & Thomas, 2015) also showed that 84% of managers believed intelligent machines would make them more effective and their work more interesting. The study also drilled down to better understand the elements of trust: managers indicated that in order to trust cognitive systems, they needed to understand how the system worked and generated advice (61%), plus a proven track record (57%) and convincing explanations from the system (51%).

Financial intermediaries in wealth management must embrace cognitive computing in their efforts to deliver deeper advice, greater value, and at economic scale. To do so, they must recognize that the role of cognitive computing, within the context of the financial institution, is not to replace the human advisor but to amplify the human advisor's knowledge and capabilities, as well as to address the cognitive limitations of the human advisor. Advisors and the financial intermediary must also recognize that commoditization has occurred for elements that used to be part of the advice value chain. This includes risk assessment, asset allocation, portfolio construction and implementation, and reporting. This means they must make space in their work processes and thinking to allow the cognitive systems to assist them in these areas and not repeat prior analyses.

Cognitive systems therefore promise to unleash huge productivity gains via new and improved solutions to business problems. The future will see an oncoming wave of autonomous and semiautonomous systems that are able to respond independently to problems they are presented with.

The aim of this paper therefore is to describe and clarify how cognitive computing can provide value for both the financial intermediaries and end consumers.

Defining Cognitive Computing

Many understand cognitive computing from the performance of IBM Watson's victory over the best human players of the TV game Jeopardy. In the program, players, including Watson, had to listen to questions in English, reason through to an answer quickly, and provide an answer – also in natural language (also English).

IBM defines cognitive computing as: “an evolution of programmatic computing that enables a system to formulate responses on its own, rather than adhere to a prescribed set of responses.” This differs from programmatic computer-based systems, where the range of possible responses from the system are predetermined. In cognitive systems, outputs are often unanticipated and outside a predetermined range.

Cognitive systems are designed to simulate human thought and reasoning using such techniques as data mining, natural language, and pattern recognition. These computer-based systems also handle ambiguity and tolerate unpredictability unlike programmatic systems that operate in predetermined ways. Watson’s play in Jeopardy illustrated the major elements of cognitive computing: (a) sensing, (b) learning, (c) inferring or thinking, and (d) interacting (in natural language) – elements that are now being applied to many business problems and contexts.

Cognitive Computing: A Brief History

Cognitive computing has its roots in the artificial intelligence (AI) work of the 1960s and 1970s, when expert systems such as ELIZA were created to diagnose disease and techniques were developed for machine vision and natural language processing. Some see earlier roots from the late nineteenth century, when Charles Babbage proposed the “analytical engine” (Roe, 2014). John McCarthy coined the term “artificial intelligence” in 1955 and pointed to the potential for making intelligent machines. AI fell out favor in the 1980s and 1990s after the promises of the earlier two decades failed to be delivered, mainly due to a lack of processing power.

AI provides a major strand of cognitive computing, which is today’s umbrella term that incorporates machine learning, natural language processing, and other capabilities described earlier in the paper. It is both a contemporary term and an expansion of the original scope of artificial intelligence by incorporating elements like big data, analytics, statistics, and the complex integration between all the elements to create a new form of interaction between people and machines.

Now, cognitive systems are commercially available and able to handle a growing list of tasks that were previously the preserve of humans.

Cognitive Computing in Financial Services

There has been an explosion of disruptive and digital transformative technology in the financial services industry over the last 3–4 years. The rapid growth of this technology sector has dramatically impacted incumbent firms which service the financial services industry. In 2016 alone, over $50 billion USD was invested in the fintech sector, covering 16 categories of technology and encompassing over 1126 companies. While the investment in pure fintech reached a peak in Q3 2016, an

emerging segment within the fintech domain has begun to take on exponential growth, namely, cognitive computing.

Cognitive computing within the fintech sector is clearly viewed as the next focus area of the artificial intelligence wave of investments. While healthcare, advertising and sales, and security have been leading the focus of investments and deals in the last several years (CB Insights), in early 2016, the finance sector began to emerge as the next focus area for the application of artificial intelligence and cognitive computing.

