LEADERS RESPOND TO THE WORKFORCE IMPLICATIONS ASSOCIATED WITH THE RISE OF ARTIFICIAL INTELLIGENCE IN FINANCIAL SERVICES DURING THE FOURTH INDUSTRIAL REVOLUTION: A CASE STUDY

by

Denise Gayle Rotatori

Dissertation Committee:
Professor Lyle Yorks, Sponsor
Professor Victoria Marsick

Approved by the Committee on the Degree of Doctor of Education

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ABSTRACT

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This research explored the growing use and application of cognitive technologies—from less sophisticated robotic process automation (RPA) to more complex forms of artificial intelligence (AI) like machine learning—which are being utilized to augment or replace operational work activity within the financial services sector during the fourth industrial revolution. This piece leveraged individual learning theories to explore how leaders are adapting to increasingly collaborate with machines during this period of transformation. This research specifically explored how executives within the sector are experiencing these changes, what the effects are on the roles and responsibilities of the human workforce, and how leadership teams are supporting the workforce transition required to adapt to this new paradigm.

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D. G. R.

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I—INTRODUCTION

Background and Context

At the first quarter of the 21st century, the human species stands on the precipice of one of the most transformational periods in its history. It has experienced a proliferation of scientific breakthroughs in far-reaching fields from the materials sciences (e.g., 3-D printing) to the computer sciences (e.g., artificial intelligence) (Brynjolfsson & McAfee, 2016; Hockfield, 2019). These changes have introduced a range of challenges for those in positions of leadership across regions, industries, and institutions (Stone et al., 2016). Organizations are being required to compete in the external marketplace with sources beyond traditional incumbents, including new entrants of all forms, while also needing to redefine their internal operations to accommodate new ways of working, including increased human-machine collaboration (Azhar, 2015; Bass, 2018). Often termed the fourth industrial revolution, cognitive technologies have begun to supersede humanity's cognitive capabilities and/or speed and efficiency, therefore becoming critical aspects of business operations (Brainard, 2018; Chui, Kamalnath & McCarthy, 2018). This dramatic change is forcing both a new paradigm in how human-machine productive activity transpires and a redefinition of the nature of work within institutions of all forms (Schwartz, Collins, Stockton, Wagner, & Walsh, 2017).

The fields of business model transformation and organizational theory have a history that extends to the early 20th century (Baden-Fuller & Mangematin, 2013). Business model science is the study of how organizations create, deliver, and capture value (Baden-Fuller & Morgan, 2010). Organizational studies involve the examination of

how individuals establish structures and practices to influence other people (Clegg & Bailey, 2008). From the maturation of these disciplines in the 1900s and the influence of academic psychology in the 1970s emerged the concept of learning within the organization—the process of creating, retaining, and transferring knowledge within an organization (Argote, 2013; Huber, 1991).

Much research has explored the role of learning as it relates to distinct aspects of business model transformation and organizational theory—from organizational performance to organizational culture (Brown & Duguid, 2000; Crossan, Lane, & White, 1999; Fiol & Lyles, 1985; Škerlavaj, Štemberger, & Dimovski, 2007). Most of this research is grounded in more traditional organizational constructs of the 1900s and early 21st century and does not reflect the degree to which technology has transformed the modern enterprise—for example, the concept of platforms (Friedman, 2016; Kansu & Parker, 2018). Select research is beginning to emerge, although it has not yet comprehensively addressed the confluence of factors at play. For instance, select research has explored a particular sector of the economy, like financial services, to understand how technology is disrupting financial services and products (Brainard, 2018; McWaters, 2018). However, this research did not specifically explore the role individual learning can play to support, make use of, and address the proliferation of cognitive technologies within the internal operations of the business to support the sale and distribution of those new products and services.

Rethinking individual learning in the fourth industrial revolution is critical for institutions that want to thrive in the financial services marketplace, let alone enterprises in the broader economy (O'Lawrence, 2017). The workforce of the future will have more

diverse actors (e.g., contractors, freelancers, crowd-sourced talent, robots) and require increasingly sophisticated and varied skillsets that are hallmarks of the digital world (e.g., agile, design thinking, customer experience) (Schwartz et al., 2017). As Abbatiello, Boehm, and Schwartz (2018) have noted:

> As automation, cognitive technologies, and artificial intelligence gain tractions, companies may need to reinvent worker roles, assigning some to humans, others to machines, and still others to a hybrid model in which technology augments human performance. Managing both humans and machines will present new challenges to the human resource organization, including how to simultaneously retrain augmented workers and to pioneer new HR processes for managing virtual workers, cognitive agents, bots and the other AI-driven capabilities comprising the "no-collar" workforce. By redesigning legacy practices, systems and talent models around the tenets of autonomics, HR can begin transforming into nimble, fast-moving, dynamic organizations better positioned to support talent. (p. 25)

According to Deloitte's 2017 *Global Human Capital Trends* report (Schwartz et al., 2017), based on input from more than 10,400 business and HR leaders across 140 countries, 50% of leaders surveyed rated their company as weak at realigning competencies to account for new artificial intelligence (AI) requirements, at redeploying employees replaced by these technologies, and at reskilling others to complement the new tools. Yet a move toward greater human-machine collaboration will require a shift in working norms; a transition that will be impossible to achieve without the right leadership interventions and sponsorship (Azhar, 2015; St. Claire, 2015; Schwab, 2018).

Humans are already operating in a collaborative, symbiotic relationship with machines in the delivery and provisioning of financial services (McCaffrey & Spector, 2018). For example, a consumer banker who greets a customer at a local branch upon walking through the front door, with an iPad in hand, able to review their customer profile real-time and support the client immediately given the purpose of their visit. For

organizations to extend this, to address the breadth and extent of change underway, leadership teams will need to establish the right organizational structure, job design, and promotion and reward mechanisms to incentivize the new, desired behaviors (Bentley, Dollar, Dharmaraj, & Levitt, 2018). The future of work demands a reconception of the individual relative to the collective, with humans and machines coming together in entirely new ways to comprise the traditional organization and business model value chain (St. Claire & Mataric, 2015).

Individual learning theories offer a solid foundation from which leaders within the financial services sector can take concrete actions to foster greater organizational growth, innovation, and adaptation. To advance further, targeted studies are needed to compare instances of specific learning alongside cognitive technologies, to other similar applications in different lines of business and institutions. The results from these human-machine collaboration experiences will begin to reveal some of the systemic variables that have the most influence (e.g., whether culture, geographical location, or access to talent have a greater effect).

Preliminary experiences have suggested that by incorporating more varied opportunities for individuals to learn alongside artificial intelligence, and by allowing for reflection, abstraction, and action on the back-end of that learning, executive leadership teams can allow the feedback cycle of insights gleaned in one area of the institution to support development opportunities and refined action in other parts of the institution (e.g., a pilot initiative with machine learning in one line of business can be reflected upon, analyzed, and scaled to support similar efforts in other parts of the business) (Abbatiello et al., 2018). The results from select research suggested that organizations

can adopt a more dynamic approach to cognitive technology experimentation, leveraging individual learning theory to determine how best to adopt, apply, and scale them (Mapalala, 2017). However, it would be helpful to see more in-depth analysis that focuses within each sector of the economy to draw appropriate sector-specific conclusions as well as general patterns across sectors.

Finally, because this business model transformation process affects not only individual role-level responsibilities but also the collective institutional capabilities, greater exploration is required of the new platform ecosystem that is redefining the sector. A great deal of emerging literature suggests that the future of the financial services sector lies in the power across institutions, rather than within them (Kansu & Parker, 2018; McWaters, 2018; Woolstenhulme, 2013). Further research at the enterprise level into the best ways to balance the use and application of cognitive technologies with the inevitable social, political, and economic changes that will ensue (Argyris & Schön, 1974, 1996; Kansu & Parker, 2018).

Gaining a better understanding of the role individual learning is playing in this period of dramatic industrial and societal change will provide insight for those in positions of leadership. Specifically, how are leaders within the financial services sector experiencing and learning from their experiences with the increased use of innovative cognitive technologies to drive the operations of their business? How are they perceiving changes to the required roles, responsibilities, and skillsets of the workforce as a result? How are they experiencing the learning and development requirements of their workforce to adapt to the new human-machine collaboration?

Research Problem

The pace of transformative change in the manner in which financial services are provided and consumed within the marketplace is occurring at extraordinary speed (Bruno, Lee, Blake, & McWaters, 2015). The demand for increasingly real-time service delivery, the integration and use of digital and mobile solutions, and the need to serve customers in a tailored manner are giving rise to the dramatic automation of historically manually intensive business processes (McWaters & Glaski, 2017). The broader introduction of cognitive technologies into the marketplace—capabilities that span the gamut from those that are less sophisticated like robotic process automation (RPA), to those that are more sophisticated like machine learning—is only further exacerbating improvements in the speed and accuracy of the operations of the financial institution itself, with the application of these technological breakthroughs to redesign products and services for consumers (Bass, 2018).

Robo-advisory services are an illustrative example that has emerged within the wealth management sector in the early 21st century, as a way of bringing traditionally high-end financial advice at scale to a mass-consumer market through the use of data analytics, algorithms, and digital platforms (McWaters & Glaski, 2017). Digital currencies in the payments sector are another example, leveraging the breakthroughs in capabilities like Blockchain; a financial transaction can be done between a set of buyers and sellers with a unique footprint via a digital ledger (Bruno et al., 2015). Countless examples like this are forcing traditional financial institutions—investment banks, commercial banks, consumer banks, wealth managers, and asset managers—which have traditionally struggled with the workforce transition and change management process for

less extensive and dramatic changes to their business operations (e.g., large enterprise resource planning system implementations), to be confronted with a scale and scope of technological transformation that is even more pronounced and exacerbated (Bruno et al., 2015). To demonstrate the dramatic rate of growth, the International Data Corporation (IDC) forecasts that worldwide spend on hardware, software, and services for artificial intelligence (AI) will reach $58B in 2021, up from 12B in 2017, making it the fastest growing technology in the marketplace (Shiver & Daquila, 2017).

Yet as demonstrated by the data from Deloitte's *2017 Human Capital Trends* survey results, the gap in Figure 1 between curves 1, 2, 3, and 4 is a massive disparity between the rate of change in technology (curve 1) with the rate of adoption for individuals (curve 2) vs. businesses (curve 3), let alone lagging public policy (curve 4) (Schwartz et al., 2017*)*. This visualization helps to demonstrate the size of the conundrum and the resulting imperative financial services organizations have faced to not only address a point-in-time catch-up, but to rewrite the curve, in order to fundamentally change the relationship between the rate of technology change and the rate of business adoption (Brynjolfsson & McAfee, 2016).

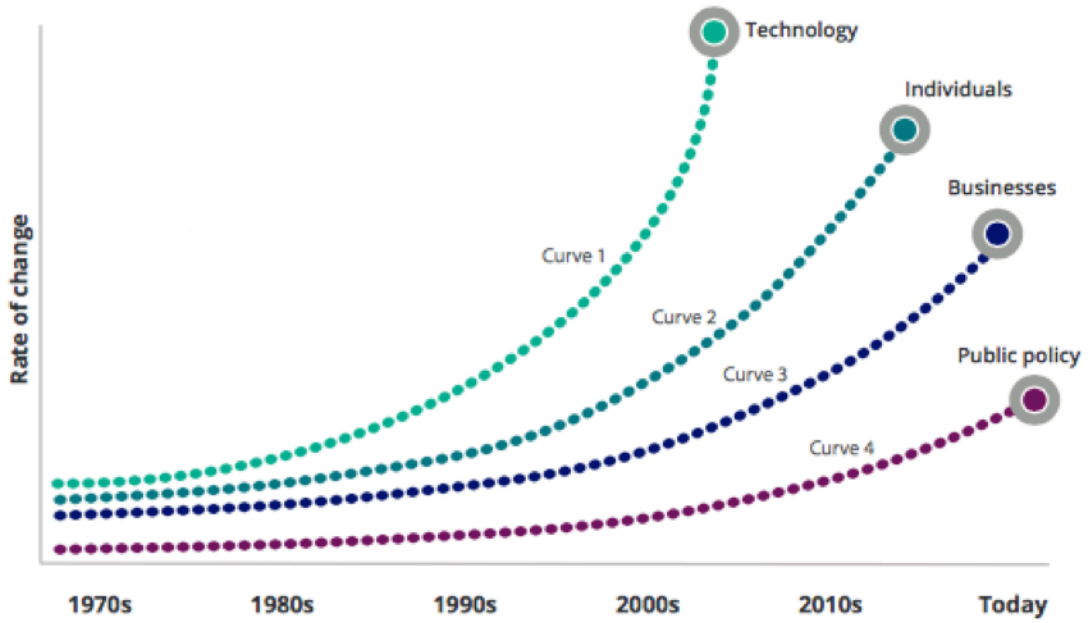

Figure 1. Variation in the rate of change between technology and businesses (Adapted from Schwartz, Collins, Stockton, Wagner, & Walsh, 2017, p. 4)

This research explored the workforce implications associated with the rise of artificial intelligence in financial services during the fourth industrial revolution because there was a gap in the literature addressing the role individual learning theories can play in supporting increased human-machine collaboration. Current research has not sufficiently addressed the intersection of financial services business model transformation, the evolving use of cognitive technologies within the operations of the sector, and the implications for the nature of work and human-machine collaboration. Current literature has tended to explore one angle of the phenomena; for instance, a particular study explored the future of work, but it is generic across sectors of the economy—not focusing on the specific dynamics within financial services (Evans-Greenword, Lewis, & Guszcsa, 2017). Additionally, given the very real-time emergence of the issue, there appear to be fewer comprehensive academic studies that have addressed the combination of phenomena being described. For example, ample literature

has explored the future of the financial services industry from a competitive differentiation standpoint, focusing on the kinds of products and services required in an ever-changing marketplace to compete and survive, but does not explore the other dimensions, like the implications for human work activity (Bruno et al., 2015; McWaters, 2018; McWaters & Glaski, 2017).

Similarly, significant research is underway around the various kinds of cognitive technologies, and the distinct ways in which they are, or are not, being utilized within the operations of a business (Brainard, 2018; Schatsky, Muraskin, & Gurumurthy, 2015, 2018). China's investment in AI, for example, is now 60% of that invested world-wide and currently being written about extensively (Deng, 2017). However, there is a limited amount of literature exploring the resulting implications of these changes for the workforce within the investment banking, retail banking, and/or wealth management sectors (Chui, Kamalnath, & McCarthy, 2018; Chui, Manyika et al., 2018; Friedman & Canaan, 2018; Schatsky et al., 2015, 2018).

Additionally, while there is a growing amount of research on the concept of the "future of work," and the ways in which the workforce will be affected by the proliferation of cognitive technologies (Manyika, Lund, Chui, Brighin, & Woetzel, 2017), research thus far has not addressed the intersection of these domains within a particular sector of the economy in great depth. For example, studies have explored how the nature of work is changing (Abbatiello et al., 2018; Azhar, 2018; Bentley et al., 2018; Evans-Greenwood et al., 2017; Guszcza, 2018), however, these studies have not been located within the operations of a financial services institution to decipher what is most important for leaders of that particular sector. Nor have these studies gone further to

analyze the differences being experienced by those leaders across different lines of business or geographic locations. For example, what is similar about their experience and what is different? How do they leverage their learning to advance the business in similar or dissimilar ways? How does their learning inform the learning opportunities they create for their workforce?

The McKinsey Global Institute's research on the future of work provides a meaningful, comprehensive, and relevant combination of both quantitative and qualitative research (Manyika et al., 2017). By analyzing scenarios for the net impact of automation and future labor demand on employment, skills, and wages, most of the models have suggested that it will be critical to ensure that displaced workers have the skills and support they need to obtain new jobs, even though there may be enough work to maintain full employment in the long term. In this analysis, the researchers assumed that every hour of automated work would result in one hour less of work for a full-time equivalent employee (Manyika et al., 2017). Yet companies often choose to redefine occupations or redeploy workers instead. For instance, after the introduction of the ATM, the number of bank tellers in the United States continued to grow for many years, even as the activities they performed changed (McWaters & Glaski, 2017). This is because the research does not model changes in work structure, such as the growth of the gig economy, platform-based businesses, or activities within an occupation that could change because of technological innovation. Nor does the research model the changing skill requirements for occupations or analyze the "skill bias" of automation technologies—that is, whether they will enable highly skilled workers at the expense of lower-skilled workers or vice-versa.

Exploring this research problem provided greater understanding of the challenges individual leaders and their organizations are facing in supporting their workforces through this period of unparalleled transformation in the operations of the business, so that the progression into the next generation of work within the sector is as effective, efficient, and valuable as possible for all stakeholders.

Purpose

This research explored how financial services leaders are learning through increased human-machine collaboration during the fourth industrial revolution. The study attempted to fill a gap in the existing literature by exploring the changing nature of cognitive technology adoption within the operations of the financial services industry through an examination of how a select set of leaders and institutions learn from their experience in order to shape policies and practices that support their workforce's adaptation. Specifically, the research intends to offer insight into how leaders are extracting meaning from their experience, and using the knowledge gained to take, or not take, action accordingly.

Research Questions

The following three primary questions were used to conduct this inquiry:

- RQ1: How do leaders within financial services experience the increased use of innovative cognitive technologies (e.g., RPA, AI) within the business model of the sector?

- RQ2: How do leaders understand and interpret the changes in workforce roles, responsibilities, and required skillsets as a result of the increased use of cognitive technologies?
- RQ3: How do leaders perceive the learning and development required to transition to this new human-machine collaboration model, and what obstacles are they experiencing?

Research Design Overview

The researcher utilized an exploratory interview design with elements of a case study, which is a qualitative form of social science research. The research design was the logic that linked the data to be collected, and the conclusions to be drawn, to the initial questions of the study. Every empirical study has an implicit, if not explicit, research design (Yin, 2014, p. 26). Approaching this research through exploratory interviews with elements of a case study allowed for an investigation into a contemporary phenomenon in its real-world context by asking "how" and "why" questions (p. 2). This is of particular importance given the recent emergence of the phenomena being studied. Furthermore, exploratory-interview-based case study research accommodated a purposeful approach to data sampling. Purposeful data sampling does not require random or representative sampling in accordance with the laws of statistics, but instead has the direct intent of targeting a particular audience to gain additional information about the conceptual categories of the study (Robson & McCartan, 2016, pp. 162-163). Sampling was therefore pursued in a *non-probability*-based format, structured as a *purposive sample* (p. 281).

The primary method for data collection was a survey questionnaire to 12 executives in globally disparate locations, representing distinct organizations, in an attempt to efficiently classify their contextual environment—for example, the size of their organizations and workforces. Additional information was collected about the experiences of these leaders and their teams through more in-depth 60-minute interviews. Finally, a third data source was utilized which involved a review of public investor relations materials published by leading financial services institutions. This was used as a mechanism to compare information shared by individual leaders to that made public by the institutions themselves. The method of data analysis was content analysis, leveraging key case study techniques, including pattern matching and explanation building.

This research utilized a pragmatic paradigm lens to account for the practicality of the phenomena being studied. Pragmatists link the choice of approach directly to the purpose and nature of the research questions posed (Creswell, 2003). By utilizing a pragmatic paradigm, the research is oriented toward what will work most effectively in the practice of business model transformation and human capital management. The pragmatic paradigm afforded the researcher an opportunity to address questions that do not sit comfortably within a particular approach to design or methodology, while still yielding meaningful results for those directly involved in the situation (Creswell, 2003).

The Researcher

"Research designs should include reflection on one's identity and one's sense of voice; [one's] perspectives, assumptions, and sensitivities" (Marshall & Rossman, 2016, p. 117). While working on this study, the researcher held day-to-day responsibilities for leading and managing through many of the complex challenges being explored; for two

decades, the researcher held these responsibilities within the industry directly or indirectly as a management consultant serving C-suite clients. In these capacities, the researcher has been responsible for driving business model transformation and the associated workforce transitions, witnessing first-hand many of the challenges being explored. The researcher was therefore interested in pragmatic aims that advanced both the theory and practice of both large-scale business model transformation and human capital management in the 21st century.

It is important to note that demand for change within the operations of any business, due to external forces and/or internal factors, is not a new problem. It has, however, evolved over the years—in particular due to the pace and complexity of change. As Thomas Friedman (2016) elegantly narrated in *Thank You for Being Late: An Optimist's Guide to the Age of Acceleration*, the globalization of business in the fourth industrial revolution is no longer about a single system, nor is there time or flexibility for the kind of sequenced and linear planning utilized by business leaders historically. Instead, it is about entire ecosystems of institutions, people, and platforms that are evolving at pace, more like evolutionary biological systems (e.g., organic morphosis) or chemical systems (rapid explosion of matter) than historical economic change.

It is in this capacity that the researcher's own immersion within the very system that is changing provided a unique opportunity to collaborate with global stakeholders to explore the implications of these changes on the financial services sector, individual institutions within the sector, individual leaders within these enterprises, and their collective workforces. The researcher hoped to leverage that experience to provide

transparency around what is unique in the current operating environment as well as that which is similar to other historical periods.

As Michael Lewis (2016) explained aptly in *The Undoing Project*, "the central question posed by Gestalt psychologists was the question the behaviorists had elected to ignore: How does the brain create meaning? How does it turn the fragments collected by the senses into a coherent picture of reality?" (p. 71). In an age of increasingly artificial forms of cognitive algorithmic computing power, humans will be required to understand more about the human brain and its capacity to translate sensory experience and information into meaning and action. Individual learning theories offer one lens with which to understand this phenomenon, offering additional research that considers ways to optimize human collaboration with cognitive technologies.

Assumptions

Part of the diligence associated with research involves being explicit about any biases, assumptions, or beliefs the researcher held when engaging in the study (Bloomberg & Volpe, 2016). The efficacy of this research was dependent on the assumption that participants would be willing and open to sharing their experiences. Additionally, the researcher was hopeful that cognitive technologies would continue to have a positive impact in the long run, opening additional opportunities for individual organizations, entire sectors like financial services, and society at large. The researcher does not intend to suggest through this optimism, however, that there will not be inevitable barriers with the increased application of cognitive technologies and human-machine collaboration, but that these barriers could be overcome if well-articulated, deliberately understood, and actively governed. This optimistic hope on the part of the

researcher should not be overlooked. There are very real ethical challenges associated with the proliferation of increasingly powerful cognitive technologies. However, it is the researcher's hope that the potential positive opportunities associated with these capabilities outweigh the risks.

Finally, the design of the study was done in a manner to enable awareness of potential biases on the part of the researcher, given the researcher's direct involvement professionally in the paradigm being explored. This had implications for the purposeful and convenient sample of participants, who were selected based on their direct experience leading business model transformation within financial services, as colleagues in the researcher's professional practice. Similarly, questions used in the study and the lenses through which findings were interpreted were determined through this pragmatic lens.

Rationale and Significance

This research has a number of potential benefits, most notably to advance the collective understanding and potential actions undertaken to address the rather abrupt and rapidly unfolding changes in the nature of human-machine interaction within business operations, in particular within financial services institutions. By gaining insight from leaders with direct responsibility into how the changes are unfolding successfully and which learning experiences have been most effective for them and their teams, the researcher sought to understand what mechanisms are making the transition process more seamless, thereby adding increased value to customers and shareholders as measured through financial and operational performance. Additionally, because the author is a scholar-practitioner with direct responsibility for delivering similar organizational change

programs for the financial services sector, the research holds direct applicability to the researcher's own professional experience.

With any research endeavor, it is important to note that there were both practical and intellectual goals, and the purpose of this research is no different. Joseph A. Maxwell (2013) best articulated the primary aims of this study in *Qualitative Research Design: An Interactive Approach*:

> Intellectual Goals
> 1. Understand the particular contexts within which the participants act, and the influence that this context has on their actions. Qualitative researchers typically study a relatively small number of individuals or situations and preserve the individuality in their analysis.… Thus, they are able to understand how events, actions and meanings are shaped by the unique circumstances in which these occur.…
> 2. Identifying unanticipated phenomena and influences, and generating new, "grounded" theories about the latter. Qualitative research has an inherent openness and flexibility that allows you to modify your design and focus during the research to pursue new discoveries and relationships.…
>
> Practical Goals
> 1. Generating results and theories that are understandable and experientially credible, both to the people being studied and to others.…
> 2. Conducting research that is intended to improve existing practices, programs, or policies, what is often called "formative evaluation," rather than to simply assess the impact or value of these.… (pp. 29-32)

Ultimately, the researcher sought to offer both an intellectual and a practical contribution to the ongoing discourse related to the future of work and the future of the workforce within the financial services sector, offering perspective for all involved on potential opportunities for action and areas for further additional academic scholarship.

Definitions of Key Terminology

Key terminology utilized throughout this research revolves around three primary domain areas: (a) the financial services industry (e.g., FinTech), (b) technology disruption trends (e.g., natural language processing), and (c) the future of work (e.g., skills gap).

Financial Services: Key Terms

The primary terms related to the financial services industry in this research include business model transformation, FinTech, robo-advisory, platform, and the Internet of Things (IoT).

- ***Business model transformation*** involves the change management approach utilized to align people, process, and technology more closely with a new or refined business strategy. It often involves operating model restructuring but extends beyond to include the technology and operational changes required to mobilize a new business ambition.
- ***FinTech*** is an abbreviation for financial technology which describes any innovation that addresses how people transact in business (from digital currencies to distributed ledgers). FinTech has also broadened to represent a subsector within the financial services industry that is focused on the introduction of disruptive technology to drive varied outcomes, from financial literacy and education, to retail banking and investment decisions.
- ***Robo-advisory*** is used in this research to refer to a field of wealth management where digital platforms are utilized to provide automated, algorithm-driven financial planning services to clients with little to no human

supervision. Robo-advisory is utilized as one example of how cognitive technologies are supplementing or replacing human involvement in the provisioning of financial products and services.