The financial services industry, and specifically the wealth management segment, structures itself into three organizational areas where capabilities reside that enable the delivery of products and services to consumers: (1) front office, (2) middle office, and (3) back office. Each of these organizational areas can benefit from cognitive computing capabilities. These functional areas are overburdened with significant amounts of unstructured information, including a rapidly evolving regulatory burden.

Additionally, each of these organizational areas encompass roles that require specialized domain knowledge, such as financial planning, portfolio management, or KYC/AML (know your client/anti-money laundering), knowledge which is often embodied in specific individuals within a firm. Lastly, the middle and back office organizational areas are burdened with manual and labor-intensive processes that require human capital to achieve both financial and capacitive scales. The challenge that these characteristics present is where the benefits of cognitive computing provide the opportunities in the financial services industry.

Applying cognitive computing to applications in the financial services industry allows for the synthesis of vast amounts of unstructured economic, financial, and market data and can deliver valuable insight to support front, middle, or back office needs. This synthesis and insight can be guided based upon the objectives of the user of the insight. Cognitive computing can also supercharge the expertise of roles which require specialized knowledge, by allowing them to quickly expand their knowledge base. This is achieved by allowing the cognitive systems to learn what knowledge is required by the specific roles.

Examples of this learning might be heuristics that a human adviser follows to allocate assets in a portfolio based on experience; it might also be new government regulations. This learning narrows the information needed to empower the roles and provides insight and meaning to the information provided, allowing them to act faster with greater accuracy. At the same time, since cognitive systems can also learn, infer, think, and interact, experts within the firm can also "teach" the system through dialog-oriented natural language interfaces.

This teaching model allows the cognitive system to embody the expertise of the firm's most knowledgeable experts plus insights embedded in historical data, allowing for the democratization of the expertise throughout the enterprise, creating scale and consistency, and reducing risk. For example, historical data about customer online behavior suggested to one financial company more appropriate, individualized web landing pages for their different customers.

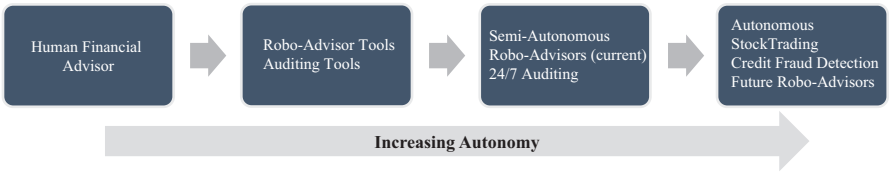

Fig. 2.1 A framework for financial tools, based on autonomy

Lastly, cognitively enabled business process automation (coined "smart robotics") allow for automation of operational tasks which would normally require human interaction. The notion of "smart robotics" moves the automation beyond binary decision-tree automation to full autonomous and self-learning operations. A conceptual framework for cognitive computing in finance might relate to the degree of autonomy of the cognitive system. As shown in Fig. 2.1, cognitive systems can range from assistants to financial workers, to completely autonomous systems.

Koch (2017) describes how a banking organization uses cognitive computing to predict overdrafts a week in advance with 94% accuracy and 4 weeks ahead of time with 87% accuracy. Chandarana et al. (2017) recently reported that banks "with the highest levels of digital execution saw front-office revenues per producer increase by as much as **eight times**, while those with the highest level of post-trade digitization posted **four times** more trades per middle- and back-office FTE than the bank with the weakest digital resources" (boldface ours).

Prior to the disruption caused by robo-advisors, these functions were considered part of the unique value proposition of the financial advisor and part of the advice delivery model. What the robo-advisors introduced was an automated and programmatic model to deliver these elements at scale. This has forced many advisors to redefine their value proposition to the consumer and to focus on the relationship model versus a transactional model. The future impact of cognitive computing will continue to enable this domain, as other dimensions of cognitive computing take hold within the advice delivery space.

The application of cognitive computing capabilities in financial services is on the verge of disrupting the industry. Areas that once relied upon human capital and human knowledge to deliver products and services are now looking at opportunities to apply cognitive computing to create scale (e.g., mass customization of products and services), efficiency, differentiation, and enhanced delivery of products and services.