- ***Platform*** as a concept applied to business models indicates the value created through exchanges between two or more interdependent groups, by harnessing large, scalable networks of users and resources that can be accessed on-demand.
- The ***Internet of Things (IoT)*** is a concept utilized in parallel with platform-based business models to convey the idea that all devices with an on/off switch can be connected to one another through networks to communicate with one another. IoT in this context refers to an architecture that connects existing technology within a particular organization and sector, in a specific way, to other organizations, enabling people and companies to accomplish entirely new things crossing historical boundaries.
- ***Executive*** or ***Leader*** is used to define a set of experienced managers working within the financial services industry with a certain level of seniority and responsibility. This population is limited to Managing Directors and Executive Directors directly responsible for overseeing operational departments undergoing these changes.

Technological Disruption: Key Terms

Terminology associated with technology disruption trends include: cognitive technologies, the fourth industrial revolution, robotic process automation (RPA), artificial

intelligence (AI) (including its subset of disciplines like natural language processing [NLP], computer vision, and machine learning).

- ***Cognitive technology*** is used throughout this research to refer to the ability to automate tasks that have historically required human perception skills, such as recognizing handwriting or identifying faces, and those that require reasoning and analytic skills, such as planning, decision making, and learning (Brainard, 2018; Schatsky et al., 2015).
- ***The fourth industrial revolution*** (4IR) is defined as the current period in the early 21st century where unprecedented technological advances and proliferation are taking place, including the introduction of cognitive technologies and device connectivity that are driving increased global collaboration and the blurring of historical boundaries (e.g., physical boundaries, biological boundaries, digital boundaries) (Schwab, 2016).
- There is no single definition of ***artificial intelligence***; however, this term is often understood as referring to a form of cognitive activity that is not derived from the human mind, even though advanced intellectual activity has historically only been a capability of the human mind (hence, the use of artificial) (Ford, 2018). (See Figure 2 for a continuum of illustrative cognitive technologies).
- ***Robotic process automation (RPA)*** is the application of technology that enables computer software to process a transaction, manipulate data, trigger responses, and communicate with other digital systems. RPA enhances the

speed and accuracy of repetitive tasks with predictable outcomes and involves automating a workflow or business process (Holden & Smith, 2016).

- ***Natural language processing (NLP)*** seeks to interpret or produce human language in either written or spoken form by understanding sentence structure, meaning, and sentiment (Chui et al., 2018; Ford, 2018). NLP technology is often integrated as part of the capabilities present with cognitive agents that serve as digital assistants capable of interacting with and solving customer and/or employee questions (e.g., chatbots).
- ***Computer vision*** is the science and technology of machines that see. It is concerned with the theory and technology for building artificial systems that obtain information from images or multidimensional data. A significant part of AI deals with performing mechanical actions, like moving through an environment. This type of activity typically needs input data provided by a computer vision system, acting as a vision sensor to provide high-level information about the environment (Ford, 2018; Manyika et al., 2017).
- ***Machine learning*** as used throughout this research refers to an approach to AI that uses algorithms to make predictions about data without explicit programming (Ford, 2018; Schatsky et al., 2018). Traditional technology has been the result of explicit human programming. Machine learning refers to technology capable of developing more complex understanding and capabilities without human involvement.

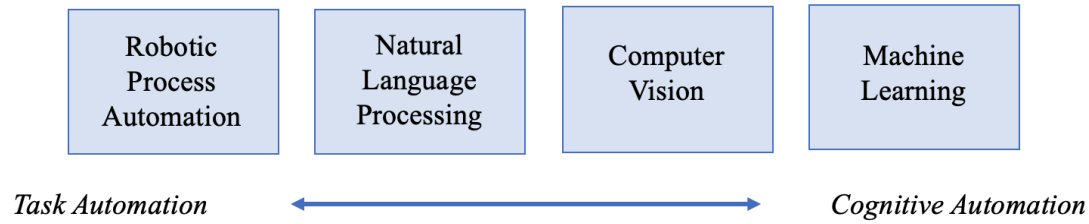

Figure 2. Continuum of illustrative cognitive technologies

Future of Work: Key Terms

The key terms used for discussing business model disruption and the implications for the workforce include: future of work, human capital management, skills gap, augmented intelligence, and human-machine collaboration.

- ***Future of work*** is not a new concept, as the topic has been studied for much of the 19th and 20th centuries while labor markets have existed. However, in the early 21st century, the term has taken on particular meaning to indicate the dramatic shifts in the nature of work activity within enterprises due to the increased collaboration between humans and machines. The future of work specifically seeks to understand the changes underway due to the increased use and adoption of cognitive technologies that are replacing historically human tasks, and what that means for role definition, skillset requirements, and the talent management lifecycle.
- ***Human capital management (HCM)*** and ***talent management*** are used interchangeably throughout this research to talk about the activities that organizations utilize to oversee their people practices. Specifically, the term indicates the deliberate and conscious management of people as an asset on the balance sheet of the business (hence, the use of capital management).

- ***Skills gap*** describes the difference between the types of skills available in the current labor market and the kinds of skills that organizations, in particular financial services organizations, require to compete in the fourth industrial revolution. The skills gap also speaks to changes in the kinds of skills required of humans as a result of the introduction of increasingly sophisticated cognitive technologies.
- ***Augmented intelligence*** refers to the use of technology to supplement and complement human intelligence. It is an alternative use of AI that focuses on AI's role in supplementing and complementing human capabilities rather than replacing them (Ford, 2018).
- ***Human-machine collaboration*** describes a model of work in which humans engage with artificial intelligence systems to perform an operational or strategic task. The purpose of human-machine partnerships is to use the particular strengths of each to provide increased value, efficiency, creativity, and quality.
- The meaning of ***learning*** has been philosophically debated by scholars for decades, whereby some suggest it is a process, and others an outcome. For purposes of this study, learning was considered a process whereby the individual gains insight – both concrete and abstract – about the world through action and interaction with it, such that he/she is in a position to reflect, refine and modify his/her thinking and behavior in the future to handle even more complex situations. This is a constructivist understanding of learning and

aligns most notably with the literature of David Kolb (De Houwer, Barnes-Holmes & Moors, 2013; Edmondson, Dillon & Roloff, 2007; Kolb, 1983).

II—LITERATURE REVIEW

Introduction

This research explored how financial services leaders are transitioning their workforces to a new business model with increasingly prolific human-machine collaboration in the fourth industrial revolution (4IR). There are several areas of literature of relevance to this study, including: (a) the manner in which the financial services sector is evolving, (b) the way in which cognitive technologies are being utilized and applied in the 4IR, (c) the implications for the changing nature of work, and (d) what individual learning theory can offer leaders in support of the transition process. The results of this literature review will demonstrate the gap that currently exists with limited integrated research, and instead an assortment of siloed and disparate studies. This research attempted to begin to address the gap by exploring the phenomena with financial services executives directly responsible for overseeing the transformation of the business through cognitive technologies, thereby offering a more integrated point of view for similar workforce transitions underway in the 4IR.

The Evolution of Financial Services

In 2014 and 2015, Deloitte's Financial Services Practice partnered with the World Economic Forum on one of the most comprehensive reviews of the changes underway in the financial services sector. The eventual study, issued in June 2015, was entitled *The Future of Financial Services: How Disruptive Innovations Are Reshaping the Way Financial Services Are Structured, Provisioned, and Consumed* (Bruno et al., 2015). The

researchers defined six core functions that comprise the essence of financial services: payments, market provisioning, investment management, insurance, deposits and lending, and capital raising. For each of these core functions, the researchers then proceeded to identify several clusters of innovation that were having an effect—from moving to a cashless world within the payments space, to moving toward crowdfunding within the capital-raising sphere.

The results of the research emerged from a combination of in-person interviews, guidance, and thought leadership from 16 C-suite executives and 25 strategy officers of global financial institutions (e.g., Visa, Mastercard, Barclays), as well as supplementary phone interviews with an additional 100 innovative new financial services entrants into the market (e.g., Coinbase, Liquidity, Seedrs), and six multi-stakeholder workshops with over 300 total participants at global financial services hub locations (Hong Kong, Tianjin, Boston, New York, London, Davos).

The collaboration between Deloitte and the World Economic Forum on this research synthesized six insights that were crucial to understanding the innovation underway within the financial services industry. These six insights were as follows:

1. Innovation in financial services is **deliberate and predictable**; incumbent players are most likely to be attacked where the **greatest sources of customer friction** meet the **largest profit pools.**
2. Innovations are having the **greatest impact** where they employ business models that are **platform based**, **data intensive**, and **capital light.**
3. The most **imminent** effects of disruption will be felt in the banking sector; however, the greatest **impact** of disruption is likely to be felt in the insurance sector.
4. Incumbent institutions will employ **parallel strategies**; aggressively **competing with new entrants** while also leveraging legacy assets to provide those same new entrants with **infrastructure and access to services.**
5. **Collaboration** between regulators, incumbents and new entrants will be required to understand how new innovations alter the **risk profile of the industry**—positively and negatively.

6. Disruption will not be a one-time event, rather a **continuous pressure to innovate** that will shape customer behaviors, business models, and the **long-term structure of the financial services industry**. (Bruno et al., 2015, p. 13)

The results demonstrated the dramatic pressure on leaders in these institutions to evolve their operations continuously in order to survive competitively.

In 2017, as the financial technology (FinTech) start-up revolution was underway, the World Economic Forum published an update to the original research, revisiting how the disruptive technology trends in financial services had progressed in the previous 24 months (McWaters & Glaski, 2017). The research once again involved a series of interviews (150) and international workshops (10) with participants from large institutions (e.g., Fidelity, Blackrock) and disruptive innovators (e.g., Slice, Ondeck) to ensure a global discussion around opportunities and concerns for FinTech disruption. The research highlighted the following eight key forces that had the potential to shift the competitive landscape of the financial ecosystem:

1. **Cost Commoditization:** Financial institutions will accelerate the commoditization of their cost bases, removing them as points of competition and creating new grounds for differentiation.
2. **Profit Redistribution:** Technology and new partnerships will enable organizations to bypass traditional value chains, thereby redistributing profit pools.
3. **Experience Ownership:** Power will transfer to the owner of the customer interface; pure manufacturers must therefore become hyper-scaled or hyper-focused.
4. **Platforms Rising:** Platforms that offer the ability to engage with different financial institutions from a single channel will become the dominant model for the delivery of financial services.
5. **Data Monetization:** Data will become increasingly important for differentiation, but static data sets will be enriched by flows of data from multiple sources combined and used in real-time.
6. **Bionic Workforce:** As the ability of machines to replicate the behaviors of humans continues to evolve, financial institutions will need to manage labour and capital as a single set of capabilities.

7. **Systemically Important Techs:** Financial institutions increasingly resemble, and are dependent on, large tech firms to acquire critical infrastructure and differentiating technologies.
8. **Financial Regionalization:** Diverging regulatory priorities and customer needs will lead financial services in different regions of the world down distinct paths. (McWaters & Glasky, 2017, p. 14)

In the years since, the research has continued and, in 2018, the World Economic Forum and Deloitte issued *The New Physics of Financial Services: Understanding How Artificial Intelligence Is Transforming the Financial Ecosystem* (McWaters, 2018). These 2018 and 2017 findings reinforced the 2015 study: the financial services business model is in the midst of dramatic disruption with unparalleled change in customer requirements, the geopolitical marketplace, and the underlying processes and technology supporting the operations of the business. These studies have served as the backbone for additional discussion from regulators and policymakers—for example, the Federal Reserve Board Governor Lael Brainard's November 2018 speech on *What We Are Learning About Artificial Intelligence in Financial Services*.

The Fourth Industrial Revolution

The fourth industrial revolution (4IR) is defined as the current period in the early 21st century where there is unprecedented technological proliferation, including the introduction of cognitive technologies (like artificial intelligence [AI]) and device connectivity (through the internet of things [IoT]) that drive increased global collaboration while diminishing historical physical boundaries. As a result, people, ideas, and things are connected seamlessly in real time. As Schwab (2016) noted:

> The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a

> fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. (para. 2)

In this context of the 4IR, financial services institutions are forced to confront both the positive and negative implications of applying cognitive technologies at scale to their business operations (Besenbacher, Buckley, Cotteleer, Goddijn, & Grossman, 2019; Bodrozic & Adler, 2018; Chui & Malhorta, 2018).

Driving the progress in cognitive technologies are four primary factors. Moore's law, which suggested that the number of transistors in a dense, integrated circuit doubles approximately every 2 years, provided the exponential growth in computing power at a given price point, facilitating computer system advances that were once unimaginable (Schwab, 2016). In parallel, the rise in the volume of data available for consumption has benefited cognitive technologies that utilize statistical models to determine probabilities associated with data. These models are now increasingly trained on larger and larger datasets, thanks to the increasingly digital world, which is in turn improving their performance. Additional advances in the internet and cloud computing technology have allowed groups of humans to collaborate with one another and inform AI capabilities at scale and more quickly (Tang, 2019). Finally, advances in algorithms, that are becoming increasingly sophisticated in their data prediction accuracy and pattern identification, are often available on an open-source basis (Briggs & Buchholz, 2019; Schatsky et al., 2015).

One of the more notable breakthroughs in the 4IR occurred when Google's AlphaGo AI machine advanced to become sophisticated enough to defeat a Chinese grandmaster at the complex strategy board game named Go (Cadell, 2017). AI capabilities like AlphaGo are maturing rapidly, and many organizations employing them

are seeing impactful benefits that improve business operations as well as develop entirely new business channels, products, and services (Briggs & Buchholz, 2019; Schwab, 2016; Schwab & Samans, 2018). Yet the economic value of algorithms and artificial intelligence does not come solely from the technological breakthrough in and of itself; rather, it emerges from cognitive technologies that have been "properly designed for, and adapted to, human environments" (Guszcza, 2018, p. 4).

The History of Artificial Intelligence

The term *artificial intelligence* was first coined at Dartmouth College in the summer of 1956 when a group of the world's leading professors and researchers in mathematics and the sciences met to discuss a wide range of topics, including language simulation and the manufacturing of intelligence artificially (McCarthy, Minsky, Rochester, & Shannon, 1955). Since then, various approaches to AI have emerged, including the once-promising development of "expert systems" in the 1980s and 1990s, which involved interviewing experts in a field and codifying their knowledge into a set of rules that would enable a computer to mimic their behavior (Ford, 2018; Stone et al., 2016).

Given AI's multiple approaches and applications, it has no single agreed-upon definition yet, although a common theme is that it involves the engineering of computers to perform tasks that normally require human intelligence and actions (Ford, 2018; Schatsky et al., 2018). This requires the ability to receive input (e.g., through sight, sound, or written text); to process it (by learning from and interpreting it); to respond meaningfully to it (by making decisions or offering advice); and sometimes to be able to physically move and manipulate objects (Crevier, 1993). To explore its growing

applications and sophistication formally, Stanford University sponsored a study that will continue for 100 years—*Artificial Intelligence and Life in 2030: One Hundred Year Study on Artificial Intelligence* (Stone et al., 2016). A study panel comprised of experts from academia, corporate laboratories, and industry, with specialties in law, political science, and economics, across geographic regions gathered to explore the proliferation of AI as well as its implications and potential opportunities (Stone et al., 2016).

Brief Overview of Common Cognitive Technologies

The most successful approach to AI recently undertaken has been machine learning. As such, the applications of AI that use some form of machine learning to perform their function have also burgeoned. AI that uses machine learning able to learn from and make predictions about data without explicit programming (Schatsky et al., 2015). While such capability has existed for years, only recently have major advances in massive parallel processing and the availability of big data techniques fueled an explosion of activity around one type of machine learning known as deep learning. Deep learning uses multiple layers of algorithms that are combined to learn increasingly complex tasks (Chui et al., 2018). For example, in a visual recognition system, the first layer may recognize edges and lines, the second layer may combine edges to recognize simple shapes, and the third layer may combine shapes to recognize objects. These deep learning systems often require vast amounts of data; the greater amount of data, the greater the accuracy of the algorithm's analytics (Briggs & Buchholz, 2019; Ford, 2018; Schatsky et al., 2018).

Artificial learning systems automatically adjust to perform tasks such as finding and classifying features or patterns in input data. Three main types of machine learning

can be implemented this way: (a) supervised learning, where the network must be pretrained using example input and output data before the system can perform tasks (e.g., recognizing objects in images or video); (b) unsupervised learning, where the network can find patterns and structure in data inputs, while detecting anomalies without any training (e.g., anomaly detection in system monitoring data); and (c) reinforcement learning, where the network learns to perform a task by interacting with the environment and responding to feedback (e.g., self-driving cars) (Chui et al., 2018; Bostrom, 2014; Loucks, Davenport, & Schatsky, 2018).

While less sophisticated in its capabilities than machine and deep learning and, therefore, arguably less cognitive in nature, robotic process automation (RPA) is another one of the fastest-growing areas of computerized automation. It is defined as the application of technology that enables people to configure computer software to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses, and communicating with other digital systems (Holden & Smith, 2016). RPA has had an impact by enhancing the speed and accuracy of repetitive tasks with predictable outcomes across the enterprise. The following from Lowes, Cannata, Chitre, and Barkham (2016) presents the operational benefits of RPA.

- **Decreased cycle times and improved throughput:** Software robots are designed to perform tasks faster than a person can, and do not require sleep making 24x7 operations possible.
- **Flexibility and scalability:** Once a process has been defined as a series of instructions that a software robot can execute, it can be scheduled for a particular time, and as many robots as required can be deployed to perform it.
- **Improved accuracy:** Robots are programmed to follow rules and robots do not make typos.
- **Improved employee morale:** Tasks and processes most suitable for automation are typically the most onerous and least enjoyable for employees, who are relieved to be refocused on more rewarding and value-added activities.

- **Detailed data capture:** The tasks performed by software robots can be monitored and recorded to produce valuable data and audit trails that can support further process improvement and support regulatory compliance. (p. 9)

Current uses for RPA within the financial services industry include financial transaction processing and automated customer-service requests that drive a reduction in error rates, and faster processing timelines. Automation of these tasks also produces output that is increasingly consistent and structured which, in turn, can be used for further analysis and cognitive insight, allowing staff to focus on higher-level value-adding tasks (Briggs & Buchholz, 2019; Loucks et al., 2018).

Application of Cognitive Technologies in Financial Services

RPA is rapidly growing in its application, most notably to repeatable and repetitive back-office activities in Finance, HR, and IT, with virtual agents and chatbots utilized to supplement service-desk support functions while reducing employee workload (DeFrancesco, 2019; Guszcza, 2018). More sophisticated cognitive technologies are also beginning to have an impact, aiding decision making and augmenting existing systems to manage business operations. The ability to find patterns and identify outliers in huge data sets lends itself to any number of practical applications. Finding correlations between numerous variables also makes AI capabilities a very effective tool for uncovering nonlinear interdependencies in data. It has been providing financial services firms with a better understanding of client preferences which, in turn, enables more individualized digital marketing campaigns and targeted product offerings (e.g., recognizing fraudulent credit-card activity within the payments space) (Chui et al., 2018). When embedded with sensors, cognitive technologies also allow tracking and reporting on structured and unstructured information in real time. This offers better analytics and insights for the

organizations using these applications as compared to their competitors (Holden & Smith, 2016).

To provide perspective on how valuable the application of AI is, McKinsey Global Institute conducted a 2018 mixed-methods study across 19 industries and 400 use cases of representative clients. The results estimated that each industry will see between 1-9% of 2016 revenue in value saved through the migration of existing operational processes to AI. For Banking, the aggregate dollar impact in trillions of US$ is estimated to be 0.2-0.3, or 2.5-5.2% of the industry's 2016 revenue. For Insurance, the percentage of revenue is higher at 3.2-7.1%, yielding an estimated 0.1-0.3 trillion US$ in savings (Chui et al., 2018).

The Power of Platforms

The Internet of Things (IoT) is the idea that all devices with an on/off switch can be connected to one another through networks to communicate with one another. Sensors deployed on mechanical or electrical equipment can send signals if temperatures go above or below a certain threshold, alerting maintenance staff. Video-monitoring sensors in the home or office can send text alerts to notify security staff or consumers on their personal mobile device, presenting real-time transparency about the intrusion. The IoT revolution is driving the concepts of "smart-homes," "smart-cars," and "smart-cities." That is, entire systems of devices that "speak" to one another metaphorically, by sending real-time information flows, which inform humans for decision-making or action (Briggs & Buchholz, 2019; Friedman, 2016). Within the financial services context, the idea of IoT is manifesting itself in many ways. It affects how the institution's infrastructure "connects" and "speaks" to itself, and to those in leadership positions. But it is also

uniquely creating the concept of platforms (Dickson, Lisachuk, Ogura, & Cotteleer, 2018).

IoT applied within the context of a business model extends the concept into architecture that connects existing enterprise operating technology in one organization to another organization, thereby enabling people and companies to accomplish entirely new things in totally new ways. Imagine connecting the organizational technology of one institution to other suppliers, vendors, customers, and regulators to create an "information value loop" (Dickson et al., 2018, p. 3). This connectivity permits an unprecedented exchange of information and concrete action and decision making, therefore creating unique additional value for the enterprises and the broader ecosystem. For the future of financial services, the concept of platforms will connect established institutions within asset management, banking, and insurance to disruptors (e.g., FinTech firms), and other providers, suppliers, vendors and partners (e.g., regulators like the Federal Reserve, or cloud service providers) (McWaters, 2018; Tang, 2019). Table 1 presents the progression from product/service to platform-based business models.

Table 1

Progression From Product/Service to Platform-based Business Models

Product/Service Business Model	Platform Business Model
• Physical product-centric • Single transaction, potential licensing • Closed ecosystem, traditional supplier and customer relationships • Initiatives, enhancements, and product life cycle driven by product owners • Resource, knowledge, and capabilities owned by the organization • Multiple marketing channels including word of mouth	• Digitally enabled and focused • Licensing, pay as you go, subscription transactions • Open and shareable content, platform components • Ability to find the right products and services, organizations drive or become orchestrators of ecosystem • Resource needs met by specialized knowledge and capabilities on-demand • Community with transparency evaluation of products and services

Adapted from Dickson et al. (2018), p. 5

The future of the financial services industry involves streamlining infrastructure to accept that emerging platforms and decentralized technologies provide new ways of aggregating and analyzing information, improving connectivity, and reducing the marginal costs of participating in the financial marketplace (McWaters & Glaski, 2017). To compete and survive, the very essence of what it means to be a financial services provider and operator in the marketplace is being reconceived (Brynjolfsson & McAfee, 2016).

The Future of Work

The implications associated with the changes underway within the financial services marketplace, and the broader disruptive technology innovation resulting from scientific progress, have forced a redesign of the operations of the industry's business model and, in turn, the nature of work for humans (Hagel, Brown & Wooll, 2018; Hagel

& Wooll, 2019). For leaders, a design opportunity has emerged to create the future of the sector, answering questions about how their institution can achieve the greatest total value from increased artificial intelligence supplementing the human workforce (Guszcza & Schwartz, 2019). As Harari (2017) noted:

> The automation revolution is emerging from the confluence of two scientific tidal waves. Computer scientists are developing AI algorithms that can learn, analyze massive amounts of data and recognize patterns with superhuman efficiency. At the same time, biologists and social scientists are deciphering human emotions, desires and intuitions. The merger of infotech and biotech is giving rise to algorithms that can successfully analyze us and communicate with us, and that may soon outperform human doctors, drivers, soldiers and bankers in such tasks. These algorithms could eventually push hundreds of millions out of the job market. (pp. 324-325)

The nature of the work is different. The key is not the quantity of work, but the nature of the work involved for humans. The changes are resulting in new constructs for roles and responsibilities that inevitably differ from those of the past (Hagel & Wooll, 2019; Kark et al., 2019; Susskind & Susskind, 2015). The October 2016 report from the National Science and Technology Council to the Executive Office of the President of the United States began with the statement: “advances in artificial intelligence technology have opened up new markets and new opportunities for progress in critical areas such as health, education, energy and the environment” (Holden & Smith, 2016, p. 5). The key is retooling the existing workforce for this new reality, while reforming development practices for generations that follow.

Reimagining the Workforce

In 2017, the McKinsey Global Institute led an extensive study to explore transitions underway in the workforce during the age of automation (Hagel et al., 2018; Manyika et al., 2017). Through a mixed-methods quantitative and qualitative study, and

with the support of academic advisors from Harvard University, the London School of Economics, the Haas School of Business at University of California-Berkeley, and the New York University Stern School of Business, the researchers looked at labor demand drivers, skill and wage analysis, and work hour automation potential. The researchers analyzed the type of work that may be created up through 2030, while comparing those findings to the types of work that automation may replace in that same time period. Looking at 46 countries comprising almost 90% of the global domestic product (GDP), the study drew on 2014 data to make grounded estimates and forecasts for the number and type of jobs that would emerge in the coming years. The results conservatively suggested that automation could displace a significant share of work globally by 2030, with an approximately 15% reduction in current jobs as the midpoint of the scenario modeling (Manyika et al., 2017).