Financial Advice and the Human Advisor

The financial services industry, and specifically wealth management, is anchored by various roles which deliver financial advice. These roles manifest themselves under numerous titles, including financial planner, investment advisor, investment manager, wealth advisor, etc. Generally, these roles are often bundled together and

called an "advisor." The roles that generally fall under the "advisor" label are responsible for the delivery (and often the execution) of financial advice for consumers. To deliver the advice they provide, advisors may be certified or licensed by different regulatory agencies and maintain their certifications and licenses through examinations and regular continuing educational credits. It's through these certifications and/or licenses that advisors maintain a baseline level of technical knowledge that enables them to provide the products and services, including financial advice.

Knowledge Domains

However, beyond the baseline level of technical knowledge that the certifications and licenses require, advisors must be active knowledge seekers to inform their decisions, actions, and recommendations for their clients. The knowledge domains include, but are not limited to:

- Macro- and microeconomic conditions both in the USA and globally
- Regulatory requirements
- Tax implications and insight
- Investment market conditions and drivers
- Investment and financial instrument knowledge
- Information about products and services from various providers

In addition to the above domains, the advisor must also have knowledge and intimacy of the specific client's situation. This extends beyond basic individual information (i.e., age, amount of investable assets, etc.) into areas such as the client's appetite for risk, what specific goals and objectives they are looking to achieve, how they might prioritize and/or make trade-offs relative to achieving the goals and objectives, and other qualitative insights into the client's mindset (concerns, fears, perspectives, needs, wants, etc.). This knowledge also informs the decision process around suitability, which ensures the investment and advice provided is suitable to the client's individual situation.

Types of Advice Offered

The term "advice" is a broad definition that at a minimum encompasses investment advice and recommendations for specific investment allocations but is often extended beyond investments to include insurance, tax planning, estate planning, college planning, retirement planning, cash flow planning, and sometimes budgeting. The financial advice may also include helping the client get organized (financial and nonfinancially) and place emphasis on helping clients achieve specific goals and objectives.

Current Technologies Used

While the ability to deliver financial advice is predicated on an extensive knowledge base and intimacy of the client's situation, advisors also use various technologies to assist in the analysis of the financial data to produce components of the financial plan. For analyzing investments, the majority of these tools utilize a Monte Carlo method[1] of analyzing the data, which uses the underlying investment instruments, portfolios, and investment product data and then simulates various sources of uncertainty that may affect their value over time. These simulations are then run hundreds of times, and the tools map the distribution of the resulting value change through the different outcomes.

In addition, these tools also typically perform a client risk assessment, or risk tolerance analysis. This assessment asks a series of multiple choice questions in an attempt to assess the risk appetite of a client. The resulting "score" derived from this programmatic test is then mapped to specific investment allocations that map to the same score. For example, if a client receives a very low score (low risk, very conservative), that score would map to investment classes that are equally low risk, such as fixed income (bonds). The majority of tools that exist within the market utilize a combination of these models to aid in the delivery of the advice to the consumer.

Limitations and Opportunities

The delivery of advice to the consumer from a financial advisor is predicated upon three dimensions: (1) extensive market, regulatory, tax, and product knowledge, (2) extensive client knowledge and intimacy of the client's situation, and (3) the ability to utilize various financial planning tools to synthesize and analyze data. It's the combination of these three dimensions that enable the delivery of holistic financial advice to the client. Ultimately, the ability of the financial advisor to maximize their knowledge across the first two dimensions enables or inhibits their ability to derive insight from the analysis of the data and to deliver comprehensive and accurate financial advice. Robo-advisors can help tremendously in both tasks, but especially the first where they can be 100% current about numerous laws and regulations – and even client knowledge in a way that human advisors cannot, due to human limitations.

Advisors are inundated with external information of the markets, economy, regulatory changes, and product options. At the same time, as an advisor increases the number of clients they service, their ability to maintain the same level of knowledge and intimacy of every client decreases. The opportunity to utilize cognitive comput-

[1] The Monte Carlo approach employs computational algorithms using random sampling within probability distributions to obtain solutions for optimization and other problems.

ing to supercharge the advisor's knowledge and enable the advisor to synthesize the client's qualitative insights will allow not only for greater scale but increased accuracy and completeness of the advice provided.