> The workforce transitions ahead will be enormous…as many as 375 million workers globally (14 percent of the global workforce) will likely need to transition to new occupational categories and learn new skills, in the event of rapid automation adoption. (p. 11)

The research was based on the premise that extensive potential shifts lie ahead in occupations, with important implications for workforce skills and wages. Through data compiled from several key sources, including the World Bank and the U.S. Bureau of Labor Statistics, the research team broke down approximately 800 occupations into more than 2,000 activities and determined the performance capabilities needed for each activity based on the way humans currently perform them. The results indicated that nearly 30% of the hours worked globally could be automated by 2030, give or take potential influences from the speed of adoption of automation, technical feasibility, development costs, and social and regulatory acceptance. The results also varied considerably by

country, reflecting the mixture of activities currently performed by workers in those countries and prevailing wage rates (ranging from a midpoint scenario of 9% of jobs eliminated in India to 26% eliminated in Japan) (Manyika et al., 2017).

Changing Skill Requirements

Given this research, the implications for skills and wages within and across occupations are immense. The mixture of capabilities required of the human workforce in an age of increasing cognitive technologies will skew toward personal interaction and more advanced levels of cognitive competence (Hagel et al., 2018; Manyika et al., 2017). Skills such as empathy, communication, persuasion, problem solving, and strategic decision making, although not new, will be even more valuable than ever in the workforce of the future (Parmalee, 2019). Machines will play an increasingly critical role in the day-to-day operations of the business, requiring even more competent humans for collaboration, governance and oversight (Bostrom, 2014; Guszcza & Schwartz, 2019). Now more than ever, the application of cognitive technology will not only boost productivity but allow workers to focus on more nuanced aspects of the financial services business, including client service and opportunities for societal impact (Schwartz et al., 2017, p. 120).

In 2017, Deloitte produced its annual *Global Human Capital Trends* report surveying hundreds of global organizations that span the for-profit, not-for-profit, and academic sectors. With over 10,000 responses (22% from large organizations [>10,000 employees], 29% from medium-sized organizations [1,000-10,000 employees], and 49% from smaller organizations [<1,000 employees]), the results demonstrated that the future no longer revolves around humans working in defined roles and performing specific tasks

within established processes. The results from the 2017 study were supported by the similar 2018 Deloitte study entitled *Rise of the Social Enterprise: 2018 Global Human Capital Trends,* which reinforced that the future of work involves humans and machines developing symbiotic relationships, each with specialized skills and abilities, in a collective workforce that delivers increased benefits to the business (Abbatiello et al., 2018; Agarwal et al., 2018). By sharing abilities (psychomotor, sensory, physical, cognitive) and skills (content, process, system, social), the workforce of the future will have enhanced role specialization, improved decision making, and increased productivity (Evans-Greenwood et al., 2017).

As advances in cognitive technologies accelerate, the workforce needs to be creative about the kinds of skills needed to stay relevant, and focused on the type of value-added activities that will impact business the most (Parmalee, 2019). Schwartz et al. (2017) offered a deeper understanding of the future of work by examining the differences between the old rules of work and how they differ from today's new rules (as presented in Table 2). Essential to the rather dramatic workforce transition is learning and development. In Deloitte's 2019 *Human Capital Trends Report*, the study expanded its focus to this very notion, discussing "learning in the flow of life."

> Rapid and ongoing changes in the nature of work itself are changing the relationship between learning and work, making them more integrated and connected than ever before. This creates a challenge and an opportunity to build robust work-centered learning programs, helping people consume information and upgrade their skills in in the natural course of their day-to-day jobs. (Volini et al., 2019, p. 2)

Organizations are being forced to reskill their workforces, with limited external support in the marketplace.

Table 2

The Future of Work: Old Rules vs. New Rules

Old Rules	New Rules
Machines and AI are taking over jobs.	Jobs and tasks are being redesigned to use more essential human skills and are augmented by technology.
Full-time employees are the main source of talent.	A continuum of talent is available, including contractors, gig employees, crowds, and competitors.
Workforce planning focuses on full-time workforce and skill requirements.	The focus in workforce planning shifts to start with work and analyzing options across workforces and technologies.
Jobs are relatively static with fixed skill requirements.	The half-life of skills continues to decrease rapidly, and work is being constantly reinvented.
Jobs and career ladders are the foundation of work and the workforce.	Projects, assignments, and tours of duty are building blocks for work; careers are portfolios of projects and experiences.
Robotics and cognitive technologies are IT projects.	Integrating people and technology is a multidisciplinary task.
The fundamental elements of work are jobs, with formally developed role descriptions.	The fundamental elements of work are tasks, which are aggregated into jobs and roles.

Adapted from Schwartz et al. (2017), p. 127

Societal Readiness for Change

Institutions of all forms—from educators to government custodians of public policy—are grappling with the proliferation of increasingly complex technologies that are changing the nature of work, and associated workforce skill requirements, more quickly than they are accustomed, challenging supporting social systems (Rudel & Hooper, 2005; Schwab 2016; Schwab & Samans, 2018). For several decades, research suggested that science, technology, engineering and mathematics – collectively known as STEM – would effectively prepare the workforce for future employment (USDOE, 1983; Zakaria,

2015). However, despite significant investment in developing these capabilities for several decades—in particular in the United States—significant gaps remain in the volume and breadth of qualified talent. Furthering the challenge is recent research which highlights the important role of softer skills like communications and critical thinking (Strauss, 2017; AACC, 2018; Ferreri, 2018; Stolzoff, 2018). This research emphasizes the degree to which humans increasingly collaborate with a much larger array of stakeholders – from regulators and clients, to suppliers and competitors – while also working alongside cognitive technologies to perform their daily work (Schwab & Samans, 2018; Stolzoff, 2018).

The World Economic Forum suggested that one of the key roles governments should play in supporting the large-scale societal transition is through business investment, the repurposing of education, and individual accountability for the reskilling required (Schwab & Samans, 2018). Yet most literature suggests there is an absence of systemic societal change incentivized through public policy (PCAST, 2010; Council of Economic Advisors, 2018). Educational institutions that have attempted innovative approaches, have been successful in niche domains, but have struggled to keep pace with the breadth of changes necessitated (USDOE, 1983; National Academies, 2007; Cardenas-Navia & Fitzgerald, 2015; Singer, 2019). There is an equal lack of confidence in local, state and federal agencies to effectively leverage public resources to prepare workers for the needs of the new economy (Bhatia, 2018; Everhard, 2019; Gewertz, Herold, Sawchuk & Sparks, 2019; Johal & Araya, 2019). While select countries have made transformational workforce reskilling a priority, like China which has issued a

national AI directive, spurring focus and investment, large-scale, systemic programs are limited (Deng, 2017).

The resulting landscape in 2019 involves a sparse web of cross-sector collaboration. Programs that bring government, educational, business and non-profit institutions together to solve the complex societal change underway would be welcome yet are currently limited in scope and volume, begging for action from leaders in a range of sectors and specialty areas (Lue, 2019; McGowan, 2019; Selingo, 2019; Kasriel, 2019; Everhard, 2019; Johal & Araya, 2019).

Insight From Individual Learning Theory

In the early 21st century, when the nature of business operations and the concept of work are being redefined, the requirement for lifelong learning has never been more profound (Brynjolfsson & McAfee, 2016). As Harari (2017) observed:

> To make use of new opportunities, people will need radical, lifelong retraining. The AI revolution won't be a single event after which the job market and the educational system will settle into a new equilibrium. Rather, it will be a cascade of ever-bigger disruptions. Even today, few employees expect to work in the same job for their entire life. By 2050, not just the idea of 'a job for life', but even the idea of 'a profession for life' might seem antediluvian. It will become increasingly difficult to know what to teach schoolchildren and university students. (p. 325)

In considering the future of work for leaders responsible for maximizing human capital, individual learning theories can offer meaningful insight for how to effectively scale the breadth and depth of growth and transformation required (Schwartz et al., 2017).

One learning theory of relevance is *learning from experience* (LFE), the concept that humans develop and grow through contact with their environment. It suggests that the manner in which the interaction between the individual and the environment is

internalized shapes future action and decisions (Argyris & Schön, 1974, 1996; Smith, 1987). John Dewey, an American philosopher of the 19th and 20th centuries, was the most prominent early advocate for the importance and relevance of this form of development. Dewey suggested two primary principles that must be exhibited for a situation to be considered an experience worthy of learning: the principle of continuity and the principle of interaction (Merriam, Caffarella, & Baumgartner, 2007, p. 162). For Dewey (2007), interaction with the environment, and the ability to contextualize what is happening in one moment within a frame of reference for what has come before and will potentially come after, are crucial for an event to be a learning opportunity.

With the formal articulation of a learning theory centered around the experience of the individual, Dewey set the foundations of what would grow into an essential component of educational philosophy in Europe, Australia, and the United States over the course of the 1900s, countering the notion that the primary form of learning can and should be passing on already codified and institutionalized scholarship. Dewey offered "a more integrative perspective on learning that combines experience, perception, cognition and behavior," putting the learner experience at the center, asking for the first time what the learner observed and conceived relative to what was being experienced (Kolb, 1984, p. 21). Dewey argued that experience alone did not produce learning. However, reflection on that experience in order to draw out meaning in an attempt to guide future experience was a profound learning endeavor that should not go overlooked (Kolb & Yeganeh, 2011, p. 4).

Following Dewey's thought leadership, 20th-century adult learning theorist David Kolb (1983) built on the notion of *experiential learning* by defining a four-step model:

concrete experience, observations and reflections, formation of abstract concepts, and testing implications of concepts in new situations. These four steps were later adapted in a revised issuance to *concrete experience, reflective observation, abstract conceptualization*, and *active experimentation* (Kolb, 1984). (See Figure 3 for an overview of David Kolb's *experiential learning* framework.)

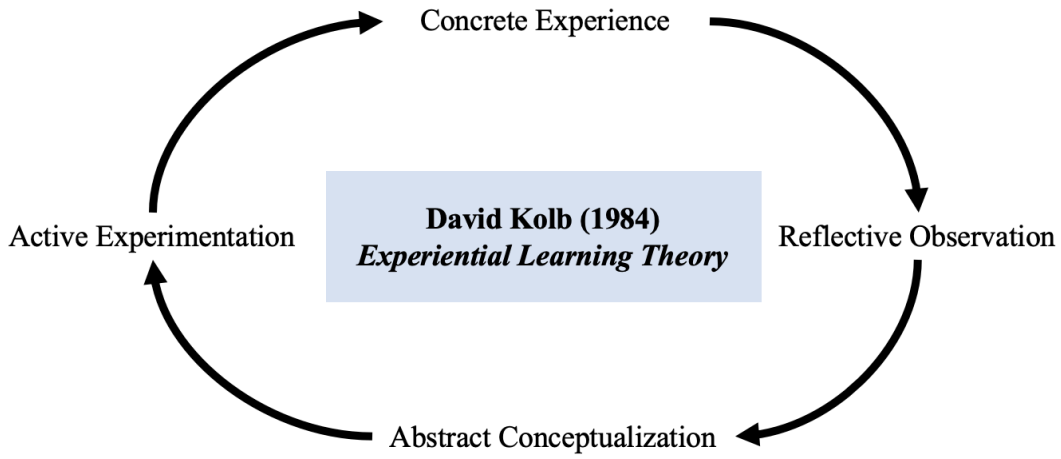

Figure 3. David Kolb's experiential learning framework

Kolb argued that the learning cycle can begin at any of these steps, but it should be approached and viewed as a continuous cycle. *Concrete experience* and *abstract conceptualization* are a continuum of perception, and *active experimentation* and *reflective observation* are a continuum of processing.

> Immediate concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences. (Kolb & Yeganeh, 2011, p. 4)

Central to Kolb's theory is the use of immediate, *concrete experience* to test ideas, and the use of feedback to change one's understanding and, ultimately, actions (Kolb & Fry, 1974). Like Dewey, Kolb emphasized the cycle's developmental nature.

Kolb's *experiential learning* model has been expanded upon in the years since to support individuals in identifying their preferred learning identity (Kolb & Yeganeh, 2011, pp. 5-8). Certain learners may be more inclined to "live in the here and now," very present and aware of *concrete experience*. Other learners observe from a distance, preferring time for quiet reflection, critical analysis, and contemplation. Still other learners may value abstract thought and the ability to conceptualize new ideas, patterns, and approaches, while other learners may be more inclined toward *active experimentation* and constant application of those new ideas. This level of awareness of natural tendencies can help in creating diverse teams that comprise a mixture of preferences. It can also support effective alignment of the individual's aptitude and preferences to the particular requirements of a role, matching optimal talent to leadership positions (Kolb, 1999). These tactics all support the notion of scaling individual *experiential learning* at the organizational level can drive greater performance and help institutions compete through periods of sector-wide transformation (Lee, 2017).

Within the field of individual learning, *incidental* and *informal* learning theory also offers insight for leaders in the 4IR (Marsick & Watkins, 2001). Often described as the opposite of formal learning—where an institution sponsors and establishes structure and controls for targeted development outcomes—*informal* learning is unstructured (p. 25). *Informal* learning is typically intentional, but not controlled. It is frequently integrated into daily routines, highly unconscious, and linked to the learning of others (p.

28). For example, an organization can intentionally create space for *informal* learning opportunities which may take the shape of networking, mentoring, or coaching by doing so without formal policies, procedures, and practices. A good portion of the learning experienced by financial services executives during this period of cognitive technology proliferation has the potential to be *incidental* and *informal*, arising organically out of the routine of daily business operations.

Finally, there is a third individual learning theory that offers insight for leaders in the 4IR. In the late 1900s, American business researchers Chris Argyris and Donald Schön brought organizational theory and *experiential learning* principles together by introducing three concepts: the idea of *governing variables*, *action strategies*, and *consequences* (Argyris & Schön, 1974, 1978, 1996). *Governing variables* are the dimensions of any given situation that the individual or institution is trying to keep within acceptable limits (e.g., to comply with dimensions set forth in a policy). *Action strategies* are the moves and plans used by individuals and institutions to keep the governing values within acceptable ranges and *consequences*—both intended and unintended. *Consequences* are the results of actions taken, both positive and negative (Argyris & Schön, 1974).

> When the error detected and corrected permits the organization to carry on its present policies or achieve its present objectives, then that error-and-correction process is single-loop learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information and take corrective action. Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies and objectives. (Argyris & Schön, 1978, pp. 2-3)

When an individual leader or a collective leadership team encounters a problem, the initial reaction is to seek another strategy that works within the confines of the

existing *governing variables*. This experience is *single-loop learning,* or learning from a failure or mistake to reflect on additional strategies that could be employed in the future within the confines of the *governing variables* already defined. An alternative response is to question the *governing variables* themselves and subject them to critical scrutiny such that an alternate set of *governing variables* could be utilized to reframe strategies and *consequences*. This alternative is known as *double-loop learning.* (See Figure 4 for a schematic outlining the difference between *single-* and *double-loop* learning.)

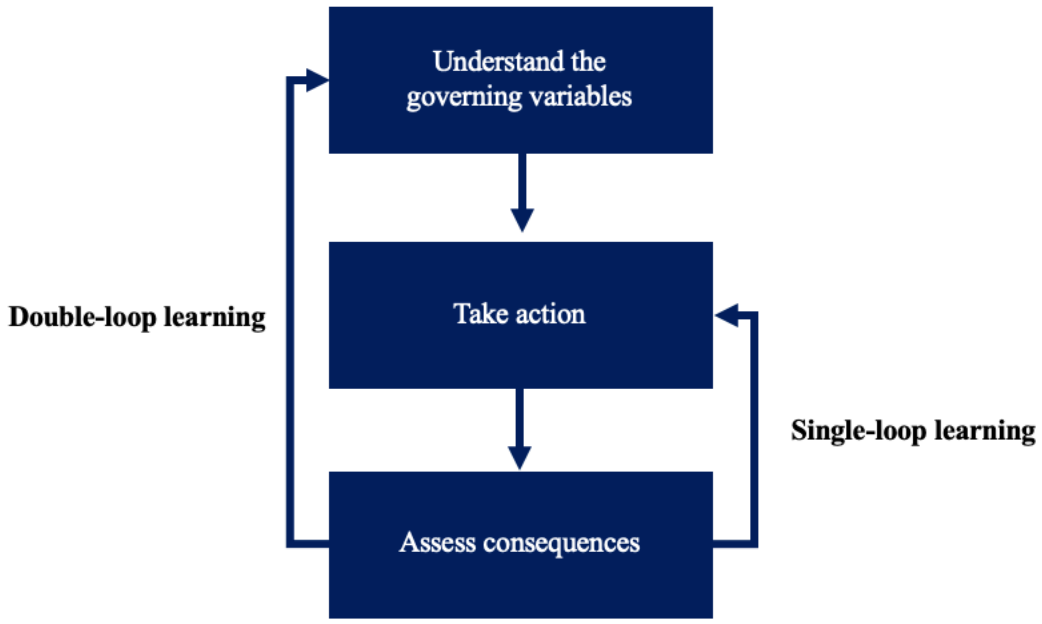

Figure 4. Chris Argyris and Donald Schön's single- vs. double-loop learning framework

In the first phase of large organizations attempting to drive learning outcomes, the objectives revolved around performing existing business processes more efficiently. Learning was about continuous improvement and aimed to reduce marginal costs. The second wave of learning and development within the organizational context focused on new product and service innovation as well as the creation of research and development.

This form of learning always existed, but technological change forced it to take place within expedited timeframes (e.g., compressed product development lifecycles). Now a third phase is unfolding in the evolution of learning within the enterprise because of the speed with which digital information is being generated, gathered, and processed. This is forcing organizations to operate at superhuman speed, while simultaneously acknowledging that other social, political, and economic activities occur on longer timescales (Reeves & Whitaker, 2018).

With the current proliferation of cognitive technologies impacting the way in which humanity interacts with machines to perform work activities, three individual learning theories—*experiential learning*, *incidental* and *informal learning*, and *single- vs. double loop learning*—offer approaches for executives looking. to scale learning outcomes across their financial services institution. By acknowledging and even appreciating the organic manner in which individual learning can transpire, institutions can become comfortable with the decentralized, non-codified nature of adapting to the increased use of cognitive technologies. Piloting these cognitive technology capabilities simultaneously, in multiple areas of the institution, in different geographical locations with distinct external systemic factors, supports the broadest and fastest form of *experiential learning* and, therefore, potential for reflection, abstraction, and further *active experimentation*, at scale.

Conclusion

Individual learning theories—be it Kolb's theory for *learning from experience*, Marsick and Watkins' *incidental* and *informal* learning theory, or Argyris and Schön's theory for *single- vs. double-loop* learning—provide a way for tangibly planning for the

operational changes underway in the financial services sector, particularly how best to lead through this period of increased collaboration between humans and machines. These individual learning theories offer suggestions for actions that leaders can take to support the workforce transition more meaningfully. This literature review discussed three primary marketplace trends that are converging: (a) the evolution of traditional financial services business models and a redefinition of what it means to be a service provider in the 21st century; (b) the rise of cognitive technologies that are rapidly surpassing and supplementing, if not replacing, human involvement in operational tasks and activities; and (c) a redefinition of the concept of work, workforce composition, and human-machine collaboration in the performance of traditional work activities. While distinct in and of themselves, these trends share some crucial overlapping components that center on changes affecting the workforce and the urgent demand for increased adaptation, learning, and behavior change. Utilizing individual learning theory as a lens through which to interpret the changes underway provides a better appreciation for how people learn from their involvement in life experiences, both individually and collectively, with opportunities for direct application for financial services leaders and their institutions as they adapt to changes in the nature of work.

The literature review suggested that while ample theoretical discussion and research have been conducted to explore each of the following individually—(a) the future of financial services, (b) the rise of cognitive technologies, (c) the future of work, and (d) individual learning theories—research that examines the intersection of all four areas is challenging to uncover. Moreover, any relevant research has not been carried out with enough depth to meet the rigorous academic criteria for trustworthiness and validity.

For instance, in the literature on the future of the financial services industry, studies have been carried out with a business purpose, for example, exploring how these disruptive trends can positively influence the industry's future business model. Patterns in the findings have revealed the increased value of cognitive technologies in evolving the business model of the sector, with a positive impact on the bottom line, and performance relative to competitors. Yet non-partisan research conducted without a profit motive is less available. Similarly, research has looked at the intersection of the rise of cognitive technologies and implications for how work activity will change—that is, how roles will evolve, and which considerations are required as a result for human capital management. But the findings do not specifically identify the kind of talent and workforce requirements the financial services sector will need over the next several years.

Despite the shortcomings of the literature, researchers generally concur that humans will be collaborating increasingly with machines to perform traditional activity-based work. The overall consensus also suggests that cognitive technologies will be used more frequently within business operations, including the sale and distribution of financial services. Finally, the literature consistently acknowledges the pace of these changes and the resulting urgency to better understand the implications of these changes for skillsets, roles, and learning requirements.

Main Gaps in Knowledge

The primary areas of uncertainty in the literature are: (a) the content at the intersection of the three marketplace trends, (b) the pace at which these trends are unfolding, and (c) access to the distinct financial services environment being explored. Only limited literature has addressed the intersection of the financial services

marketplace, the use of cognitive technologies within business operations, the impact on the future of work, and the resulting evolution of human-machine collaboration. Current research is homing in on how the financial services business model is most likely to be disrupted and what capabilities are required to compete and survive in the future. Similarly, research is progressing to more clearly understand the potential role for cognitive technologies to augment the business model and operations of various sectors of the economy. Some siloed studies are also being conducted on the concept of the future of work. However, at the present time, in-depth literature specifically focusing on the workforce in financial services and the potential value of leveraging individual learning theories—like Kolb's *experiential learning* theory, Marsick and Watkins' *incidental* and *informal* learning theory, or Argyris and Schön's theory for *single- vs. double-loop* learning—to support the ongoing collaboration of humans with cognitive technologies remains non-existent.

These gaps in the literature are partly due to how quickly these trends are evolving as well as to the need for confidentiality of access to those involved. For example, learning studies exploring how these changes are affecting the internal operations of the business in the sector require access to the leaders involved in making decisions and addressing these paradigms real time. Given the seniority of the executives involved, and the competitive sensitivity of the content being discussed, gaining access can be difficult. Additionally, conducting more comprehensive studies with larger sample sizes of longer time horizons is required, and recommended for further exploration, but has been challenging due to the access required over long periods of time to measure the

changing nature of daily activities across a large number of organizations, departments and teams.

Moreover, while current research is addressing important implications for increased human-machine collaboration, very little of what is publicly available transpires within a competitive business environment because of confidentiality issues and the real-time nature of these developments. For example, there is ample AI research underway within engineering and computer science departments at institutions like Stanford and MIT, but often is not situated within the financial services industry, nor is it integrated with other academic disciplines like public policy, psychology or communications. Consequently, the literature is vague about how entirely new platform ecosystems will disrupt existing financial services business models and how much the human-machine collaboration will be a part of driving those changes. For example, the literature only provides a cursory exploration on the types of financial services roles where cognitive technologies will augment human capability (Kao & Venkatachalam, 2018; Susskind & Susskind, 2015). Perhaps the only unanimous and solid agreement is that this will happen, and over a matter of years—not decades or centuries.

Individual learning literature is also only beginning to explore how human beings and machines can learn together and the degree to which one supplements the other (Saikia & Hazarika, 2017; Sandry, 2017). The focus thus far has been on a particular form of cognitive technology and how a limited audience (not in financial services) interacts with it (Kim, 2015). The research has not fully entered the financial services sector nor addressed the specific business processes at the center of its service delivery model (e.g., trading or investment advising). Nor are there sufficient data on emerging

trends and patterns around what is and is not working effectively (e.g., comparative studies across organizations). Some key questions for example: How does the effective (vs. ineffective) application of AI improve financial advisor quality and timeliness, and what were the differences between how AI supplemented the human advisor experience in those two scenarios? Learning literature should become more targeted on particular roles within the sector and draw comparisons across institutions and teams to demonstrate greater clarity on what is or is not having the most profound impact.

Finally, many studies on the evolution of financial services are limited because they are based largely on the perspectives of those already participating or competing in the financial services marketplace, for example research produced by the World Economic Forum, McKinsey or Deloitte. As a result, the research has overlooked ways of thinking about the phenomena from others outside of the industry—for example, from academics or public policy think tanks.

Conceptual Framework

Individual learning theory provides a way of thinking about the collaboration transpiring between humans and machines within the financial services sector, and the most impactful action leaders can take to support the workforce transition. Introduced in this literature review were three primary marketplace trends that are converging: (a) the evolution of a traditional financial services business model, and a redefining of what it means to be a financial services provider in the first half of the 21st century; (b) the rise of cognitive technologies that are rapidly surpassing human capability and supplementing, if not replacing, the need for human involvement in certain tasks and activities; and (c) a redefining of the concept of work, the composition of the workforce,

and the engagement between humans and machines in the performance of traditional work activities. These trends, while distinct in and of themselves, share some crucial overlapping components which, at the center, involve changes affecting the workforce of the financial services sector, and how those individuals learn, develop, adapt, and evolve. Individual learning theory offers a lens through which to understand and interpret how leaders are developing themselves and their teams during this period of dramatic change. (See Figure 5 for an overview of this research's conceptual framework).

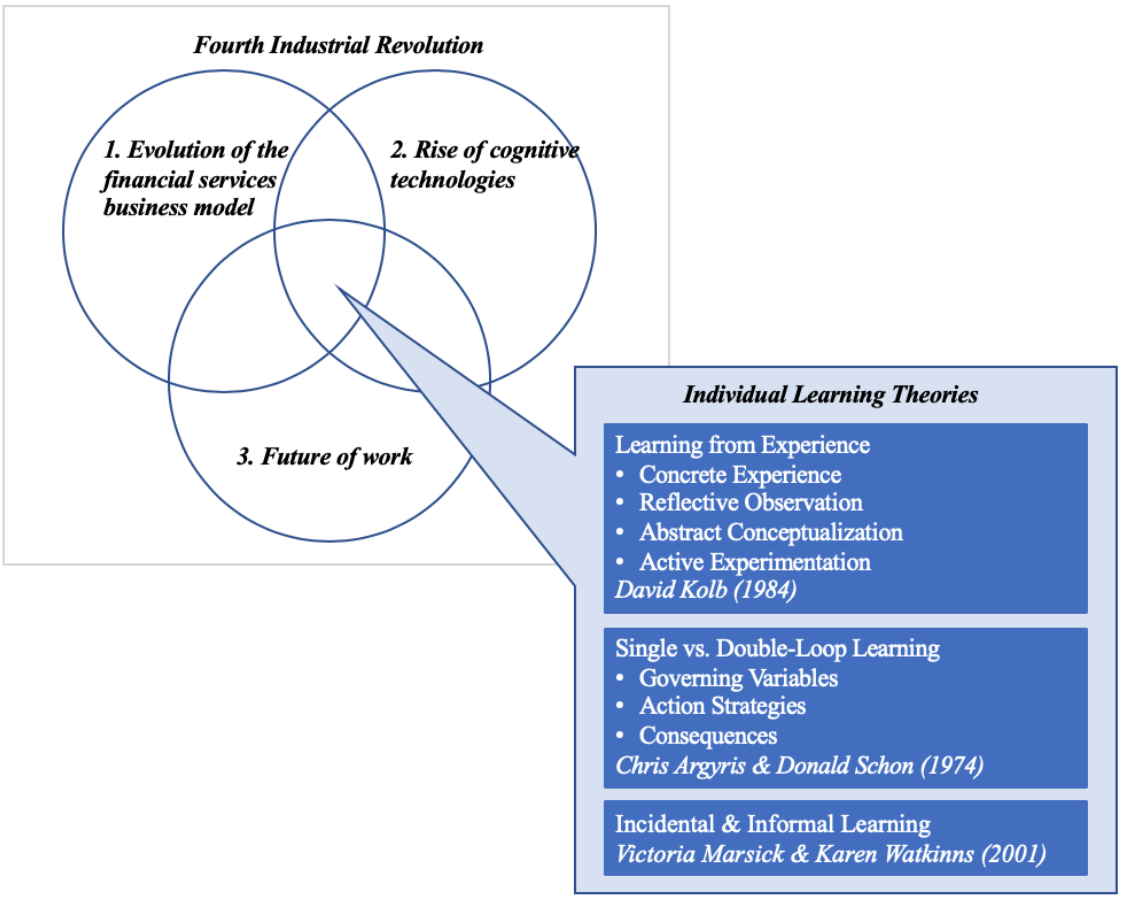

Figure 5. Conceptual framework

III—METHODOLOGY

Research Design

The research design served as a blueprint for the study and involved answering: what questions to study, what data elements were relevant, how the data should be collected, and how the data should be analyzed to understand the results (Yin, 2014, p. 29). This study utilized a qualitative research design and an exploratory interview methodology with elements of a case study, which was ideal for answering "how" and "why" questions (p. 29). Since the focus was on the experience of executives directly involved in the phenomena, qualitative research was an appropriate approach to allow for exploration of their lived experiences and common realities in their day-to-day work. "Qualitative research can give us compelling descriptions of the human world, and qualitative interviewing can provide us with well-founded knowledge about our conversational reality" (Brinkmann & Kvale, 2015, p. 55).

The primary data collection method for this study involved a survey questionnaire to classify participants and the organizations and workforces they represent. Additional data collection involved interviews in a semi-structured format to solicit more nuanced insight. Finally, a review of the involved organizations' public investor relations materials was conducted to provide insight beyond the individual leaders' perspectives, into the organizational messaging being shared. The method for data analysis was pattern matching and explanation building.

Three primary questions were explored through this inquiry process:

- RQ1: How do leaders within financial services experience the increased use of innovative cognitive technologies (e.g., RPA, AI) within the business model of the sector?
- RQ2: How do leaders understand and interpret the changes in workforce roles, responsibilities, and required skillsets as a result of the increased use of cognitive technologies?
- RQ3: How do leaders perceive the learning and development required to transition to this new human-machine collaboration model, and what obstacles are they experiencing?

Research Sample

The research utilized a sample size of 12 executives actively working within the financial services industry. Those involved were selected through both purposeful and convenience sampling—not random sampling—based on their experience level (tenure of 15+ years), level (Executive Director or Managing Director), involvement in the phenomena being explored (direct oversight for delivering on these transformation endeavors), flexibility to speak candidly about their experiences and observations, and proximity to the researcher (participants were volunteers recruited through the researcher's professional network). Exploratory interviews built on preliminary survey findings by discussing the experiences of this sample population and their perceptions of the organizations and workforces they represent.

The interview participants were globally distributed, with some based in the Americas (New York, NY; Washington, DC; Charlotte, NC; San Francisco, CA); Europe, Middle East, & Africa (EMEA) (Zurich, Switzerland; Warsaw, Poland; London, United Kingdom); and Asia Pacific (APAC) (Singapore, SG; Mumbai, India; Hyderabad, India). The setting was the financial services industry, specifically the sub-sectors of retail banking, commercial banking, investment banking, and asset management, as well as the mid-to-back office corporate functions that provide support for these large firms. This study did not include the insurance or hedge fund and private equity sub-sectors within financial services.

A handful of objectives typically associated with the purposeful sampling approach were relevant for why this was deemed the most effective data collection approach for this study.

> The first [objective for purposeful sampling] is achieving representativeness or typicality of the settings, individuals, or activities selected…deliberately selecting cases, individuals, or situations that are known to be typical provides far more confidence that the conclusions adequately represent the average members of the population…. The second goal…is the opposite of the first—to adequately capture the heterogeneity in the population. The purpose here is to ensure that the conclusions adequately represent the entire range of variation, rather than only the typical members or some 'average' subset of this range.… The third goal is to deliberately select individuals…that are critical for testing the theories that you began the study with, or that you have subsequently developed.… The fourth goal in purposeful selection…[is to] establish particular comparisons to illuminate the reasons for differences between settings or individuals.… Finally, a fifth goal…[is to] select groups or participants with who you can establish the most productive relationships, ones that will best enable you to answer the research questions. (Maxwell, 2013, pp. 98-99)

The sample population selected through purposeful sampling provided a rich source of experiences for discovery.

Methods for Protecting Human Subjects

Study participants were protected during the course of the research. This protection was controlled through a number of mechanisms, including voluntary participation on the part of the individual. Additionally, information shared was at the sole discretion of each participant (e.g., confidential information was encouraged not to be disclosed), and the findings from the interviews and survey questionnaire were summarized thematically or anonymized, and not directly attributed to an individual participant. Finally, at the institutional level, only publicly available information available on the company's website was utilized and directly attributed to that institution.

Information Needed

For validity and trustworthiness reasons, this research required the perspectives of those directly involved in leading the transformation of the financial services business model during the fourth industrial revolution (4IR). Therefore, a purposeful sample of executives with direct responsibility for operational functions was selected. Required information included the experience of these leaders and their perceptions of their organizations as they transition their workforces to the future of work in the sector. Perspectives were garnered from leaders representing several distinct institutions (headquartered in different parts of the globe), lines of business and corporate functions (revenue generating vs. support functions), and geographic locations (leaders based in APAC, EMEA, and the Americas). See Table 3 for a full presentation of information that was required for this study.

Table 3

Information Required

	Survey Questionnaire	Interview Protocol	Public Document Review
Perspectives of financial services leaders directly involved in the phenomena on their own learning, and that of their workforces	X	X	
Experiences of the workforce	X	X	
Distinct institutions	X	X	X
Distinct lines of business	X	X	X
Different geographies	X	X	X

Data Collection

The primary method of data collection for this research was a 12-question survey questionnaire (see Table 4 and Appendix B), followed by a 60-minute semi-structured audio interview (see Table 5 and Appendix C). The survey questionnaire was developed and tested as part of a field pilot exploring the future of work in financial services in the spring of 2018. It was subsequently refined based on the findings and reused in early 2019 for a second field pilot. The survey was loosely based on other similar surveys conducted by human capital professionals studying this phenomenon within global organizations (e.g., McKinsey, Deloitte). The final survey was distributed to participants as a mechanism for classification by summarizing the basic demographic data associated with the organizational environment in which each participant is operating (e.g., provide

context around the size of the organization, geographic location, scale of adoption thus far, etc.). See Table 4 for survey questionnaire details.

Table 4

Survey Questionnaire

#	Question	Answer	Type
SQ1	How large is your institution's workforce?	• 10,000-50,000 • 50,000-100,000 • 100,000-250,000 • 250,000+	Multiple choice; single selection
SQ2	How large is the workforce you are influencing with respect to cognitive technology transformation (e.g., your department and/or the functions you are responsible for)?	• <100 • 100-1,000 • 1,000-10,00 • 10,000-50,000 • 50,000+	Multiple choice; single selection
SQ3	Across approximately how many countries does your organization currently operate? *If you do not operate in a particular continent, please note.*	• <5 • 5-10 • 10-50 • 50+ [Free text field optional]	Multiple choice; single selection
SQ4	In what year did your organization begin to apply cognitive technologies to the operations of the business?	• 2010-2014 • 2015 • 2016 • 2017 • 2018	Multiple choice; single selection
SQ5	From your perspective and experience, approximately how many roles have been affected within your organization based on the application of cognitive technologies thus far?	• 0-100 • 100-1000 • 1,000-10,000 • 10,000-50,000 • 50,000+	Multiple choice; single selection
SQ6	From your perspective and experience, approximately how many roles do you think will be affected within your organization based on the application of cognitive technologies by 2025?	• 0-10 • 10-100 • 100-1000 • 1,000-10,000 • 10,000-100,000+	Multiple choice; single selection

#	Question	Answer	Type
SQ7	What type of cognitive technologies are the most prevalent within your department and/or function(s)?	• Robotic Process Automation (RPA) • Machine Learning • Deep Learning • Natural Language Processing (NLP) • Sensors, Device Connectivity and the Internet of Things (IoT) • Other form of cognitive technologies and artificial intelligence (AI) [Insert Name]	Multi-select; rank top 3
SQ8	What type of cognitive technologies are the most prevalent within your organization?	• Robotic Process Automation (RPA) • Machine Learning • Deep Learning • Natural Language Processing (NLP) • Sensors, Device Connectivity and the Internet of Things (IoT) • Other form of cognitive technologies and artificial intelligence (AI) [Insert Name]	Multi-select; rank top 3
SQ9	What are the most frequent barriers to cognitive technology adoption?	• Lack of clear AI strategy • Lack of talent with appropriate skillsets • Lack of leadership ownership and commitment • Lack of technological infrastructure • Functional silos constraining end-to-end solutions • Lack of available data • Under-resourced • Limited relevance of insights gained from AI • Uncertain or low expectations for return on AI investments	Multi-select; rank top 3
SQ10	How are you sourcing AI capabilities (e.g., building in-house and retaining employees)?	• Building AI capabilities in-house • Partnering with businesses or others (e.g., academic institutions) to find talent • Buying or listening capabilities from large technology companies • Retraining or upskilling internal talent • Buying capabilities from AI-focused startups • Crowdsourcing AI capabilities • Buying capabilities from professional services or system integrator firms • Acquiring other companies • Hiring external talent	Multi-select; rank top 3

#	Question	Answer	Type
SQ11	What is the scale of human collaboration with cognitive technologies in your organization?	• Very high (most roles) • High (more than 50% of roles) • Moderate (Some roles, in an organized way) • Low (Some roles, but ad-hoc and inconsistent) • Very low (minority of roles)	Multiple choice; single selection
SQ12	What are the top three things your organization will do next to enable more effective human-machine collaboration to scale cognitive technology?	N/A	Free text

Upon completion of the survey, participants were scheduled for interviews which were recorded for transcription and data analysis. A semi-structured interview protocol (see Table 5) was utilized as the field instrument to help ensure levels of validity, reliability, and trustworthiness (Bastos, Duquia, González-Chica, Mesa, & Bonamigo, 2014). The interview protocol was originally developed and utilized in the spring of 2018 for a field pilot with a select set of financial services executives and was refined accordingly. The revised version was utilized for a second field pilot in early 2019 before being finalized for this study. Questions in the interview protocol were intentionally sequenced both for substantive reasons (e.g., to progress from the more fundamental to the more complex) and for ease of use (e.g., allowing for the building of rapport). By moving from more generic to more precise questions, a degree of trust was built around a common foundation of dialogue from earlier questions (Leech, 2002).

Table 5

Interview Protocol

#	Question
IQ1	What is your experience of adopting and adapting to major cognitive technology disruptors changing the nature of the business (e.g., AI, RPA, machine learning)?
IQ1a	What are two the most significant moments you (and your team) have had learning to work with cognitive technologies in new ways?
IQ1b	What learning experiences from having collaborated with machines will you most carry forward to utilize in the future?
IQ1c	What partnerships, internally or externally, are you leveraging as a leader to address this challenge (e.g., supplier partnerships)?
IQ2	What particular areas of the business (e.g., front-office revenue generating, back-office operations) have been most affected to-date?
IQ2a	What types of work activity are you experiencing is being impacted most beneficially from the application of cognitive technologies?
IQ2b	In those examples you've just cited, what kind of increased human-machine collaboration is your department/ institution experiencing?
IQ2c	In what ways are you collaborating collectively with other leaders within your organization to address the transformation underway?
IQ3	How experienced is your workforce with respect to the major technology disruptors affecting the business (e.g., RPA vs. machine learning)?
IQ3a	How have the skillsets required evolved since adopting cognitive technologies?
IQ3b	How have the roles and responsibilities of your workforce changed since adopting cognitive technologies?
IQ3c	What has been your experience as a leader witnessing these changes in workforce skillsets and roles?
IQ4	How have you supported the workforce learning required to enable the transition?
IQ4a	What are two or three of the more significant efforts your leadership team has undertaken to assist in greater levels of adoption and human-machine collaboration?
IQ4b	What are some of the primary constraints and challenges your leadership team has encountered while supporting the workforce through this transition?
IQ4c	What kinds of new learning tools, approaches, methodologies are needed to support the new demands for adapting to increased human-machine collaboration?

In addition to the survey questionnaire and interview protocol, a third data collection method was leveraged to gain insight into the research problem. This involved a review of publicly available investor relations materials that discussed the institution's perspective on cognitive technologies and how/where they had been successfully adopted. Investor relations commentary was gathered directly from each institution's website, after individual leader survey and interview data was gathered. The publicly available investor relations information served as a valuable point of comparison to the perspectives shared through individual leader interviews and questionnaire results. See Figure 6 for an overview of the three data sources utilized to triangulate findings; numbering represents the order of data collection.

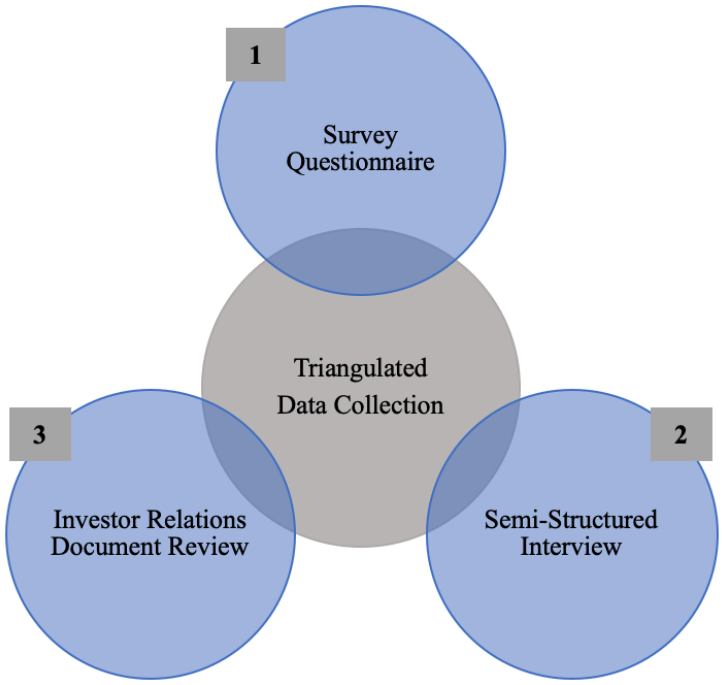

Figure 6. Triangulated data collection

Purpose for Instruments

The survey questionnaire utilizing 12 largely multiple-choice questions was used as the primary instrument for data collection, to allow for effective categorization and classification of participants and their organizations. Data collected through the survey helped provide the broader macro environmental context within which the experiences shared by leaders were unfolding and allowed for a more direct comparison of participants (e.g., leaders based in the United States vs. those working in other geographies).

Supplementing the survey questionnaire results with an interview protocol afforded the ability to gain greater depth and nuance around each individual's experience, and what is unique about their organization, line of business, and workforce. Semi-structured interviews also allowed for follow-up questions and probes. This was important in the design to allow for dynamic dialogue when items raised by the interviewee warranted further exploration. Additionally, the review of external facing investor relations materials demonstrated how leaders of these organizations were articulating what was transpiring externally, as compared to their more personal reflections shared during the interviews.

Data Analysis and Synthesis

Upon completion of data collection through the survey questionnaire, interviews, and a review of public investor relation materials, the researcher utilized several processes for analysis. The survey questionnaire was analyzed through frequency tabulation, noting the percentage of respondents answering in a particular manner. The

qualitative interviews and investor relations websites were analyzed using the process of coding to categorize the data.

> Generating names and labels for phenomena identified in the data—themes, categories—is coding. Coding is the representation of analytic thinking; it is not analytic thinking itself…. [The] open coding process is similar to immersion in the data, where ideas bubble up and are noted…. While coding, the researcher develops conceptual categories and explores their definitions and meanings.… [The] codes are clustered around points of intersection, or axes. (Marshall & Rossman, 2016, pp. 222-223)

This research utilized a standard qualitative research methodological approach for coding. Coding is typically conducted in several iterations, including during the data collection process itself (Miles, Huberman, & Saldana, 2014, pp. 71-93), and the researcher followed multicycle coding processes. Codes were established based on David Kolb, Chris Argyris, Donald Schön, Victoria Marsick, and Karen Watkins's learning theories, and refined as the researcher reviewed the raw data. These codes would be iteratively utilized to review the transcripts. For example, the components of David Kolb's experiential learning framework (*concrete experience* [CE], *critical reflection* [CR], *abstract conceptualization* [AC] and *active experimentation* [AE]) were each used as categories for coding the transcriptions.

One of the benefits of coding was that it afforded the researcher an ability to find and cluster segments of the interviews, questionnaire results, and public document content quickly and in a way that themes, hypotheses, and other conceptual constructs became clear. Codes also had the benefit of being prompts or triggers for greater reflection and analysis by the researcher (p. 73). This research utilized a combination of *descriptive, in vivo,* and *process coding* during the first cycle (pp. 74-75). Descriptive coding was utilized to cluster what executives shared thematically. In vivo coding was

utilized to preserve the integrity of the interviewees' own words, which helped shape an understanding of where there were consistent phrases and manners of approaching the phenomena at hand. Finally, process coding was utilized to understand if the actions and behaviors manifesting within the interviewees' respective teams and organizations were similar or dissimilar.

For the second cycle of coding, the researcher utilized *pattern coding* or *pattern matching* to elaborate on the map developed during the first cycle. This helped extend beyond the preliminary formation of relationships between conceptual ideas into a more integrated whole. Pattern coding also allowed for cross-case analysis, examining each individual leader's experience and organizational entity. For example, are leaders within the same organization experiencing the same things? How do their experiences differ from leaders in other organizations? Pattern coding was used to test the logic of the individual experience against an empirically based pattern that was identified before and during data collection, specifically what the literature suggested. The researcher also utilized *explanation building* as a specific type of pattern matching, where the goal was to build an explanation about the case—establishing causal links and answering "how" and "why" questions (Marshall & Rossman, 2016). Unfortunately, developing more in-depth cause-effect relationships were not possible without larger sample sizes.

Limitations and Delimitations

Conducting exploratory interviewing research, with elements of a case study, was useful by allowing for a focus on the perceptions, attitudes, and meaning schemas of participants. Yet it also had the possibility for response bias. Bias is possible directly because of the participants' own innate preferences and reactions to the manner in which

interview and survey questions were framed and/or because of the interviewee's desire to provide the interviewer with what he or she wants to hear (Yin, 2014, p. 106).

> Limitations derive from the conceptual framework and the study's design…. [It is a reminder of what the study] is and is not—its boundaries—and how its results can and cannot contribute to understanding. Framing the study in specific research and scholarly traditions places limits on the research. A discussion of these considerations…[is a reminder that] the study is bounded and situated in a specific context. (Marshall & Rossman, 2016, p. 85)

The study was also limited due to the nature of its participants. The participants in the study were those within the financial services industry with whom the researcher had an opportunity to work over the course of her professional career. Those participants also voluntarily agreed to participate. The audience therefore had a vested interest in the continued maintenance of the professional relationship and the success of the financial services sector. These facts allowed for the potential of skewed findings which supported the participants' and/or the researcher's agenda. To mitigate this risk, the findings are presented as the explicit perspective of those holding particular positions to avoid generalization. Additionally, the researcher's own bias has been transparently articulated given her own professional role and interest in the topic being studied.

One of the benefits of qualitative data is that the information can be collected naturally with confidence, due to its local groundedness. All of the participants were in close proximity to the specific situation. They were therefore bounded in a case study transpiring within their industry and organization. The emphasis on the local context was not stripped away but instead taken into account, supporting the identification of latent, underlying, and nonobvious aspects of the experiences being studied (Miles et al., 2014, p. 11). This was particularly crucial to support the richness and vividness of the findings.

Finally, investor relations materials utilized in the study were limited based on their availability and accessibility. Certain institutions had content on the topic being explored readily available, while others did not. So only available content could be used to shape the narrative. Therefore, findings from the document review have the potential for bias based on accessibility (e.g., how easy to access for the public) and availability (e.g., is there any content publicly available).

IV—FINDINGS AND ANALYSIS

Introduction

The findings from this study were categorized into four primary areas: (a) the ways in which the financial services industry is adopting cognitive technologies in the 4IR, (b) the role leadership is playing in accelerating financial services business model transformation, (c) the type of workforce readiness efforts underway, and (d) opportunities for broader societal change. The first set of findings revolve around the manner in which cognitive technologies are being adopted within the financial services sector in 2019, including variability of impact depending on geography, line of business, and type of technology. These findings trace the implications of these changes on the. redesign of work, roles and jobs.

The second set of findings revolve around the role of financial services leaders during this period of significant business model transformation. Leaders are unclear about the potential value of different forms of cognitive technology, and this ambiguity has led to a lack of alignment and clarity around how best to deploy them. Furthermore, this ambiguity has led to a lack of alignment between these organization's cognitive technology adoption strategy, and their workforce strategies.

The third set of findings focus on the kind of skillsets required in the new operating environment, and the preparation underway to support the financial services workforce develop these capabilities. There has been a shortage of critical skills available in the labor pool over the past decade to support the growing demand within financial services, and the gap between supply and demand appears to be getting worse. A large

number of roles within the industry continue to go unfilled because of gaps in talent supply, despite decades of growing demand. Yet workforce reskilling is only happening for limited roles and for select capabilities and is not being led in a systemic enterprise- or industry-wide manner.

The fourth set of emergent findings offer areas of additional opportunity beyond the financial services sector. Despite societal demand for skills that have been in short supply for well over a decade, the formal education system does not appear to have flexed or adjusted effectively enough to prepare successive generations. Additionally, the transformation underway due to the use of cognitive technologies in the 21st century is not only creating a new paradigm for the future of work in financial services but is bringing dramatic change to all sectors of society—from retail to healthcare. This type of societal change requires a substantial re-evaluation of public policy and the infrastructure investment that supports it.

Overall, the findings suggest the biggest challenge for financial services leaders during the 4IR is the degree of disruptive business model change at a pace and scale unlike prior periods. There was widespread acceptance of the long-term value of these changes for all involved stakeholders, yet executives recognized systemic workforce readiness efforts are not fully in place, nor are they effectively aligned with the business strategy to support the extent of transformation. This chapter is organized around each of the four sets of findings, providing detail on each. The chapter opens first with a review of the sample population involved in the study and concludes with a recap of the findings.

Description of the Sample

This study was situated in 2019, a period characterized by dramatic societal transformation due to advances in disruptive technologies. The study was further situated within the financial services sector, and the experience of executive leaders working within large global banking institutions (e.g., retail banks, investment banks, commercial banks, and asset/wealth management firms). Within the confines of these large global banking institutions, the study focused on the experience of 12 senior executives with Executive or Managing Director titles and at least 15 years' experience leading through this period of industry transformation.

Participants in this study were selected based on their roles as senior executives leading business model transformation within the financial services industry. Participants had to be working within large institutions of at least 40,000 employees and at least $300 billion in assets under management (AUM). Participants were also selected based on their current responsibilities as leaders accountable for transforming the operations of their firm through the use of cognitive technologies (see Table 6 for an overview of participants).

Table 6

Overview of Participants

Participant	Location	Age	Gender	Operational Responsibilities
Jim	Mumbai, India (APAC)	40s	M	Mid-Office
Don	New York, NY (AMER)	50s	M	Mid-Office
Kathleen	Singapore (APAC)	50s	F	Back-Office
Curt	New York, NY (AMER)	30s	M	Back-Office
Adam	Hyderabad, India (APAC)	30s	M	Mid-Office
Matt	London, United Kingdom (EMEA)	30s	M	Front-Office
Harry	Washington, DC (AMER)	40s	M	Front-Office
Susan	Charlotte, NC (AMER)	50s	F	Mid-Office
Robert	Zurich, Switzerland (EMEA)	40s	M	Back-Office
James	Warsaw, Poland (EMEA)	30s	M	Back-Office
Sally	San Francisco, CA (AMER)	40s	F	Front-Office
Sam	London, United Kingdom (EMEA)	40s	M	Front-Office

Participants were intentionally selected from multiple geographic regions representing the Americas (50%); Asia Pacific (APAC) (25%); and Europe, the Middle East, and Africa (EMEA) (25%) to avoid location bias, e.g., U.S.-centric perspective (see Figure 7 for the geographic location of participants).