Digitizing Advice

In late 2009 to early 2010, a small contingent of well-funded Silicon Valley technology startups were launched into the wealth management market which delivered "financial advice" to consumers using a technology-only approach, absent of any human advisor. These technologies quickly gained notoriety in the wealth management market and were coined "robo-advisors."

Current Digital Advice Offerings (Robo-advisors)

Robo-advisors are software programs, delivered via mobile or web experiences, that assist customers by delivering financial advice and customizing investment portfolios, typically without any human advisor input or engagement. While the depth and breadth of the advice provided was limited as compared to their human advisor counterparts, the robo-advisors exploded into the wealth management market and gained significant press and amassed assets from consumers quite quickly. Since the initial launches in late 2009 and early 2010, some 40+ robo-advisors have entered and disrupted the traditional investment and financial advice market. In 2015, assets under management (AUM) in the robo-advisors segment totaled $66 billion. This is forecast to rise to $225 billion by 2017 and over $1 trillion by 2021, according to Statistica (2017).

As this disruption occurred, it forced legacy brands and market incumbents to react to this new model of advice delivery. As a result, most major wealth management companies have adopted, or are in the process of adopting, some form of digital advice (robo-advisor) capabilities for their clientele. Some organizations, such as WealthFront, utilize digital advice exclusively, while others such as Vanguard, Fidelity, and UBS use digital advice in conjunction with human financial advisors.

Robo-advisors are transitioning from the management of customer financial portfolios to digital platforms. By doing so, they open opportunities for increased understanding of customers and improved risk management. They also offer increased appeal to millennials and digital natives who are more comfortable with computer-based access to services.

Types of Advice Delivered

While much is made of the intelligence and type of advice provided by robo-advisors, with few exceptions, all of the leading providers in the digital advice space utilize algorithmic solutions to portfolio management. They mostly support passive investors using ETF-based products and use buy-and-hold strategies. They offer dramatically lower costs to consumers, in the range of 0–20 basis points (bps) versus the typical 70–135 bps associated with human financial advisors. The robo-advisor market is now projected to reach $255 billion by 2020.

Techniques Used

Most digital advice (robo-advisor) technologies adjust balances between equities and bonds, international versus domestic stocks, and make their programmatic decisions based on various structured data inputs such as age, expected retirement date, amount to invest, the target amount needed, and aversion to risk. Many of the digital advice tools utilize models to show user-friendly projections of the investments being made and the likelihood of achieving their investment needs. They continually track markets, rebalance portfolios, and may feature tax loss harvesting. The majority of digital advice (robo-advisor) programs use a mix of:

- Modern portfolio theory (MPT), which maximizes expected returns based on tolerable investor risk.
- The Black-Litterman mathematical model for portfolio analysis developed by Goldman Sachs.
- The Fama/French three-factor asset pricing model. Eugene Fama and Kenneth French were professors at the University of Chicago Booth School of Business who incorporated risk, comparative performance of small and large firms, and book/market calculations to create their model.
- In-house expert opinion.

Market Impact

After a slow reaction to the disruption occurring in the market, the legacy and incumbent wealth management companies, such as Fidelity and BlackRock, have responded quickly to the pure play companies that deployed the first wave of robo-advisors. Along with many traditional financial institutions such as banks, the legacy brands and incumbents have now begun to adopt the digital advice technology to reach new client segments, service existing ones who desire a more passive and digital interaction, and have incorporated the technology into the enterprise to create scale and efficiencies for their human counterparts.

Cognitive computing is bringing new capabilities to the digital advice (robo-advisor) segment. While only a few of the current providers use machine learning, providers such as ForwardLane (powered by Watson) and Kavout now incorporate machine learning for automated research and natural language interfaces for their users. The new generation of cognitive computing-based digital advice platforms will be able to adapt to changes in market dynamics, learn more about investors, adapt to changing styles, and improve performance beyond basic MPT.