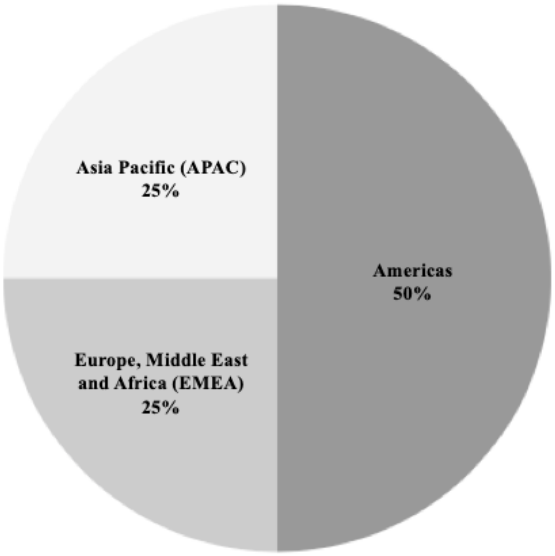

Figure 7. Geographic location of participants

Participants were 75% male and 25% female. Finally, participants were selected to represent various parts of the business, from the front-office with revenue-generating responsibilities like investment management, trading, and retail banking (33%); to the mid-office like operations, treasury services, and collateral management; to the back-office support functions like finance, technology, and human resources (67%) (see Figure 8 for the operational responsibilities of participants).

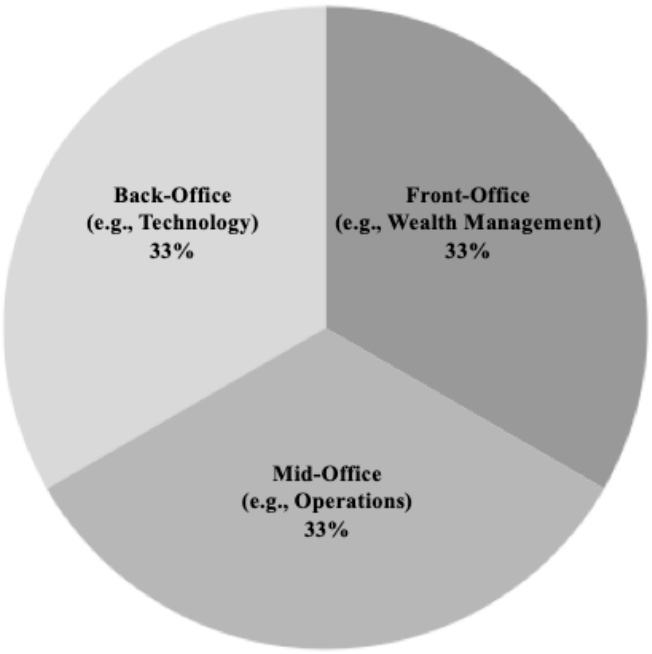

Figure 8. Operational responsibilities of participants

All participants were part of the researcher's professional network. In total, 12 senior executives participated in this study, as summarized in Table 6.

The institutions represented by participants in this study are leading global banks, with multiple lines of business (e.g., retail banking and investment banking), and operate in every region of the globe (APAC, Americas, and EMEA). Participants represent eight distinct organizations (see Figure 9 for institutional representation of participants).

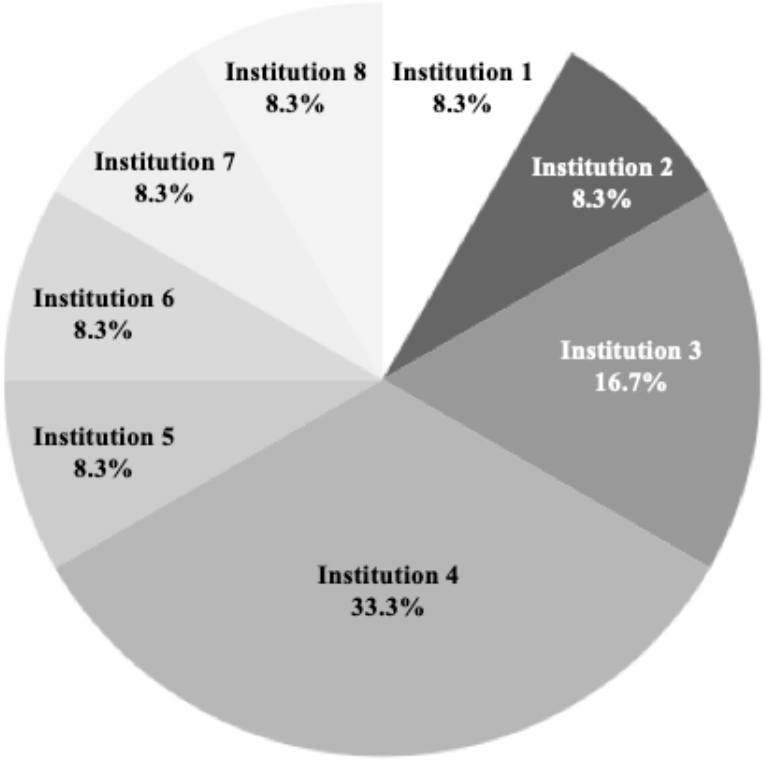

Figure 9. Institutional representation of participants

Five of the eight institutions have global headquarters in the Americas and three institutions have global headquarters in Europe. This diversity offered perspective on how various financial institutions with a global presence have addressed the phenomena similarly or differently. Table 7 provides a summary of the institutions represented by participants in this study.

Table 7

Institutional Demographics

Institution	Assets Under Management (AUM) (Approximate)	Workforce Size (Approximate)
Institution 1	2.5 Trillion	250,000
Institution 2	2.5 Trillion	200,000
Institution 3	350 Billion	50,000
Institution 4	750 Billion	45,000
Institution 5	375 Billion	50,000
Institution 6	950 Billion	60,000
Institution 7	1.2 Trillion	80,000
Institution 8	1.9 Trillion	260,000

Adapted from content available on Wikipedia as of March 2019

It is important to note that while APAC-headquartered financial institutions were not included in this study (e.g., executives from the Bank of China or the Bank of India), the researcher reviewed public documents from these financial institutions and included in this study leaders from European and American institutions based in APAC (Singapore, Mumbai, and Hyderabad), as noted in Table 6.

Overview of Findings

Findings from the study provide insight into the original research questions. Organized around four primary themes, the findings represent topics the majority of participants discussed as part of their survey and interview responses. Table 8 provides a summary of the percentage of participants that addressed each finding as part of this study.

Table 8

Overview of Research Findings

Research Question	Finding	Respondents *(Sample = 12)*
RQ1: How do leaders within financial services experience the increased use of innovative cognitive technologies (e.g., RPA, AI) within the business model of the sector?	**Finding 1:** Industry Adoption a) Early stages of value generation b) Full potential remains elusive c) Variability of impact d) Ecosystems, partnerships and platforms e) The redesign of work, roles and jobs	 a) 100% b) 83% c) 100% d) 50% e) 100%
RQ2: How do leaders understand and interpret the changes in workforce roles, responsibilities, and required skillsets as a result of the increased use of cognitive technologies?	**Finding 2:** The Role of Leadership a) Overcoming ambiguity b) Creating talent strategy clarity c) Supporting symbiotic human-machine collaboration	 a) 100% b) 100% c) 83%
RQ3: How do leaders perceive the learning and development required to transition to this new human-machine collaboration model, and what obstacles are they experiencing?	**Finding 3:** Workforce Preparedness a) In-demand skills b) Systemic reskilling	 a) 100% b) 100%
	Finding 4: Societal Opportunity a) Rethinking education b) Refreshing public policy	 a) 75% b) 75%

Finding 1: Industry Adoption

The first set of findings revolve around the manner in which cognitive technologies are being adopted within the financial services sector in 2019 and associated implications and learnings for industry executives.

Finding 1a: Early Stages of Value Generation

The application of cognitive technologies within financial services—from more fundamental robotic process automation (RPA) to more sophisticated artificial intelligence (AI) and machine learning—is still in its infancy, with the earliest use cases emerging in 2016 (see Table 9). Yet the impact for organizations, customers, and shareholders has already been profound.

Table 9

First Application of Cognitive Technology within the Organization (Sample size = 12 Executives)

2014 or earlier	0.00%	0
2015	7.69%	1
2016	53.85%	7
2017	30.77%	4
2018	7.69%	1

The onslaught of technology disruption has made it clear that the future of the sector involves technology-driven business model transformation, and many leaders explicitly acknowledge this in their comments to shareholders and investors (Bouée & Warner, 2018; Dimon, 2019a; Fairbank, 2018).

In 2019, all leaders involved in this study confirmed that financial services organizations are only a few years into the transformation of their business model through the use of increasingly sophisticated technologies. An executive participating in this study, explained this in an interview:

> Options traders spend a significant percentage of their time hedging their book—essentially reducing the risk in the portfolio through derivatives. This is a time-consuming effort and can cut into time spent with sale people and clients to generate and execute trades. However, traders sit on large amounts of data that if used properly, could help them hedge much more efficiently. We launched a tool that uses statistical and machine learning based techniques to look across multiple historical scenarios to find what to trade to best hedge an option portfolio. By exploring a side project to see how to apply traditional cash-oriented statistical approaches to portfolio risk, cost and expected performance in the options market, we experimented for a while mainly out of intellectual interest until we figured it out. By testing statistical regression models and applying it to the vast amounts of historical market, pricing and trade data, we started to identify patterns and make suggestions for hedging. (Harry)

In part, it has taken some time to realize the potential of these capabilities due to the maturity of the market. Yet as AI and robotics have matured, the ability for financial services firms to source them in the marketplace for application to internal business activities has grown. Furthermore, unlike past advances in artificial intelligence which were incremental, the practice and science of AI is poised to advance significantly over the next decade due in part to advances in adjacent enabling technologies.

Enabling technology advances in recent years now provide both the volume of data required for algorithms to be effective and the cheap high-speed, high-volume processing power required to compute at the scale and pace needed. Additionally, those leading the development of AI solutions in 2019 within financial services are software engineers and technologists, not purely academics; thus, what is being built is more

practical, solving real-world use cases. This is promising for leaders in the sector, as an executive interviewed in this study, Matt indicated:

> We launched a RoboTrader that seeks to improve pricing and hedging using machine learning at a lower cost to the firm. The original prototype was created in late 2017 and moved to an alpha model in 2018, and as we sit here talking today in 2019, it is now using historical data to continually improve. (Matt)

Over 75% of executives in this study (sample size of 12) indicated that over the past couple of years, they have made progress driving greater enterprise governance over critical aspects of how these applications are utilized. Participants described similar approaches where their organization identifies hundreds of potential use cases across different business processes and functions, to see which make it all the way from prototype to production. Pilots have been critical, as many ideas do not progress into tangible solutions. Therefore, while the participants acknowledged that their organizations have deployed cognitive technologies like AI, RPA, and NLP in particular lines of business or corporate functions successfully over the last few years, they still felt their organizations could put in place additional foundational practices to scale effectively. Kathleen provided insight into this:

> While we have hundreds of machine learning models within our firm, we can't compete with Google and Facebook who are running tens of thousands. They have embedded machine learning into everything they do, and we are not there yet. (Kathleen)

One executive, Don, cited how his organization made enterprise improvements to scale cognitive technologies when they established firm-wide design requirements. In his case, it involved utilizing the same RPA platform for all development activities globally—the platform Blueprism™. Another executive, Adam, cited how the move toward greater enterprise oversight centrally was a pivotal moment for their firm to move

in a more cohesive direction. It allowed teams in different geographic locations and different parts of the business to utilize a common platform, a common taxonomy, common vendor partnerships, and common ways of working. Over time, it also had the benefit of building very specialized skillsets within the workforce around a particular capability.

Another participant, Harry, discussed how his organization is attempting to become even more effective at utilizing lessons learned in one part of the business to apply in another. One executive, Susan, cited a successful instance where machine learning, which was built to support tax activities within Corporate Finance, was then leveraged for a similar business process within Account Management. This suggests that the advances made in taking an enterprise-wide approach to cognitive technology governance over the last few years have made a difference in quickening the pace of adoption.

Ultimately, executives indicated financial services firms are finding increasing success in transforming their business through cognitive technologies and are beginning to capitalize on the additional value. They also adamantly believe technology is the future of financial services and this is only the start of more significant changes ahead. However, given the pace at which these technologies are evolving, leaders are keenly aware that their institutions have not yet identified the best ways to balance competing demands for pace, efficiency, and controls. They recognized the need for enhanced enterprise-wide oversight and believe in the constant cycle of investment-based experimentation to uncover where the next best opportunities exist.

Finding 1b: Full Potential Remains Elusive

While approaches for applying cognitive technologies have extended beyond preliminary project-based piloting efforts in 2016-2017 to more structured and deliberate investment opportunities in 2018-2019, delivering on the full promise of cognitive technologies remains elusive. All of the financial services leaders in this study acknowledged that the impact cognitive technologies have already had is noticeable and impressive, with the volume of successful applications extending beyond preliminary pilots in 2016-2017, toward larger business process transformation in 2018-2019. However, the majority of executives (83% of the 12 participants) struggled to reconcile that while they saw greater opportunity for disruptive technology to improve the sector's growth and productivity, the pace and scale of implementation were overwhelming (see Figure 10 for the most frequent barriers to cognitive technology adoption per survey findings).

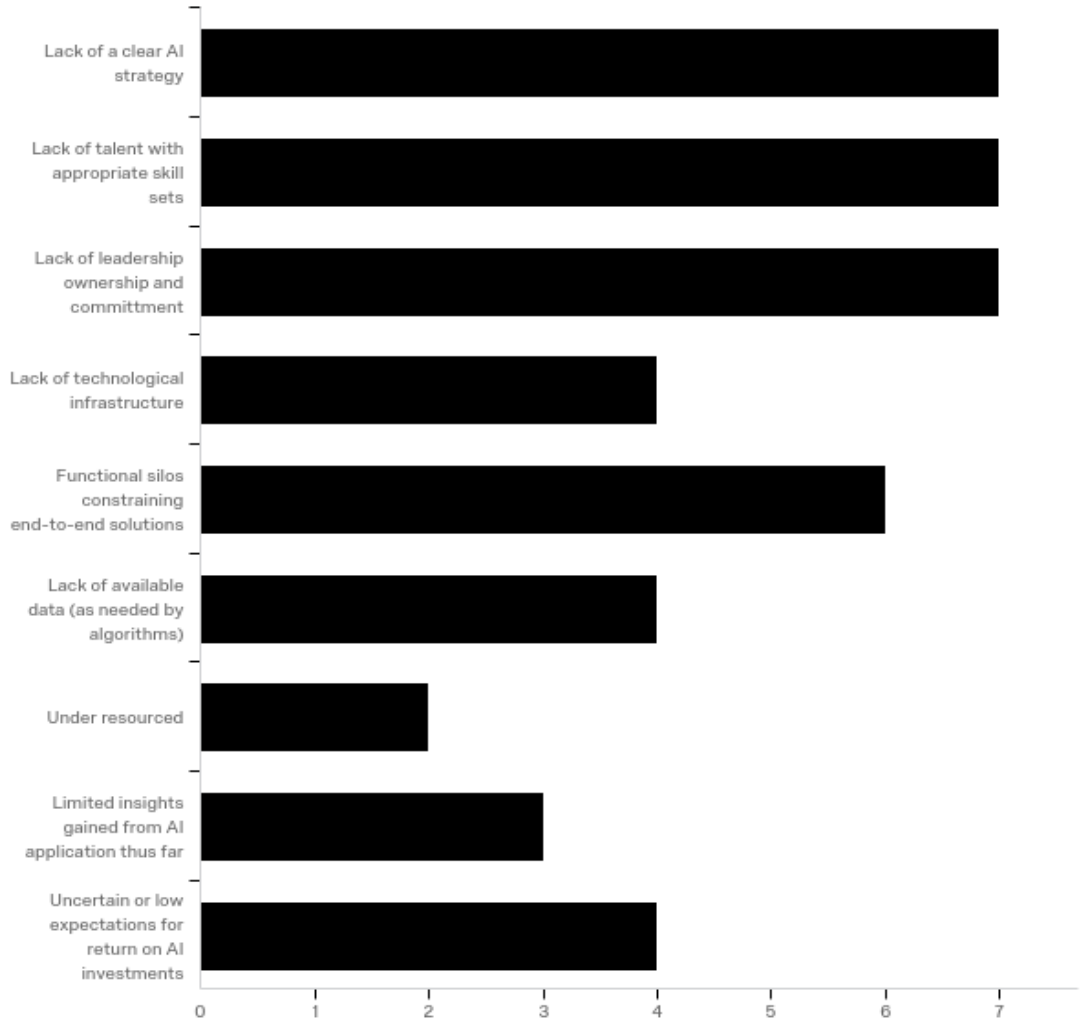

Figure 10. Most frequent barriers to cognitive technology adoption

Executives interviewed indicated that their leadership teams were developing more familiarity with these capabilities and investing the capital required, but the emphasis during the first couple of years was to invest in more straightforward automation outcomes, most notably robotic process automation, as a means of experimenting with "safe bets" that offered clear returns on investment (ROI). RPA was seen as a good example of a more incremental progression from earlier forms of process automation, lean six-sigma process re-engineering, and business model transformation during the 20th century. This form of RPA-driven business restructuring results in the

replacement of human labor with software and is a much more familiar model of gaining efficiency in the business.

The replacement of human service desks in corporate functions by automated chatbots was an example that was raised by 83% of the executives involved in the research (sample size of 12) as prevalent across their financial institutions in 2019. Yet success with these pilots has led to a desire to expand toward even more sophisticated cognitive technologies like AI and IoT that can extend value generation within the business even further. For success in this next wave of business model transformation, executives indicated that establishing a more common understanding of each technology's potential would allow leadership teams to align more collectively around priorities.

Another constraint noted by several executives was the degree to which the financial services industry is regulated. As organizations strive to move forward with 4IR emerging technology solutions, they are often confronted with a host of ethical challenges, which have business as well as societal ramifications (e.g., data privacy). As a couple of participants (Don, Jim, and Adam) explained, even with the development of increasingly powerful algorithms that can process patterns in data and autonomously reach decisions, some are uncomfortable from a public policy standpoint with a machine operating entirely without human oversight. When the decision will impact a human customer, for instance, turning down someone for a loan or mortgage, many believe there should be a level of human subjective oversight. While these industry-level governance decisions over the use of cognitive technologies in financial services are still in their nascent stages and being debated at the time of this study, it is possible cognitive

technologies may never fully replace human involvement, but instead require new symbiotic ways of working between humans and machines.

One leader, Harry, explained how his firm processes approximately 40 million checks daily, making the identification of check fraud with speed and accuracy a critical business challenge. He explained how his leadership team considered the ways in which cognitive technologies could address the situation. In part, they were challenged because accurate image-processing was a form of AI that took longer to become readily available. Through trial and error as well as enhancements in optical image processing, their consumer bank was able to develop a new machine learning model to flag potentially fraudulent checks. Utilizing object detection, the new capability focused on important components within the check, including the signature, payee, and serial number. Signatures were verified against images from the bank's existing database on the consumer's history, assigning a score based on patterns and irregularities from images, and if the score hits a certain threshold, the check gets escalated to a fraud team for human review. The machine learning model, which was deployed in 2019, is expected to save the firm $5 million or more per year.

This type of human-machine interaction requires a new level of design thinking from leaders: to identify the ways in which machines can increasingly supplement and complement key business activities, without entirely removing human involvement for oversight. Half of the leaders interviewed explained that the extent of financial regulatory requirements by jurisdiction also means that the industry has a unique set of challenges when adopting cognitive technology relative to other sectors. This is particularly pronounced when compared to technology firms that have faced fewer regulatory

expectations historically (albeit this is changing) and whose business model is already digitally native (e.g., Amazon, Google, Netflix).

> Our use of artificial intelligence is fairly controlled. I don't see that changing significantly over time. We have highly technical Finance and Engineering experts that oversee the use and application of our algorithms to ensure that the results generated don't deviate significantly from what would be expected had they not been utilized. Unless of course we can trace all the reasons why the result is different. This ability to 'see inside the black box' is critical for us, and for our regulatory partners. So, the capabilities don't become so complex no one utilizing them truly understands them. (Sam)

The positive news from all executives interviewed was that their institutions are having increasing success, despite these constraints, and there was a general sense of optimism and excitement about what lies ahead. For example, while regulatory and compliance requirements are high within financial services, AI advancements in compliance and risk mitigation can help. Areas like fraud detection, capital optimization, and portfolio management which all reduce risk to clients, shareholders, and the solvency of the institution are early examples where cognitive technology has had an impact.

One research participant, James, explained how a first-time wealth management customer at his institution can open an investment account in 3 minutes by mobile phone rather than spending time at a branch signing a ream of documents. Underlying this capability is powerful technology that can scan and interpret volumes of data at a speed unparalleled by human labor. At another institution, Sam explained how an institutional investor can now benefit from software to scan myriad financial reports to locate companies likely to issue more debt or equity, saving hundreds of hours of human labor while simultaneously providing a more thorough and rigorous output. Another interviewee explained how his institution is using natural language processing (NLP):

> Natural language processing is helping augment an investment manager's research, helping to interpret management sentiment during earnings calls and predict a company's future performance, by parsing sell-side reports for wording to gauge changes in analyst projections, and by sifting through volumes of unstructured data like blogs and news reports to identify trends and potential investment ideas. (Matt)

Application of these algorithms toward a common business activity helps investment analysts save time and uncover insights they would otherwise overlook.

Ultimately, nine of the leaders interviewed were still uncertain about how best to approach scaling adoption beyond their early successes, despite believing in its potential. They felt success with AI is heavily dependent on getting the execution right, from developing an effective strategy, to pursuing the right use cases, to building the right culture that cultivates experimentation, yet were unclear which type of technology will have the most impact for a particular business process, and how quickly they will get to a place where there is a tangible efficiency or financial gain. Since ambiguous outcomes are often not rewarded in the short- to-mid-term business cycle, hesitancy lingers when it comes to the more cutting-edge, potential opportunities. Meanwhile, more explicit opportunities with tangible return on investment (ROI) have increasingly been addressed, leaving a more complex set of business activities remaining.

All executives interviewed realized that solely focusing on a particular type of disruptive technology was not sufficient to address the diverse ways in which the business could be transformed due to the potential of these technologies in their totality. Not only is a strategy needed that assesses all of the capabilities individually, but also analyzes their dependencies and synergies. Advances in one technology may increase the capability of another with which it interacts; for example, as quantum computing emerges, the power of big data and analytics grows exponentially. This leaves a complex

landscape for leaders to navigate. The opportunity for leaders is to establish a more cohesive understanding for the strategic implications associated with the entire suite of technologies, not just each individual capability, will support their ability to implement impactful changes at the pace and scale required.

Finding 1c: Variability of Impact

All of the executives involved in this study indicated there is variability in which types of cognitive technology are having the greatest impact on the sector. Impact varies depending on the part of the business (e.g., front- vs. mid-to-back office), geographic location (Americas vs. APAC), type of technology (RPA vs. machine learning), and way in which the technology is enabled (e.g., data required for certain machine learning capabilities can only be utilized with powerful compute capabilities in the cloud). Refer to Figure 12 for rankings of cognitive technology prevalence from participants in this study. This may be interpreted based on the color-coded legend. The horizontal axis represents the number of participants who responded with that ranking, and the vertical axis represents the ranking itself. For example, RPA, in green, was ranked first by six participants, machine learning was ranked first by five participants, and IoT was ranked first by one participant. This gives all 12 executives' perspective on which of the technologies was the single-most prevalent within their institution—ranked first—and provides the next most frequent, all in ranked order.

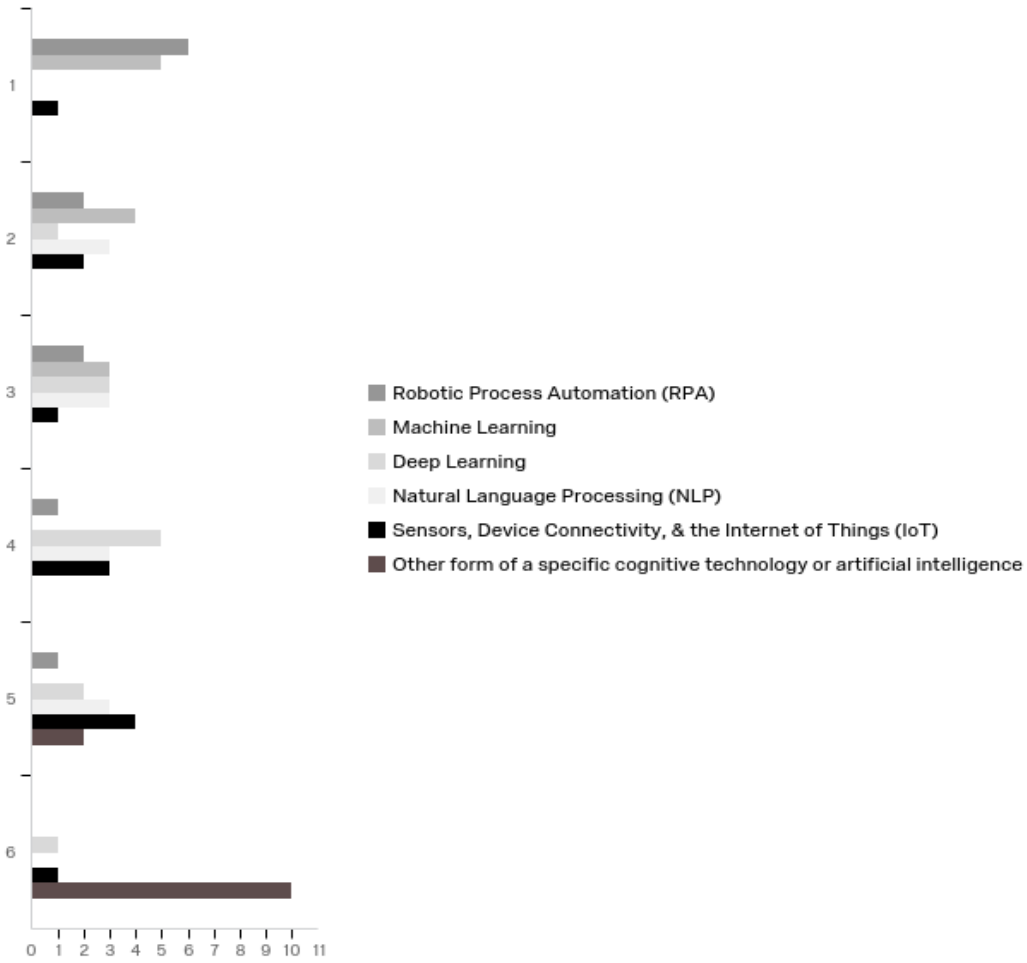

Figure 11. Forced ranking of cognitive technology prevalence
(Sample size = 12 executives)

In 2019, cognitive technologies are at varying forms of maturity, and their impact on the operations of a business varies by industry. Some forms of artificial intelligence like machine learning and natural language processing are having a profound effect within financial services quickly, where other forms of AI like those driven by optical capabilities are taking longer to apply. Additionally, participants explained how the type of cognitive technology having the greatest impact varies depending on the part of the business (e.g., front-office revenue-generating equity trading desk vs. mid-to-back-office operations function). RPA, for example, is having a greater impact in the mid-to-back

office, where it can replace higher-volume operational and transactional activities. For example, Adam explained how his institution's tax department utilized RPA to analyze compliance with the tax code in every country with which the firm did business. The software compared rules and regulatory expectations by jurisdiction to actual payment information, identifying where over- or under-payment had occurred.

> Operations teams have gotten a lot of exposure to these [RPA] capabilities. Front-office teams are aware that RPA exists but have not really had much direct contact nor are they responsible for exploring or considering them. But machine learning is probably the opposite, where teams in the front office have explored it and teams in the back office have not. (Adam)

Algorithms like machine learning are having a greater impact in areas of the front office where complex decision making is required. One interviewee, Sally, explained that her firm has portfolio managers that are conducting investment research from a wide array of sources, and AI applications are emerging to supplement and replace some of this work. AI tools that process data quickly and enhance investment analysts' forecasting, decision making, and idea generation are in particular demand. AI is not only enabling large-scale data processing at a rapid rate but are integrating traditional data sources with new ones like web traffic, web search trends, and social media. The application of these algorithms helps investment analysts save time and uncover insights they would otherwise overlook.

One form of cognitive technology that is having an impact in multiple areas of financial services from the front office (e.g., client service) to the back office (employee service) is natural language processing (NLP). One executive, Susan, discussed how treasury services at a large investment bank receive an estimated 50,000 emails each month from clients, with large teams spending time reading, routing, and resolving those

inquiries. By leveraging an NLP-enabled service engine, the team has been able to dramatically streamline the process of getting information to clients faster, and freeing client service professionals to spend more time on proactive client engagement. This is the first type of NLP being utilized at scale across this particular investment bank. As Kathleen described, identifying the reason the email was sent, extracting information from the email, determining the information needed to reply, and solving for where that information is stored within the firm are complex tasks. Yet their NLP engine is able to deliver this to the client service professional in a much more succinct format, saving time and energy.

Another example from Don involved his firm launching a virtual assistant in their treasury services department to handle cash management. The organization was the first to offer this service to clients and differentiate itself from competitors. The virtual assistant helps clients make working capital decisions by answering questions about balance levels and calculating those balances in different currencies. The assistant is also able to make suggestions to internal staff, for example, letting the treasury services team know certain clients are behind on payments.

In other parts of the enterprise that are less close to clients, interviewees discussed how NLP is being utilized to replace internal corporate function service centers, help desks, and ticketing agents—for example, an IT service center or HR help desk. Curt, Robert, Susan, Sally, Jim, and Don all discussed chatbots that can converse with humans via web-based instant message or over the telephone through voice dialogue. Chatbots are helping solve increasingly large volumes of common employee challenges like being locked out of one's computer. This significantly reduces the volume of issues requiring

human involvement, saving the business money while making for a more on-demand, real-time, and customized support experience for the end user.

Geography is also having an impact on cognitive technology use and application. There were some noticeable constraints facing leaders in institutions who are still addressing post-2008 financial crisis cost pressures. They were not in the same position to invest in large-scale cognitive technology adoption as quickly as their peers who had recovered more seamlessly. Leaders in most financial services institutions based in the United States appeared to have recovered from the 2008 financial crisis by 2019 and had not found it as challenging to invest in the future of the business through technology and workforce reskilling. However, participants working for European-based institutions indicated they have been less well positioned to tackle this kind of business model transformation since it required intensive capital investment.

Additional location-specific differences emerged from the research. Since financial institutions have been strategic about the locations where they perform work activities, differences emerged relative to the use and application of cognitive technology (Loucks, Hupfer & Jarvis, 2019). For example, front-office client-facing roles often remain in financial center hub locations like London, Zurich, and New York, while back-office support activities may be offshored or outsourced to lower-cost locations in Poland or India. Each location, by nature of its concentration of distinct business activities, has seen increased use and application of select technologies. India, for example, was cited by several participants (Jim, Don, Kathleen, and Adam) as central to the robotic process revolution. In London and New York, the center of the capital markets, the focus has been on higher-powered algorithms like machine learning which can influence decision

making. The result is variability not only in which cognitive technology is being utilized more frequently in which location; these investments are also establishing local talent pools, vendors, and ecosystems of partners and providers.

Finding 1d: Ecosystems, Partnerships, and Platforms

The 4IR has not only meant changes for how an individual institution is organized to deliver a product or service—through digitized platforms—but also how that organization partners with its suppliers, vendors, and other providers in the marketplace. Half of the leaders involved in this study discussed how the entire stakeholder value chain for a financial services institution is being connected in new ways, unlocking immense value through networked partnerships, platformed products and services, and ecosystems that promote scale. These changes are also bringing historically non-financial services firms to the table, for example Apple, with the launch of its payments platform Apple Pay.

> We're becoming a platform for financial transactions. Rather than solely producing goods and services, we're attempting to create an open ecosystem where consumers and producers interact. As a platform, this means we establish 'plug-and-play' infrastructure where third-party producers can easily connect to consumers through our firm. This includes the secure exchange of data, including authentication and authorization data, to reduce transaction costs. Our platform has the potential to deliver exponentially more value, bringing a much larger group of stakeholders and capabilities together. (Matt)

At the center of this change toward platforms is information—or more specifically, data. The exchange of information through digital networks of people, and now things (e.g., IoT), means these institutions are connected in a web-like ecosystem of partnerships which are critical to their survival in the 4IR. Partnerships are a necessity because organizations that want to access the full benefits of AI will need to consume vast quantities of data. Data is a commodity, an asset, and machine learning algorithms

are data-hungry. Both depth and breadth of data matters. Diverse data sets are critical for enabling more complex use cases that bridge distinct knowledge domains and sets of information. Additionally, access to the end user or customer is critical to enable a virtuous cycle of data collection, analysis, monitoring, and action so institutions are keen to stay close to the user. This means a new set of partnerships, and those who succeed in this new era are forming alliances and turning themselves into hubs within the financial services ecosystem.

The increasing use of cognitive technologies to process, analyze, and make sense of vast quantities of data within the sector also holds the potential for AI-driven tools to enable a radically safer financial system. Select leaders interviewed discussed how there are early indications of cross-industry collaboration, with AI at the center to facilitate collaboration based on the value of shared data sets (e.g., to prevent money laundering and fraud). Firms that will be successful are those with depth and breadth of data.

In addition to the role of data in driving ecosystems, partnerships, and platforms, executives cited how vendors are becoming important partners in the design and deployment of cognitive technologies and, as a result, are developing specialized skillsets and talent pools to address the demand.

> A lot of vendors started by pitching the world. They tried to convince banks like us that the technology could solve all kinds of problems. But the key is for them to start to get more practical about the impact. And they have started to become much more targeted about knowing where they can leave a tangible result. To give you an example, don't say RPA can transform our tax department end to end. But when they came to the table with a way to calculate VAT taxes owed to the U.K. government through a new algorithm that eliminated a lot of manual excel-based processes, we were not only impressed but saved massive amounts of time. Ultimately, it allowed us to actually forecast our spend more effectively. The more vendors apply their knowledge to specific business activities to solve real problems for the industry, the more essential they have become to the future of our business. (Jim)

Financial services firms had been slower to invest in buying and building skillsets around cognitive technologies, yet they are finding value from their application. Thus, vendors have been the short-term solution and are emerging with increasingly deeper talent in areas like RPA and data science, as Jim pointed out:

> I've seen a lot of success with partnerships for capabilities like robotics. There are a lot of vendors out there. In India in particular, given the concentration of back-office banking capabilities. And these service providers have really made a difference in accelerating application. (Jim)

Vendor partnerships have been a critical facet of accelerating enterprise adoption of cognitive technologies over the past few years when the institutions have not had the internal capabilities required to do so.

> Vendors in the data science space are developed and very advanced. They have strong visualization capabilities and "drag and drop" dashboarding for data scientists to utilize. This has been pivotal to spare us time in building these things from scratch internally. (Sally)

Another partnership that is emerging in the financial services ecosystem is with cloud providers like Amazon, Google, and Microsoft. These partnerships are critical to provide the underlying compute capability required to scale artificial intelligence and machine learning. Cloud allows firms to run complex algorithms that are leveraging big data and also provides benefits to engineers and application developers with off-the-shelf reusable cloud-native toolchains.

> As far as partners, the major cloud providers are key for us now. They need to understand more about our legacy, local business processes to be able to help our technology teams redesign these workloads in the cloud-native environment. I find the startups and smaller firms nimbler and more effective at working with us to change how we do certain things so we can take advantage of these technological advances. Refactoring applications and workloads for the cloud is critical now. So perhaps it will require both partnerships with the cloud providers and niche service providers until the cloud providers invest in helping Banks move more quickly in public cloud adoption. (Don)

On the front end of the business, financial services firms have built out their network through partnerships with FinTechs. These startups tend to have technology talent that also has a fundamental understanding of some aspect of the financial services marketplace—for example, the payments space—and can therefore add immense value bridging technical capability with financial domain expertise. An example may be Mastercard with Net1, a partnership that seeks to provide bank accounts and debit cards to 17 million social grant recipients in Africa, thereby digitizing social grant payments.

Finally, some executives highlighted the importance of cross-industry peer forums. These peer-to-peer user groups of leaders who are piloting similar technologies as a way to learn from one another were very popular (e.g., around NLP-based chatbots). This form of peer exchange and sharing is particularly useful in areas where there is less competitive differentiation and products are more commoditized (e.g., in the back office).

> I really value my cross-industry peer forum for IPSoft's Amelia platform. We launched chatbots internally and it gave me a forum of similar users who were learning how to leverage her technical capabilities while still building in humanistic elements so she can interact with our employees in an effective manner. (Kathleen)

These peer exchanges are more informal forums, but they provide an opportunity to learn from like-minded colleagues, discuss challenges, areas of opportunity, and share lessons learned from one another's experiences.

Finding 1e: The Redesign of Work, Roles, and Jobs

All of the executives involved in this study noted how the use of artificial intelligence and robotics is automating and augmenting business processes within financial services, and in so doing, work activity traditionally performed by humans. All of the leaders involved in this study discussed how this is driving a change in roles,

responsibilities, and the nature of human-machine collaboration required to yield productive outcomes and value for customers and shareholders in the 4IR.

One of the most noticeable areas where leaders noted this transformation has been underway is the back office. Over time, the automation of routine activities has made many of these business processes commodities, shifting the competitive basis of firms toward their front-office activities and changing the distribution of talent in the industry. Executives explained that back-office processes in financial services have become increasingly uniform among competitor institutions. Each institution consuming similar capabilities from service providers. As a result, talent has shifted over time, moving from being employees of financial institutions to employees of their service providers instead. One participant, Curt, explained how this phenomenon unfolded within his corporate real estate function over the last decade:

> All of our workforce has left and no longer works at the bank, but instead has shifted over to many of our service providers, working for the CBRE or JLLs of the world. This is true not only for support functions like real estate, but other corporate groups like HR as well. As Banks increasingly source these capabilities from providers, it is no longer valuable to build these capabilities in-house and employ people on payroll to perform these activities. (Curt)

This has dramatically altered the talent landscape within the industry, creating different skillsets in the suppliers that support the industry, and the result is an evolving financial services supplier ecosystem.

For those roles that remain in financial services, the work is changing to be more collaborative with machines. In the front office, this has meant mobile applications in retail banking that alleviate the need for customers to go into a physical branch for many services, questions, or support from human bankers. Robo-advisory services in wealth management is another example where a traditional human financial planner is no longer

required to offer basic investing advice to customers and, in fact, affords wealth advisory offerings for the first time to new customers and clients who otherwise would not have qualified for a human advisor (e.g., their assets under management are not substantial enough to generate the fees required).

In some cases, the use of cognitive technologies is directly and entirely replacing the need for human involvement in the business activity. In other cases, it is creating capacity for humans to provide support for more complex related activities or to offer supplementary services. For example, a retail banking client is now able to deposit checks digitally through their mobile application with no involvement from a human employee, yet once their account balance hits a certain threshold amount a notification is triggered for a private banker to contact the client for an in-person consultation (e.g., to discuss additional customized services and products). One participant, Sally, shared:

> We have a lot of learning from our experiences. It has shown we really have to think about our business as a service and think about the end-to-end business processes. It taught us the importance of process rigor. We have to do use cases to identify the root cause or problem and work backwards from that experience or outcome to all the steps involved and then re-design it to get what we want to achieve. This new era really involves end-to-end business process redesign. (Sally)

This continued co-evolution of technology supporting and/or replacing certain financial services work activities allows for greater human ingenuity to refine services and products to make them even more tailored to customers' needs.

> Bridging engineering skills with business redesign skills is the key. I think there's a lack of people coming out of schools that intuitively understand how machines work from a mechanical perspective but then we need them to think about ways to automate a process that involves that equipment. Formal training and learning don't really exist for those types of roles. (Curt)

Ultimately, financial institutions will need to conceptualize a new union of talent and technology as they compete to deliver compelling products and services in an increasingly mature and competitive market. This will require achieving a balance between the rapid nature with which new technologies are deployed and the lengthier timelines associated with workforce development.

Finding 2: The Role of Leadership

The second set of findings revolve around leadership's role during this period of significant industry-wide business model transformation.

Finding 2a: Overcoming Ambiguity

Leaders interviewed were conflicted between the potential value of cognitive technologies and their own preparedness to lead the dramatic business model transformation underway.

> There seems to still be a bit of ambiguity around some of these technologies and what they are capable of. In the early days, there was so much hype and over-selling of the potential of disruptive technologies that some leaders are a bit apathetic now. (James)

The issue was described as a lack of clear understanding of the myriad technological capabilities available and, therefore, ambiguity around what was possible to achieve with them.

> I definitely see leaders that are still resisting it. They see it's the future and know they need to get onboard but they're not necessarily in favor of taking action now or being first out of the gate. (Robert)

In spite of these levels of uncertainty and anxiety, leaders indicated they share an equally positive orientation toward the potential of these emerging technologies. These findings were consistent with their institutions' public investor day memos and annual report

commentaries, where senior leaders acknowledge the value and potential of cognitive technologies. In his 2019 letter to shareholders, one CEO acknowledged the need for his leadership team to continue to advance their understanding of the power of artificial intelligence and machine learning (Dimon, 2019a).

In addition to the need for demystifying current technological trends so leadership can become more aligned around their strategies to employ them, executives indicated that greater cross-functional collaboration has been required to deliver on these technologies effectively. Participants (Sally, Jim, Don, Curt, Adam) consistently cited that historic siloes and functional boundaries have become somewhat less relevant in the 4IR, which requires more end-to-end solutions for the enterprise. Executives shared that even more of this cross-functional, cross-enterprise delivery is required.

> Leaders have had to learn how to work across the organization in new ways. But we are not really working across the organization to the degree these capabilities require…yet. We aren't really setting up enough utilities, for example. We have a robotics center of excellence (COE) for example, but I don't see the full buy-in from various parts of the firm yet employee the COE to do end-to-end process re-engineering. We had success with one business process, client onboarding. But we identified three other similar processes to automate thereafter and are still negotiating with the owners of these business processes around what many of us view as minutiae relative to the opportunity. (Susan)

Part of what is driving the acceleration of adoption over the last 18-24 months has been intentional decisions around enterprise governance—a realization that the use of capabilities like AI does not exist in a vacuum. Many of these emerging technologies, like big data analytics and machine learning, require things like cloud computing, which in turn requires a coordinated enterprise effort—it cannot be done in isolation for only part of the business or a select team. This results in a tension at times for the enterprise—between centralized technology adoption, for example, attempting to migrate enterprise

infrastructure collectively to a cloud computing environment, vs. a more decentralized tolerance for technology adoption in the case of rapid prototyping cognitive technologies for distinct business activities. Leaders indicated the open-sourced model of allowing for flexible experimentation, where autonomy to disparate lines of business and corporate functions has been paramount in moving quickly enough to experiment with different forms of technology and learn from those experiences. Establishing central oversight and governance to provide guardrails and direction was viewed as the only way the institution could be in a position to compete and keep up with disruption from outside (e.g., FinTech startups).

Leaders discussed how their organizations are also increasingly sharing their strategies around cognitive technologies and workforce reskilling publicly.

> I think that for leaders, it is still about change management…and change management is all about stakeholder identification, assessment, communication, awareness, and engagement. This is a fundamental transformation of the financial services business. So that means being transparent, communicating regularly, getting buy-in to the rationale for why we are doing what we are doing. We have to adapt, and so people have to understand the implications. (Robert)

This was supported by investor relations materials, where many leading banks discuss their use and application of disruptive technologies, as well as the workforce reskilling efforts underway to support the transformation of their business (Bouee & Warner, 2018; Corbat, 2019; Dimon, 2019b; Fairbank, 2018; McFarlane, 2019; Moynihan, 2019; Scharf, 2019; Siqing, 2019; Tucker, 2018). It seems important that, in parallel to the socialization transpiring external to the enterprise, equal effort be given to driving greater clarity among leadership teams. Clarity around the potential of each of these technologies, how they coalesce into a cohesive enterprise strategy, and the resulting expectations for their

roles and responsibilities of their workforce will be essential for financial services leaders seeking to lead from the front.

Finding 2b: Creating Talent Strategy Clarity

All of the executives interviewed in this study indicated that their current attempts at a cohesive, top-down, integrated talent strategy to address the future of work and its implications for their workforce, skills, and talent pipeline are deficient. Using AI to streamline existing business processes offers institutions immediate benefits with small-scale investments. Yet leaders felt their institutions were delinquent in balancing these short-term wins with a sufficient long-term focus on more dramatic business transformation.

> I think we've spent a lot of time thinking about innovative technology disruptors and what it means for the future of our business, and we have a lot of great strategies articulated. But we haven't acted on most of these ideas. I think we're significantly behind the curve of where we could be. Certainly, compared to the tech firms, the digital natives. We are not piloting IoT [internet of things] capabilities within our facilities with sensors and getting the building operators and the facility engineers involved. The whole ecosystem has to change through including incentives for service providers, and the like. But we have not been willing to move the needle to start to shift this within how we run real estate for the Bank. From the engineering side alone and how we operate our buildings and how we interface with staff, there is so much opportunity to get smarter and adjust our cost structure. And it starts with a talent agenda. (Curt)

The criticality of reinventing themselves, not only with technology but with a human focus, was apparent to some of the leaders interviewed (Adam, Robert, Curt, Kathleen, Sally). For these leaders, the future of the workforce will involve a redesign of jobs to better enable people to work alongside machines, robots, and new forms of off-balance-sheet talent (e.g., gig workers and crowdsourced talent).

> I built a brand-new team at two different leading financial institutions over the past few years, and in both cases, I did not hire a single individual who had delivered the kind of transformation we undertook. I hired a linguist to support

> natural language processing work, I hired a neuroscientist to help make our machines interactions more human, and to better recognize motions. I hired people with passion and grit. (Kathleen)

Leaders indicated that their talent strategies varied in levels of comprehensiveness and sophistication. They felt they had intentionally invested in and amassed talent and capabilities around cognitive technologies. In part, the approach has involved sourcing talent from external sources, hiring engineering and computer science skillsets increasingly from academia and technology firms (e.g., Google, Microsoft), in part through the development of the existing workforce as individuals and teams have the benefit of spending the past 2-3 years working on cognitive technology implementations.

Hiring top technology talent has been a priority for all of the institutions represented by those interviewed, with explicit acknowledgment that they do not see the focus on talent acquisition changing for the next few years. See Figure 12 for participant approaches to sourcing critical AI talent.

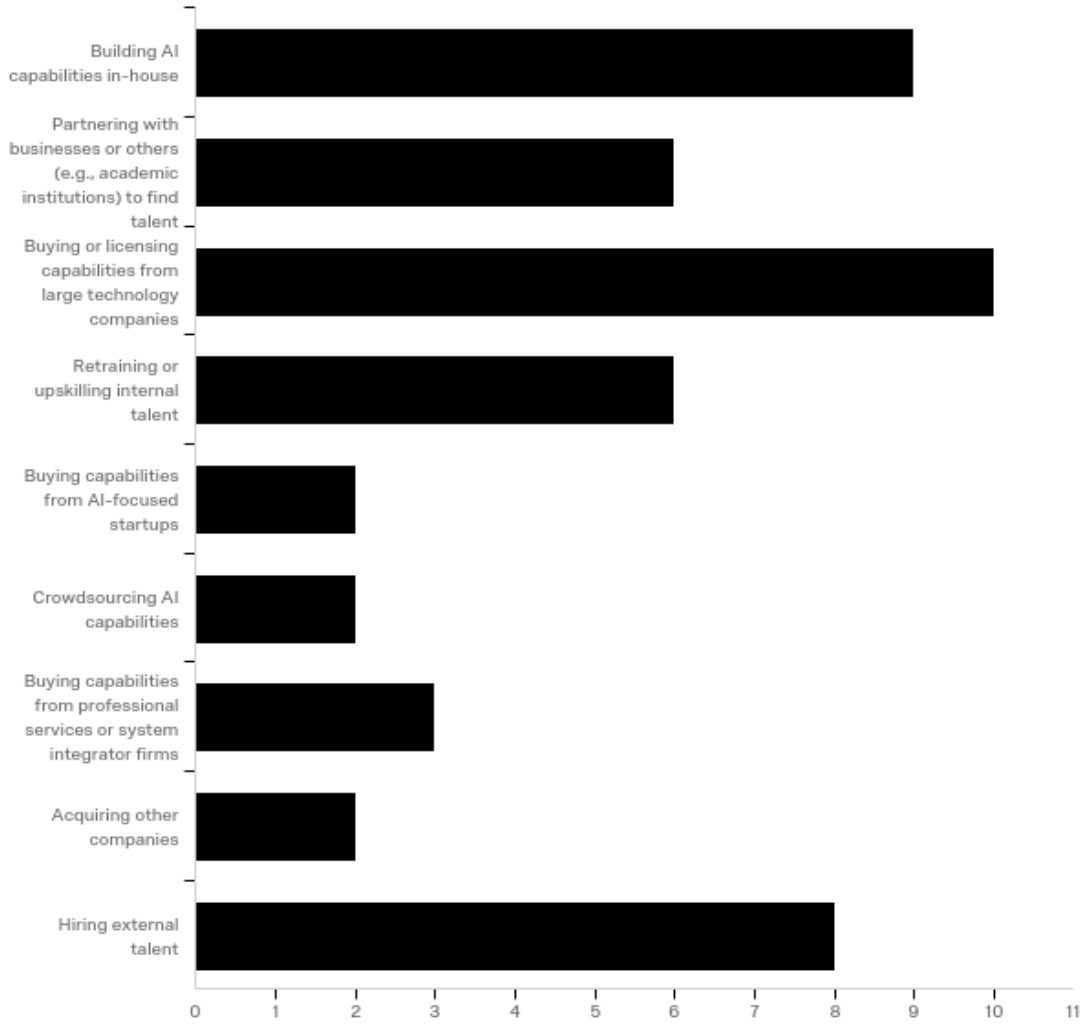

Figure 12. Sourcing AI capabilities
(Sample size = 12 executives, multi-select)

There are, however, some concerns around the value proposition of financial services and its impact on their ability to attract and retain technologists. Some of the concerns are around the underlying motive and purpose of the sector, e.g., about principles and values, most of the concerns revolve around the legacy-operating models of these institutions. Five executives discussed these concerns in varying levels of detail, explaining that financial services firms are attempting to transition themselves quickly, away from traditional structures toward those that are flatter, more nimble, agile, and flexible—an

environment that is more appealing to technologists who have an equal opportunity to join firms that are already organized in this manner (e.g., Amazon, Google, Apple). Amazon's recent expansion to the Washington, D.C. was cited as an illustrative concern for financial services firms already operating in the area. They are worried about the potential for their technology talent to get lured away by competitive salaries and a more compelling brand, work environment, and culture after years of investing in their workforce.