Applying Cognitive Computing to Advice

Traditional programs for portfolio management decision support leverage structured data, that is, data stored in relational databases. These data are stored in rows and columns but represent only a fraction of the data available to support investment decisions.

Structured and Unstructured Data Processing

New robo-advisors like Kavout and ForwardLane incorporate unstructured data such as text-based analyst reports and financial and economic news. These data are regarded as unstructured because they do not fit into typical database structures, e.g., tables and rows, and are usually nominal, not categorical, data. Kavout and similar advisors ingest unstructured data from many sources and build overlapping neural network models using that data. They then use those models to improve portfolio analysis and decision-making.

Natural Language Processing and Speech Synthesis

Natural language processing is another key feature of the leading robo-advisors. This enables users to interact with the advisers using spoken language, making them much easier to use. Natural language is digitized, converted to text, tokenized, semantically interpreted, and used to query existing knowledge structures within these advisors.

Some of these advisors also have the ability to communicate with their users via natural language. This feature is speech synthesis – the artificial production of human speech. Again, just like natural language understanding, speech synthesis reduces the communication barrier between human users and advisors.

Sentiment Analysis, Making Inferences, and Recommendations

Sentiment analysis brings expressed sentiment in unstructured data into play in portfolio management. Unstructured data such as analyst reports can be analyzed by the expressed sentiment and the strength of the sentiment regarding specific stocks or markets or companies. This has become a powerful tool enabling the addition of new variables to the process of portfolio management.

Ultimately, the strength of these cognitive robo-advisors in wealth and asset management is that they can make inferences, evaluate the trade-offs between different decisions, and offer recommendations. It is this reasoning ability, coupled with the ability to draw upon vast amounts of data, that gives robo-advisors their immensely powerful capabilities and future promise.

Future Impacts of Cognitive Computing in Financial Advice

Today's use of cognitive computing in the delivery of advice is in the early stages of adoption. A small number of platforms exist which are applying a limited number of capabilities that fall under the artificial intelligence and cognitive computing definition. The most common applications today include sentiment analysis, predictive and prescriptive analysis, and natural language processing. As the depth and breadth of adoption of cognitive capabilities increase, the ability to impact all of the related parties within the value chain of financial advice delivery will accelerate and dramatically increase.

Platforms will expand on their utilization of NLP (natural language processing) to understand what the clients are concerned with, what their priorities are, and what their goals and objectives are. They will be able to know the sentiment of the consumer and where trade-offs and recommendations can be made, and the systems will offer those in context to the learning that the system has garnered from the advisor themselves. At the same time, the cognitive systems will expand further into the knowledge domains, enabling advisors to break through their cognitive limits and have access to synthesized and insightful data that will enrich the advisor's relationship with the consumer.

How Will Advice Be Generated?

The future of cognitive computing for the consumer is one that will continue to advance as well and quite rapidly. The advances in NLP (natural language processing) will continue to allow natural language interactions through cognitively enabled chat bots that move away from preset, programmatic answers to contextual responses based upon the consumer's input. There will be a transition for the consumer from

a transactional-based model with current digital advice platforms (robo-advisors) to a relationship-based model. The systems will be expanded in their ability to learn about the client's unique situations and combine that knowledge with information external to the client, such as the economy, product insight, or investment market conditions. This convergence of data, specifically unstructured data, will enable the next generation of robo-advisors to deliver even better digital advice and expand in use as customers become more used to them.

The technologies will be enabled to interact with a consumer in ways similar to that of their human counterparts, asking questions that allow adjustments in recommendations and the ability to make inferences to help the consumer think about options. This iterative model, similar to a face-to-face meeting with an advisor, will allow the cognitive-based systems to adjust recommendations and the advice they deliver with full consideration of risk, suitability, external market conditions, and the unique client situation.

Impact on the Customer

Ultimately, as the advances in cognitive computing continue, there will be greater positive impacts to the consumer. Consumers who desire a more digital engagement augmented by financial advisors will be able to receive comprehensive and accurate advice, at an economic value that the consumer demands. At the same time, consumers who wish to engage in a face-to-face advisory relationship will have access to human advisors who are more knowledgeable and can provide greater insight and advice.

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