> Amazon's decision not to bring a new headquarters and thousands of new technology jobs to New York City recently garnered a sigh of relief for many in technology leadership roles within financial services—including many of my peers. Our top talent would have been tempted by some of the opportunities. And after years of deliberate attempts to attract, retain, develop, and create a compelling vision for technology talent, to have a mass exodus… that would have been hard. One of our consumer banking competitors in the D.C. area is being forced to grapple with this challenge, however, given Amazon will be moving into the Virginia suburbs. (Don)

Continuing to understand what is compelling for top technology talent will be crucial for financial institutions to maintain competitive positioning with other employers. In particular, as these firms seek to pivot their business models away from pure finance domain expertise toward technology firms, they will have to adapt incentives and other offerings fast enough to make a compelling case for talent to join and stay.

> When it comes to turning a sensor or a device in a building into something that we can utilize for additional insight and decision making, we are talking about translating physical device data into specification level language that a construction manager can put in place and tie back to our control systems. I don't think there has been a pivot yet internally to hiring different types of talent, that have higher skillsets and can do this type of design work. Currently we are too commodity-oriented with our thinking. But the kind of talent we need to help do this work requires both an understanding of the mechanical and electrical systems, and that of design engineering expertise to then apply a cognitive technology solution to solve the problem in a unique way. (Curt)

New talent models involve bridging line of business finance expertise with technology capabilities to redesign how business activities transpire. Collaboration between line of business specialists (e.g., derivative traders, private wealth advisors) with technologists (application developers, engineers) will be critical to redesign the end-to-end flow of the business. Talent models of the future will involve those with design thinking skills who can reshape how new technologies can be integrated into delivering a product or service in a new way.

> Ten years from now I'm not necessarily going to have a team of programmers come in and rewrite code or check individual lines of code. We need to be able to get things constructed and built in a way from the start that can generate the anticipated results. At the center of this is a better understanding of our data. We get a ton of data at the moment, but it's at a scale beyond what a human can make sense of. We need to be able to make sense of the trends in our building data, our equipment performance, and even run predictive analytics on our facilities. Somebody has to be able to unlock the potential already available within these facilities products deployed on our equipment and in our buildings. (Curt)

Finding 2c: Supporting Symbiotic Human-Machine Collaboration

The majority of executives involved in this study (83% of the 12 participants) spoke openly about the greatest potential from advances in technology involved the symbiotic collaboration between the human workforce and machines.

> [Illustrative technologies like] 5G, WiFi6, IoT devices, autonomous vehicles, augmented reality… these are just some examples of technologies that are changing now and will unveil a whole host of new capabilities. For our responsibilities managing corporate real estate for the firm, it will influence our new building construction and how we service our facilities. We have already started to use robot vacuum cleaners! They work alongside our existing staff, whether engineer design staff or facility maintenance staff, in new ways to more efficiently and creatively deliver services to the firm. (Curt)

One of the consistent themes from executives interviewed was that the 4IR does not involve the replacement of humans in the provisioning and distribution of financial services. Executives do not believe humans will be removed entirely, if for no other

reason than to accommodate public policy and regulatory expectations. The industry is so heavily governed through oversight controls that a simple business process like disbursing a loan—a process which could be automated through an intelligent algorithm, thereby replacing the human underwriter—is unlikely to happen.

However, executives do believe that roles will be increasingly changed due to the use of cognitive technology. Over 50% of executives surveyed indicated that thus far, ~100 roles have changed within their organizations as a result of cognitive technology adoption, yet 66% of those same respondents indicated that somewhere between 10,000-100,000 roles within their organizations will change in the next 5 years (see Appendix D, Survey Questions 5 and 6 for details). The solution that emerges for the industry is more of a symbiotic partnership between human and machine, with cognitive technologies supporting human capabilities to create even more customized, tailored, accurate, and timely services and products. (See Figure 13 for participants' survey responses on the scale of human-machine collaboration).

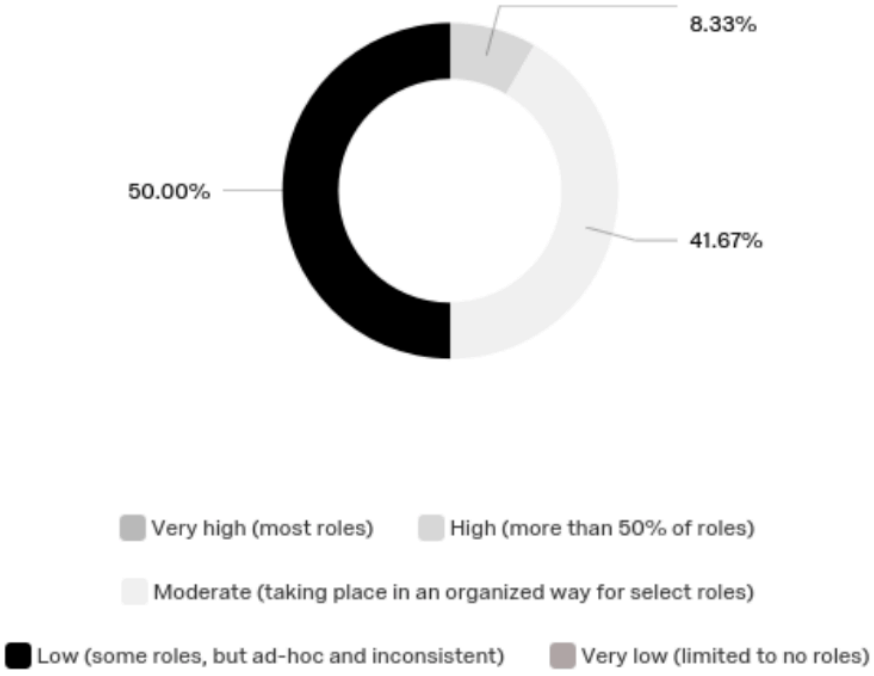

Figure 13. Scale of human-machine collaboration
(Sample size = 12 executives)

Algorithms are already able to analyze large quantities of data and recognize patterns that would go undetected through human analysis. This additional insight provides more informed decision making.

> People are our greatest asset. And the second greatest asset for financial services firms is data. So, when these two are combined it's powerful! Data can be utilized to create business capabilities and generate new revenue opportunities. We are starting to transition from being reactive to preventive and even proactive in our data management and analytics capabilities. Even applying machine learning in some places. For example, in our equities business. We have used data analytics to change the nature of trading. Offering optimal bid and spread information based on a determination of the client's expectation. Another product we launched calculates the optimal portfolio of hedges for client trades, considering risk and pricing. The trading floor as a result will evolve to be more balanced between traders, quants, and technologists. (Sam)

Additionally, while cognitive technologies will fully replace some of the functions' humans have traditionally performed, there are several areas where human

capability is still a differentiator—for example, the ability to be creative and generate meaning from experiences. All but one of the leaders interviewed discussed how the advent of cognitive technologies actually affords humans the opportunity to do more uniquely human work, thereby increasing overall productivity and satisfaction. Cognitive technologies can manage more routine work, freeing up humans to be more engaged and derive meaning from their work. Even more significant is the potential for these symbiotic working partnerships with cognitive technologies to create unique opportunities for human development.

> Considering HR is a people-oriented function, some are surprised that we would have launched "bots." They're not the first thing that comes to mind. But if you stop to think about the many repetitive tasks handled across typical HR functions it makes sense. Bots allow our teams to build more efficient processes, improving the way we work. And in so doing, free up more capacity for high-touch, value-added time with leaders, for example thinking about learning strategies or future talent pipelines.
>
> We've launched bots to automate processes in Learning and Development, Onboarding/Offboarding, Compensation, Payroll, and Recruitment. This has saved us several thousand hours of employee effort each month. But we started small. As we realized the first bots reduced error, lowered costs, we began to explore additional processes. The bots provide our HR workforce with more capacity to deliver high-quality services to the firm. (Robert)

Due to their processing power, computers are far more effective at calculations and pattern recognition. However, big-picture strategic thinking still remains the unique capability of human brain power in 2019. One of the more widely known examples of this that a participant shared was the game of chess. When computers (e.g., Deep Blue) began to beat legendary chess players like Gary Kasparov, initial indications appeared they were far superior to humans. However, when teams were made up of a combination of humans and computers, they played the highest level of chess ever seen. Pattern recognition may be a specialized skill of computers; however, that ability is constrained

by a rule-bound world. In worlds that are less bound by tactical patterns and require big-picture strategy, empowered humans still appear to be a competitive differentiator. Human competency is the opposite of a computer's narrow specialization; it is the ability to integrate broadly. Therefore, while humans may not have much to contribute in very siloed, narrow disciplines, human lateral thinking is critical in more open-ended disciplines. Adaptation requires being effective at taking knowledge from one pursuit and applying it creatively to another.

The results for financial services organizations seeking to realize productivity gains from these new symbiotic operating models is to manage the people aspects of the transition artfully. Jobs, career paths, and social contracts will all need to be redesigned to combine unique human and machine skillsets effectively to create the most productive workforce composition for years to come.

Finding 3: Workforce Readiness

The third set of findings focus on activities underway to prepare the financial services workforce for the new business model.

Finding 3a: In-demand Skills

All of the leaders interviewed as part of this study indicated that the rapid pace of change in the global economy requires a broad set of skills. Demand for skillsets like analytical capabilities to support data science, or technical and engineering capabilities to support the design of increasingly sophisticated algorithms, has been growing for over a decade. Supplementing this demand for traditional science, technology, engineering, and mathematics (STEM) skills is a need for increasing sophisticated humanities skillsets—

those of interpretation, design, creativity, curiosity, imagination, and emotional intelligence. This has resulted in demand for an abundant and broad set of skills in the marketplace.

Executives frequently cited that beyond just technical skills, there is a need for certain personality attributes, like the need for grit, resilience, and work ethic. The future involves moving beyond basic technical skills like the ability to code in Python, to dispositions such as collaboration, critical thinking, and entrepreneurship. The future extends traditional disciplines like mathematics and chemistry and, instead, involves moving toward hybrid themes such as bioethics and cyber technology. Yet current workforce skills and attributes in financial services have not evolved broadly or quickly enough. Furthermore, those that have been developed, have occurred in pockets of the organization based on teams piloting targeted initiatives and learning from that experience (e.g., project-based experiential learning versus a deliberate large-scale effort).

Over half of the leaders interviewed suggested that the future of learning and human development requires moving beyond discrete disciplines to interdisciplinary topics and problems, beyond the mastery of content to connecting content to life situations and productive action. One executive explained:

> No one on my team when I built Amelia at [Institution Name] knew anything about natural language processing, chatbots or virtual assistants. But they were eager to learn, they had ambition, grit and their life experiences showed they would be great at learning on the job. (Susan)

The resulting opportunity is how financial services institutions comprehensively define the workforce skills needed for competitive advantage in the next century, and whether

they have clearly identified the ways in which private, public, and higher education systems need to respond to support in the accelerated development of those capabilities.

Finding 3b: Systemic Reskilling

Leaders in this study all acknowledged that AI is giving rise to a new discipline for how financial institutions plan for future talent. In the first sense, there is a prolonged skills deficit. Efforts to reskill are lacking a clear view on the roles and responsibilities that the institution needs today and how the demand for skills will change over time. This lack of vision and coordinated strategy puts institutions at risk of exacerbating the issue, given the importance of talent as an enabler of AI advancements. Those institutions that get people-management activities right are beginning to gain a competitive advantage, proactively creating new talent experiences through the delivery of evolved policies, processes, and structures that accelerate and do not hinder the evolution of the business.

Yet all but one executive involved in this study indicated there have not been enough strategic, systemic workforce redevelopment efforts for their own workforce. They felt their firms have significant gaps in workforce skills required to leverage and apply the full suite of disruptive technologies effectively to propel their business forward.

> There hasn't been a massive internal effort to pull together a plan and say, "Okay, these are the types of skills we expect will be replaced by cognitive technologies, and these are the skills we anticipate needing more of, so here's what we're going to do about it." That systematic plan, by line of business or function, by skillset doesn't exist right now. But [it] would really benefit us. (Don)

As a result, financial services firms are struggling to compete for the best and brightest technology talent.

> Our technology talent is bang average. We had a new CIO who started eighteen months ago, and her mission has been to clean up the shop, standardize, centralize, create more shared services, eliminate a lot of legacy debt. But that

> mission is not being complimented by the pursuit of innovation and disruptive technology, of AI or anything like that. We are consumed by legacy issues and don't have the right mix of investment in our financial and people resources toward addressing the future. (Don)

Leaders interviewed indicated that financial institutions often lag in the recruitment and retention of people with the knowledge, skills, and capabilities needed for a workforce that can enable AI.

> We have a large in-house IT department, like fifteen thousand people for a Bank of around fifty thousand. For an institution of our size, that's very big. We are not particularly sophisticated about our approach to address the changing nature of work, and the kinds of transformation we need to be undertaking, including the transformation of our workforces' skills. (Don)

Large technology firms are in the lead on this front, able to secure their talent positioning through generous compensation packages and targeting of non-traditional roles and career paths. Additionally, the promise of working in industries that are less heavily regulated than financial services offers more latitude for top science and engineering talent to pursue their interests on a day-to-day basis.

One executive, Don, explained how his organization has successfully launched an initiative branded "New Skills at Work," with a several hundred-million-dollar 5-year investments. A large part of this initiative involves a partnership with the Massachusetts Institute of Technology (MIT) Initiative on the Digital Economy (IDE) to determine what kind of future workplace skills will be critical to the future of financial services. However, the investment extends beyond looking at the firm's own workforce. It includes studying how to strengthen education and training systems to improve the communication between employers and educators, including community colleges. Better alignment between supply and demand is critical.

Another executive, Sally, explained how her institution is supporting several hundred cutting-edge educational institutions to provide training programs for jobs in growing areas like information technology and health care. She mentioned efforts at Georgetown's Center on Education and the Workforce, which is trying to identify better alignment between education systems and the labor market. Another organization discussed in their annual report how they have combined a focus on education with a clear business objective, partnering with the Wharton School to establish a Wealth Management Institute and providing the first of its kind of global, executive education for wealth advisors. This shows both the commitment of the financial services firm toward professional development and client service, and a strong partnership between one of the top business schools and one of the world's leading global banks.

Another executive, Susan, spoke about workforce reskilling by segmenting the workforce into three distinct segments: the technologists (e.g., engineers), the analytics layers (e.g., data scientists), and the finance line of business stakeholders (e.g., traders) closest to the client/customer. Each has unique requirements for reskilling.

> I definitely see the bottom-up interest. People are interested in learning new skillsets…how can I learn to do machine learning or RPA? How can I better apply data analytics to what my team does? I hear these questions all the time. So, there's interest. But there isn't a systemic top-down strategy with supporting infrastructure offered by the organization to support them. (Susan)

Establishing targeted development programs for each of these critical skillsets is a foundational necessity to prepare the workforce for the roles that will remain in the 4IR.

According to those interviewed, many organizations have announced targeting reskilling initiatives to address the needs of their business and workforce; some cited the 2019 announcement by Amazon to invest $700 million to retrain 100,000 of its own

online retail workforce for a digital future, including in fields like machine learning (Cutter, 2019). Yet these efforts remain ad hoc, with some institutions investing in more robust efforts than others. Even organizations that have developed programs often narrowly focus on select roles or skillsets, but not on the full suite of disruptive technologies (e.g., programs related to machine learning but not data science). Given the exponentially growing gap in skills required, a more urgent approach to systemic workforce reskilling is warranted. This requires more substantial investments like the select examples noted earlier, and increased use of partnerships with key providers in the marketplace.

Finding 4: Societal Opportunity

The fourth set of findings were emergent, and not deliberately solicited as part of the study, yet offer areas of additional opportunity in the 4IR beyond the financial services sector.

Finding 4a: Rethinking Education

One theme that emerged in dialogues with financial services executives involved in this study was the urgent demand for talent, skills, and capabilities that are in smaller and smaller supply. The shelf life of skills has decreased from a matter of decades during the 20th century to a matter of years at the start of the 21st. Individuals are expected to learn continuously and be able to adapt and flex regularly; the implications for the systemic structures that support that learning are vast yet have not been thoroughly reconsidered.

However, 75% of executives interviewed (sample size of 12) also noted that the global education system is currently unable to support the demand for a workforce with the breadth of skills at play, both technical STEM skills and uniquely human skills like empathy and critical thinking. Furthermore, these skills are changing regularly, requiring continual refreshing every week, month, and year. Leaders used to utilize degrees as an indication of capabilities during the hiring process, and several decades after graduation, a bachelor's degree from a leading institution or a master's degree from a top-tier business school still served as a meaningful indication of a candidate's capabilities and potential. But organizations can no longer rely on a degree granted 15-20 years ago to ensure relevance for delivering capabilities in the current operating environment. Ongoing growth at each stage of one's career, flexibility in the manner and nature of the learning, and a reasonable cost point are critical factors that were highlighted in discussions with executives around why traditional education is no longer working.

One executive, Adam, spoke about the opportunity for primary school to better prepare high school graduates for productive futures, without the burden of a 4-year college. There is unmet potential for community colleges, 2-year universities, and other such institutions at lower cost points to supplement primary education by providing professional, workplace-oriented learning opportunities. Yet many legacy institutions of the late 20th century are not adjusting quickly enough or scaling to large enough audiences for the requirements of the 21st century. Emerging to supplement these traditional institutions are platform-based educational firms like Coursera (online learning platform founded by Stanford professors) and Udacity (for-profit educational institution offering massive open online courses) to thousands of learners every year. One

executive spoke about some of the more cutting-edge educational trends that have started to make an impact:

> Massive online open courses (MOOCs), digital and virtual learning environments, supplemented by augmented reality, have the potential to offer one solution. Perhaps we should re-think physical presence in education even further. Sitting in a formal classroom for eight hours a day for our young people for so many years. Digital capabilities can bring people and ideas together at an early age without requiring proximity to the most affluent public or private educational setting. (Kathleen)

Yet even Kathleen indicated that while these new capabilities are filling some of the void, they are not doing enough to address the growing gap at the scale required to address the issue fully.

One promising education-related innovation Harry discussed was Harvard University and MIT's partnership in starting edX. Founded in 2012, it was an attempt to create a consortium of leading institutions that would offer online, modular learning opportunities to global participants. The platform became more popular than originally intended, and currently not only boasts over 100 leading educational institutions that provide learning through the platform, but now also caters to corporate clients with learning for business audiences.

> edX is integrated into our firm's LMS [learning management system] and we all have an opportunity to utilize a lot of their courses. The firm pays for many of them, but there are also others available at small fees, let's say one thousand dollars, but you walk away with tangible skills that can be applied on your job the next day. Some of my data scientists have done their micro-degree on data science. (Susan)

Learning opportunities like those afforded by edX are targeted, modular, at the right cost, and short enough in duration while still providing value. Workers often do not have time to return to a college environment for several years of additional formal education later in their lives when they are juggling full-time workloads and personal responsibilities of

managing households. edX's format—offering credentials like micro-degrees—means that it takes less than 25% of the time and cost of traditional degree programs, while simultaneously offering credits should the individual ever choose to apply them toward a full-time degree, and this has been quite compelling. edX is just one example of a new platform-based learning concept that is emerging. Yet there are many others, and this diversity of approach and dynamism is precisely what industry leaders require.

Another example cited by Adam was an MITx pilot, launched to create a digital replica of a classroom. It's first prototype course—entitled Circuits and Electronics—launched in March of 2012 to over 150,000 students from more than 160 countries. Less than 5% of registered students passed the course, but that negates the impact of the experience on the students—over 7,000 students passed the class in a single semester. This is more students than MIT could accommodate to attend in person over a forty-year period.

A similar example that was cited by several participants (Don, Sally, Jim) was Singularity University, which support individuals, startups, and enterprises as they explore opportunities and implications associated with exponential technologies that are shaping the future. Bringing together stakeholders from local communities around the world into a global community around a shared mission, and through the use of a collective platform, is allowing Singularity University to drive content and dialogue otherwise missing in the marketplace.

One educational model noted by James that is returning to prominence is the notion of apprenticeships. He spoke about the strength of the apprenticeship programs in Europe, particularly in Germany. These programs are offered to millions of young people

each year who are paid, thereby earning some income while gaining in-demand skills and education. Vocational schools collaborate with local businesses to ensure students will have a role post-graduation.

Another educational arena Kathleen suggested is better cross-disciplinary learning opportunities. Many top-tier universities launch institutes to address this challenge—such as the Science Learning Center at the University of Texas, Dallas or the Kock Institute for Integrative Cancer Research affiliated with MIT in Boston. These institutes, often affiliated with a leading research university and led by premier scholars in their respective fields, help foster collaboration and understanding across different disciplinary siloes. As leaders embrace the pace of change in the 4IR, they will have no choice but to innovate in the ways they educate and prepare the next generation.

Finding 4b: Refreshing Public Policy

The transformation underway due to the use of cognitive technologies, automation, and artificial intelligence is not only creating a new paradigm for the future of work in financial services, but it is bringing dramatic changes across all sectors of the economy and, therefore, to the very foundations of society itself. Leaders involved in this research (75% of the 12 participants) suggested there is a general sense that government is unable to deliver on societal needs. The need for public policy, investment, and governance change expressed by participants was not incremental; it was dramatic. To be able to support human rights in the 4IR and beyond, executives reinforced the need for rethinking the systems that operationalize public policy (Bostrom, 2014; Ford, 2018).

Over the next decade, the majority of executives interviewed were confident the relationships between society and businesses—like financial services providers—will be

redesigned. The benefits of AI will be further realized when societal structures and processes adapt to support new ways of working. Global communities will continue to have a mutual interest in mitigating the risks and harms associated with rapid technological development—from the safety of the financial system itself to consumer protection and employment concerns. These issues of workforce disruption, ethics, and systemic risk are at the heart of the public-private partnership that will be required to address the societal issues magnified by the use of AI in financial services.

Nations that are taking this competitive differentiation seriously are starting to differentiate themselves from one another, with those developing AI strategies seeking to advance their capabilities through deliberate investment, incentives, talent management, and risk management. They are starting to pull away from those who have been less deliberate. Some governments were referenced by study participants, like China, which has developed formal AI frameworks to help spur economic and technological growth, e.g., China's "Next Generation Artificial Intelligence Development Plan." But China is not alone, and other countries like Germany, Canada, and the United States have offered similar executive orders or public policy direction, e.g., the "Pan-Canadian Artificial Intelligence Strategy". These efforts by government agencies focus on education and talent, investment, research, and collaborative partnerships to address a whole gamut of issues from privacy and safety to transparency and accountability.

Sustained federal commitment to fund research and technology development (R&D) enabled the United States to rise to its position of leadership in the 20th century, largely due to investments produced during the second World War. The government made new commitments, including partnerships with private and public institutions, and

support for agencies like the National Institutes of Health, the National Science Foundation, and the Department of Energy and Defense. Recent declines in federal R&D funding significantly affect cross-disciplinary research, encouraging more conservative decisions around known outcomes rather than exploring more uncertain terrain. Yet the 21st century requires pushing the boundaries on a number of new frontiers. In 2013, the Brain Research through Advancing Innovative Neurotechnology Initiatives (BRAIN) launched a 10-year project that brings together engineers, physical scientists, and neurobiologists to design new technologies that unravel the complexities of the mind and the diseases that harm it. This is an example of the kind of continued multidisciplinary research in which public policy and government funding play a critical role in sponsoring.

Executives interviewed for this study explained that despite more limited government involvement thus far, there are increasing pockets of investment showing promise. One participant, Robert, shared how his firm has started an effort in conjunction with local business-government partnerships in Paris to help rebuild sections of the city that have been underserved. Through an investment of $30 million over a 5-year period, the goal is to address unemployment and poverty through small business growth and workforce development initiatives. Another participant, Adam, shared stories of how his firm is working with local governments in cities across the United States to benefit from tax-incentivized reinvestment opportunities in struggling U.S. cities (e.g., Baltimore, Detroit). This focus on underserved communities is important, as the pace of change in the 4IR leaves these particular individuals more vulnerable, often without the support systems to navigate through the change.

Summary of Findings

Findings from this research speak to a contextual environment that involves great change, with leaders who are optimistic about the future yet acknowledge that greater efforts are required of them to support a successful period of transition—for the sector and society at large. The first set of findings revolve around the manner in which cognitive technologies are being adopted within the financial services sector in 2019 and associated implications and learnings. In conclusion, the financial services industry is still in the early stages of value generation based on the use and application of cognitive technologies, having started in earnest as recently as 2016. As a result, while there is a high degree of confidence in the potential, the full realization of these benefits has not yet come to fruition. There has also been variability in the impact associated with these technologies, with the most notable variations appearing based on the area of the business (front- vs. back-office), geography (Americas vs. APAC), and the institution's financial health (those still recovering from the post-2008 financial crisis vs. those fully recovered). This is resulting in the redesign of work, roles, and jobs with increased human-machine collaboration.

The second set of findings revolve around the role of financial services leaders during this period of significant business model transformation. Leadership teams are grappling with the ambiguity associated with these technologies, conflicted between the potential value and how best to deploy them tactically. Part of the leadership gap involves an absence of a systemic approach to talent that addresses the future of work and its implications for the workforce, skills, and learning and development. Executives believe that the greatest potential for value creation is in the symbiotic collaboration between the

human workforce and machines yet mobilizing around this ambition and what it means for the design of business processes, roles, and future workforce requirements is still in its early stages.

The third set of findings focus on the kind of skillsets required in the future business of the sector, and the activities underway to prepare the financial services workforce for the new operating environment. There has been a shortage of critical skills available in the labor pool over the past decade to support the demand within financial services, and it appears to be getting worse. Despite decades of growing demand for certain capabilities, a large number of roles within the industry continue to go unfilled because of gaps in supply. Workforce reskilling is happening for limited roles and for select capabilities, but is not being led in a systemic, enterprise-, or industry-wide manner. As a result, there is ambiguity around who will address the growing gaps between talent supply and demand.

The fourth set of findings offer areas of additional opportunity during the fourth industrial revolution (4IR) beyond the financial services sector. Beyond the financial services industry, there are wider societal considerations. Despite demand for skills that have been in short supply for well over a decade, the formal and more informal educational systems do not appear to have flexed and adjusted to better prepare successive generations to fill the void. The transformation underway due to the use of cognitive technologies in the 21st century is not only creating a new paradigm for the future of work in financial services, but it is bringing dramatic change to all sectors of society. From transportation to consumer products, healthcare to financial services, the

fundamental dynamics of every sector is in the midst of change which requires policies and partnerships across the public and private sector that support societal transition.

V—SYNTHESIS AND INTERPRETIVE DISCUSSION

Introduction

This study utilized three research questions to understand the experiences of senior financial services executives leading business model transformation through the use and adoption of cognitive technologies during the 4IR in 2019. The findings that emerged provided insight into the original questions and were subsequently synthesized and interpreted within the context of individual learning theory. David Kolb's (1984) *experiential learning* theory and Victoria Marsick and Karen Watkins' (2001) *incidental* and *informal* learning theories were utilized to interpret both the *individual* leader's learning as well as their perceptions of the systemic *workforce* learning transpiring within the financial services industry during the 4IR. The following provides an overview of the study's research questions, findings, and subsequent interpretive categories.

RQ1: How do leaders within financial services experience the increased use of innovative cognitive technologies (e.g., RPA, AI) within the business model of the sector?

The first research question (RQ1) inquired into how a sample of twelve leaders experienced the growing use of these innovative new technologies. The findings suggested they are overwhelmed by an unprecedented pace and scale of change but remain optimistic about the potential long-term value of these changes for all involved stakeholders. In fact, leaders have already realized significant benefits from cognitive technology use and adoption, including greater efficiency in their operations, enhanced

quality controls, and enhanced insight for decision-making through data analytics. Furthermore, leaders explained that just as there is internal operational transformation driven through the use of these new technologies, digitization is also driving external business model change, creating new ecosystems, partnerships and platforms in the financial services marketplace. Leaders discussed how the combination of these internal and external changes have forced a redesign of the work-activities performed within the sector, and the resulting roles and responsibilities for the human workforce. The most notable involving increased human-machine collaboration, with cognitive technologies augmenting and/or supplementing humans in the delivery of a financial service or product. Leaders are excited by the early progress with cognitive technology adoption and the potential to drive even greater impact for all involved stakeholders.

RQ2: How do leaders understand and interpret the changes in workforce roles, responsibilities, and required skillsets as a result of the increased use of cognitive technologies?

The second research question (RQ2) in this study explored how leaders understood and interpreted the changes in workforce roles, responsibilities, and required skillsets as a result of the increased use of cognitive technologies. The twelve executives involved in this research believed that the nature of work within the sector will continue to evolve, changing what is required of the workforce dramatically. In fact, more so than in any other prior period of business model transformation which were described collectively as much more gradual transitions comparably. Leaders viewed the current changes in two parts. The first involved a continued evolution of traditional business process automation, where more routine work-activities performed by humans becomes

automated through machines. This is similar to prior periods of process improvement leveraging new technologies, like the advent of the automated teller machine (ATM). The second part is new, given the enhanced cognitive capabilities of emerging technologies, and involves much more integrated collaboration between machines and the human workforce. Now machines are augmenting and supplementing human analytical capabilities.

Given the extent of these changes, executives expressed concerns around the degree to which their workforce programs were comprehensive enough to address the breadth of reskilling required. They acknowledged it has been a failure on their own part, to understand and embrace these technologies quickly or broadly enough, such that large segments of their workforce were learning organically on the job, experimenting and piloting with new capabilities. Ultimately, leaders shared a common perspective that their firms need a more defined point of view on what the future of work within the sector will look like, so that it can inform tangible, comprehensive workforce and talent practices.

RQ3: How do leaders perceive the learning and development required to transition to this new human-machine collaboration model, and what obstacles are they experiencing?

The third and final research question (RQ3) in this study explored how the sample of twelve leaders perceived the learning and development required to support the new human-machine collaboration model which has emerged in the 4IR. This was a more disheartening set of perceptions, given the significant gap between skills required by their firms (the demand), and the supply in the marketplace; a gap which has been widening over the last decade, not narrowing. Executives discussed an absence of systemic

reskilling efforts, citing instead examples where innovative approaches have been taken for particular roles or in association with a particular technology. Yet integrated approaches to intentional learning at the enterprise-level does not exist; with no learning paths offering clearly designed trajectories for each occupation in collaboration with each distinct type of cognitive technology.

Executives went further to note how this absence of intentional, scaled learning and development is a broader issue than solely within their industry. Other industries from healthcare to transportation are grappling with similar changes, as cognitive technologies play larger roles in day-to-day operations. Furthermore, executives believed the education sector has struggled to adapt quickly enough to the 4IR and has therefore not evolved its practices to support the reskilling required for subsequent generations. Leaders also believed the public sector has not done enough through policy and investment to incentivize reskilling. Ultimately, executives foresee ample educational opportunities that not only focus on supporting the existing workforce with learning how to use and apply these technologies, but how to do so with appropriate controls, and ethical oversight practices. These findings have subsequently been interpreted through several interpretive categories.

Interpretive Categories

Adult learning theorist David Kolb (1984) suggested individuals learn through a cycle, starting with a *concrete experience*, which is reflected on to form *reflective observations*, which are then theorized into an *abstract conceptualization* and then tested through *active experimentation*. Kolb viewed the learning process as a continuous cycle

which progresses developmentally, like a spiral, to greater levels of understanding (see Figure 14).

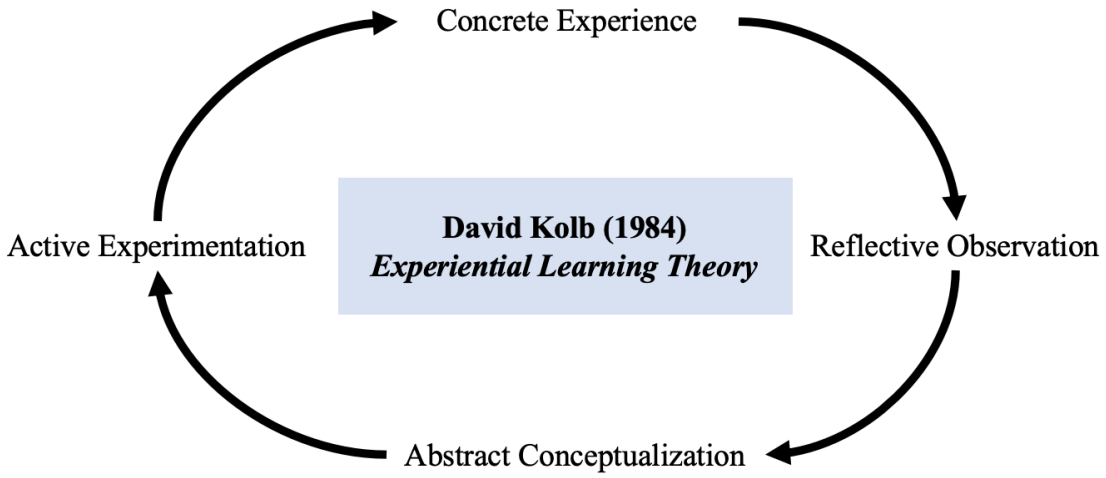

Figure 14. David Kolb's experiential learning framework

In Kolb's framework, learning can begin at any of the four stages. One instance of learning may begin through *active experimentation* which, in turn, leads to a *concrete experience* that one critically observes and reflects on to reach a new conceptual understanding. Alternatively, another instance of learning may begin with a *reflective observation*, which becomes conceptualized into a theory and is put into practice through *active experimentation* (Kayes, Kayes & Kolb, 2005; Kolb, 1983, 1984, 1999; Kolb & Fry, 1974; Kolb & Yeganeh, 2011). The learning cycle becomes progressively developmental where the learner is able to anticipate potential outcomes and effects of actions when encountering new experiences under different sets of circumstances.

Kolb's framework for *experiential learning* is oriented around the individual—and was therefore useful to analyze the experiences of specific leaders involved in this study. By identifying the type of experiences each leader described, patterns emerged where there were multiple instances of *concrete experiences, reflective observations,*

abstract conceptualizations and *active experimentations*. Across the sample size of 12, there were many shared and similar executive experiences.

Table 10

Interpreting the Experiences of Financial Services Executives in the 4IR
(Count of experiences cited during each leader's interview which align to David Kolb's framework; Sample size = 12 executives)

Participant	*Concrete Experience*	*Reflective Observation*	*Abstract Conceptualization*	*Active Experimentation*
Jim	5	*4*	*4*	*3*
Don	*2*	*4*	*4*	*3*
Kathleen	*3*	*4*	*3*	*3*
Curt	*5*	*3*	*3*	*5*
Adam	*3*	*4*	*3*	*3*
Matt	*4*	*7*	*7*	*2*
Harry	*4*	*3*	*4*	*3*
Susan	*4*	*5*	*5*	*2*
Robert	*3*	*6*	*9*	*4*
James	*3*	*4*	*4*	*5*
Sally	*3*	*4*	*2*	*2*
Sam	*2*	*5*	*2*	*4*

Another adult learning theory was useful to provide insight into the larger systemic dynamics affecting not just the individual, but the holistic financial services *workforce*. In 2001, Victoria Marsick and Karen Watkins established the notions of *incidental* and *informal* learning which involve growth that is integrated into daily routines, is highly unconscious, and is linked to the development of others. It manifests in organizations through vehicles like networking, mentoring, and coaching, and occurs without formal institutional structures and controls. While the data collection process for this study did not explicitly source firsthand *incidental* or *informal* learning data, the experiences shared by executives paralleled the literature, with observations of this type of learning occurring regularly within their organizations. Given the extent to which this type of learning is pervasive in organizational settings, it is a key dimension for consideration within the financial services sector during the 4IR.

It is therefore through the lens of both David Kolb's *experiential learning* theory and Victoria Marsick and Karen Watkins' *incidental* and *informal* learning theory that the findings from this study have been analyzed and interpreted. Five interpretive categories were used. The first four focus on the four stages of Kolb's framework (*concrete experience*, *reflective observation*, *abstract conceptualization*, and *active experimentation*) to explore how leaders within financial services are learning from their experiences working alongside cognitive technologies. The fifth interpretive category transitions to explore the kind of *incidental* and *informal* learning at play within dynamic financial services systems, as the institutions utilize increasingly complex cognitive technologies in the operations of the business.

Interpretive Category #1: Concrete Experience

The first interpretive category focuses on the first stage of Kolb's *experiential learning* framework—the *concrete experiences* of financial services leaders at the start of the 4IR (see Figure 15). What new experiences and situations have been encountered?

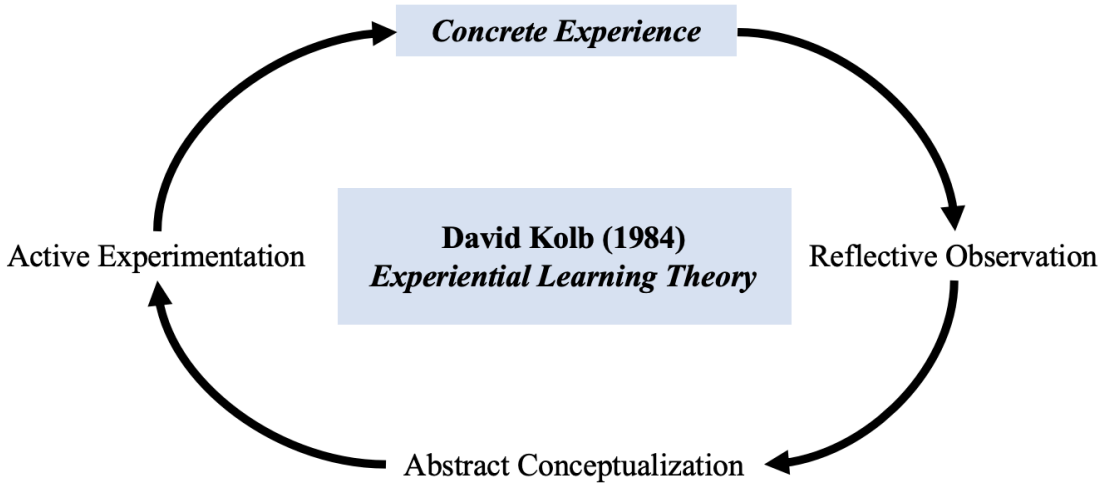

Figure 15. Concrete experience

Cognitive technology adoption within financial services was described by leaders interviewed as providing a new set of experiences compared to prior waves of business model transformation—like mergers, acquisitions, or lean six-sigma process re-engineering. The use and application of increasingly sophisticated automation and intelligent algorithms emerged as a critical business imperative only within the last few years, and at a pace that is unprecedented compared to prior periods of business model change (Bender, Henke & Lamarre, 2018; Bruno et al., 2015; McWaters, 2018; McWaters & Glaski, 2017). Leaders described their experiences of piloting technologies selectively to solve particular business problems, like pricing trades, providing more efficient loans, or offering automated wealth management advice (Loucks et al., 2018).

> The market for technologies such as robotic process automation (RPA)—software to automate manual tasks—is growing at 20 percent per year and is likely to reach US$5 Billion by 2024. Reflecting this growth, 41 percent of respondents to the 2019 Global Human Capital Trends survey say they are using automation extensively across multiple functions. (Volini et al., 2019, p. 28)

These new *concrete experiences* with cognitive technology adoption were described as positive, in that the results offered additional opportunities to improve the business. But leaders also described experiences that were murky and ambiguous. Curiosity, enthusiasm, and excitement resulted from successful pilots, but apprehension and anxiety were also present from the novelty of the new terrain (Agarwal et al., 2018; Renjen, 2019; Volini et al., 2019). Navigating how to get funding for new ideas, being clear on which capabilities would yield the best results to make investment trade-off decisions, and knowing how best to partner within their firm or with external providers were all *concrete experiences* leaders cited which challenged existing frames of reference and left them with some degree of uncertainty. In Deloitte's *2019 Human Capital Trends* survey of approximately 10,000 executives around the globe representing every industry from life sciences, to energy, to health care, the data reinforced what financial services executives shared as part of this study.

> Only 26 percent of respondents stated that their organizations were ready or very ready to address the impact of these technologies. In fact, only 6 percent of respondents said their organizations were very ready, suggesting that organizations are now beginning to understand the scale and massive implications for job design, reskilling and work reinvention involved in integrating people and automation more extensively across the workforce. (Volini et al., 2019, p. 29)

Leaders also described their *concrete experiences* applying cognitive technology with mixed results. Some forms of cognitive technology—like natural language processing—were having more of an impact within the sector than others. Some forms of cognitive technologies—like robotic process automation—were found to be most

relevant to particular areas of the business and not as readily scalable enterprise-wide (Chui & Malhorta, 2018; Crevier, 1993; Guszcza, 2018; Loucks et al., 2019). Most leaders experienced RPA as being effective when applied to higher-volume transactional processing, which occurs in mid- to back-office operational functions like operations, finance, and information technology (IT). Machine learning was another example where leaders described *concrete experiences* of it having more of an impact when applied to complex business challenges with large data sets within the front office, like analyzing a client's portfolio allocation, to facilitate more informed decisions (Briggs & Buchholz, 2019; McWaters, 2019).

Leaders involved in this study discussed their *concrete experiences* investing in automation opportunities that resulted in direct headcount reduction with explicit savings. Public headlines like the 2019 story in Business Insider further demonstrates how lucrative these opportunities can be for firms willing to invest: *Morgan Stanley is rolling out an AI chatbot to research clients early next year. Wall Street thinks the tech could save $8 billion annually* (DeFrancesco, 2019). A 2019 Fortune survey of executives representing 300 companies indicated that over half of the leaders are spending more than $50,000 each, piloting new disruptive technologies (Vanian, 2019).

Beyond the excitement and ambiguity associated with these new experiences of applying cognitive technologies, leaders also described a landscape of business model change with limited scaffolding and support (Baden-Fuller et al., 2013; Baden-Fuller et al., 2010). Their *concrete experiences* suggested that traditional support systems were limited, whether that involved leveraging the experiences of peers, more systemic organizational efforts for cross-functional enterprise assistance, or broader marketplace

resources from suppliers, vendors, and consultants. Leaders indicated that the current phenomenon is new and happening quickly for everyone, and therefore limited offerings are in place for support. As a result, leaders felt they were navigating an uncertain landscape without the typical support systems to which they had become accustomed (Daecher et al., 2018; Renjen, 2019).

Leaders also described *concrete experiences* with shifts in their workforce—specifically, the type of work activities being performed, the associated roles needed to continue to operate effectively, the makeup and composition of the team, and therefore in-demand skillsets. According to the McKinsey Global Institute's July 2019 study on *The Future of Work in America*, surveying 315 cities and more than 2,000 counties across the United States:

> Technology has always reshaped the workplace—from the cotton gin, the steam engine, and Henry Ford's assembly lines to the typewriter, the switchboard, and the copy machine. In the past two decades, digital technologies have altered the day-to-day fabric of work for millions. Drivers have gone from memorizing local streets to relying on GPS, while architects have gone from hand drafting to AutoCAD. Ubiquitous smartphones mean that many workers are always plugged in, and more of them are able to work from anywhere.
>
> The next generation of digital tools will bring even more far-reaching changes in the decade ahead. Robots can assemble cards, deliver food, and handle dangerous, dirty tasks on industrial sites. Systems enabled by machine learning can provide customer service, manage logistics, personalize marketing, optimize pricing in real time, spot defects and fraud and analyze medical records.
>
> Millions of jobs with a high share of automatable tasks could be phased out in the decade ahead. Others will be created, more than making up for those losses in many scenarios—although they may be different occupations located in different places. (Lund et al., 2019, p. 35)

Leaders explained how in the back-office of the business, many positions that once existed were no longer required, with relatively sizeable layoffs or outsourcing arrangements. Capabilities within corporate support functions like Human Resources, Real Estate, and Facilities Management had become commoditized and leaders explained

how service providers were able to provide them at a better cost point by scaling delivery across many institutions simultaneously. Executives noted that this led their firms to utilize external providers for these services and shifted the composition of their workforce. As a result, executives experienced that relationships with external partners and suppliers also evolved due to the workforce landscape shifting toward commoditized service providers. They experienced their firms' engaging in much more substantial, longer-term contracts, building a much more integrated supplier ecosystem where their firms were more dependent on others for a full front- to back-service delivery model.

In the front office, leaders shared *concrete experiences* competing for top talent. They experienced greater demand for talent that can bridge science, technology, engineering, and mathematics (STEM) backgrounds with Finance subject matter expertise to design entirely new ways to deliver products and services to customers. See Table 11 for an evolution of the top ten most critical skills as identified by the World Economic Forum which echoes the skillsets leaders highlighted as part of this study.

Table 11

Evolution of Top Ten Skills (Schwab & Samans, 2018)

In 2020	In 2015
Complex Problem Solving	Complex Problem Solving
Critical Thinking	Coordinating with Others
Creativity	People Management
People Management	Critical Thinking
Coordinating with Others	Negotiation
Emotional Intelligence	Quality Control
Judgement and Decision Making	Service Orientation
Service Orientation	Judgement and Decision Making
Negotiation	Active Listening
Cognitive Flexibility	Creativity

According to leaders involved in this study, and the supporting literature, financial institutions have been actively sourcing this talent wherever available. In that process, they've found themselves struggling to compete with technology firms (e.g., Google, Apple, Facebook, LinkedIn) and startups (e.g., FinTechs) in an ongoing battle for top STEM talent. Part of what they have experienced involves talent opting for non-financial services institutions due to generational expectations for workplace culture, shared values, and approaches toward compensation and incentives (Abbatiello et al., 2018; Agarwal et al., 2018; McFarlane, 2019; Schwartz et al., 2017; Volini et al., 2019). As one illustrative example, in Q1 2019, Universum released its report on the most attractive employers in the United States, with over 53,000 respondents representing undergraduate students at 218 universities across 151 areas of study. Two financial services firms made the top five list (JPMorgan Chase & Co. and Goldman Sachs), and

four made the top 25 list (Morgan Stanley and Bank of America). This was slightly behind technology firms, which had two firms in the top five (Amazon and Apple), and six in the top 25 list (Netflix, Spotify, Microsoft, BuzzFeed) (Universum, 2019). The draw for top talent toward environments that are seen as leading-edge is prominent.

Beyond talent sourcing and retention challenges for financial services leaders, the experiences of executives involved in this study reinforced the existing literature, suggesting that the roles which remain within the industry require a combination of technical aptitude and non-technical human traits like creative problem solving and empathy (Bentley et al., 2018; Epstein, 2019; Guszcza, 2018; Guszcza & Schwartz, 2019; Schwab, 2018).

> Jobs in highest demand today, and those with the fastest acceleration in wages, are so-called "hybrid jobs" that bring together technical skills, including technology operations and data analysis and interpretation, with "soft" skills in areas such as communication, service and collaboration…. Technology has not only changed the nature of the skills the job requires but has changed the nature of the work and job itself. (Volini et al., 2019, p. 30)

The combination of these attributes is often challenging to find. During this period of increased automation and reliance on machines, the roles that remain for humans to provision financial products and services require comfort collaborating with cognitive technologies in entirely new ways (Saikia & Hazarika, 2017; Schwab, 2018; Schwartz et al., 2018).

Yet leaders described limited strategic alignment, vision, and support for the extent of workforce transformation required. Limited programs are in place to provide tools and support for teams. One leader explained how internal reskilling efforts and external recruitment approaches remained similar to a decade ago, with only incremental improvements. For example, the use of tools like LinkedIn for targeted recruiting or

learning purposes added value to their organization's talent management practices but was not a more dramatic reconception of how their firm can handle external recruiting or workforce learning. The resulting *concrete experiences* for executives were a growing gap between the talent required for the future of the sector and the supply available within the marketplace (Bentley et al., 2018; Evans-Greenwood et al., 2017).

Additionally, financial services leaders described *concrete experiences* where these had been an absence of broader societal support.

> Absent direct policies and concerted action…the economy of the future could fail to create a broad base of well-paying jobs with stable wage growth and benefits. As important as these issues are for the US and other developed nations to examine and address, they also have important ramifications for developing countries. Many nations have been on a deliberate path to mimic the economic growth path taken by developed countries. These countries have embraced the process of advancing urbanization and shifting the workforce from agriculture to manufacturing to services, with a view toward preparing more labor to participate in high-value, higher-income activities. Yet technological developments may have created a break in the development chain.
>
> As important and necessary as education investment are, their impact will be limited if not undertaken in concert with a holistic range of economic and social policies. This may well include a new look at a range of economic levers, including changes to the tax code, increases to minimum wage, reform of unemployment and wage insurance, effective savings programs, and modified compensation structures. Beyond income, more may need to be done to address the cost and access to decent housing and health care at the community level. (Farrell, 2019, p. 4)

The education system, while still effective at producing a talented workforce, is doing so at a pace and with the capabilities appropriate for the 20th century, not the 21st. The results have meant a failure to meet the growing demand for talent in a broad set of disciplines (Farrell, 2019; Hockfield, 2019). Other forms of societal support—like public policy—were also experienced as limited. Some leaders had experienced preliminary dialogues with regulators and governing bodies around the types of cognitive technologies being utilized across their firms and the associated controls that may or may

not yet be in place (Murphy, Garg & Sniderman, 2019; Schwab, 2019). However, these preliminary dialogues have not materialized into a systemic strategy or execution approach for industry-wide governance (Bostrom, 2014; Ford, 2018; McWaters, 2018; McWaters & Glaski, 2017; Murphy et al., 2019; Schwab, 2019). Interest from select regulators like the Federal Reserve Bank (FRB) and the Basel Committee for Banking Supervision (BCBS) led to initial dialogues but did not yet materialize into an approach to transition the industry.

> As artificial intelligence (AI) gains popularity in the banking sector, it is attracting attention from regulators. The application of AI in banking has many benefits… however, it also has some drawbacks, including the potential for lack of transparency and bias in the algorithm's decisions and potential risks to financial stability. The U.S. Treasury Department released a report, embracing the development of "competitive technologies" in the financial services sector. Meanwhile the Financial Satiability Board has publicly acknowledged the benefit of AI solutions to consumers. The Fed supports banks adopting AI because it is concerned that non-regulated entities may derive an advantage over existing banks form using AI. However, it remains unclear how AI fits into the existing regulatory landscape. (Schoeps, 2019, p. 2)

Ultimately, there are an emerging set of experiences leaders across financial services have begun to encounter at the start of the 4IR, namely experiences related to industry adoption, their own roles in leading the transformation of the sector, the preparedness of their workforce, and the limited forms of broader societal support. What are the resulting *reflective observations* they have gathered from these experiences?

Interpretive Category #2: Reflective Observation

The second interpretive category focuses on the second stage of Kolb's *experiential learning* framework, *reflective observation* (see Figure 16). What are the *reflective observations* and reflections of financial services leaders involved in the 4IR?

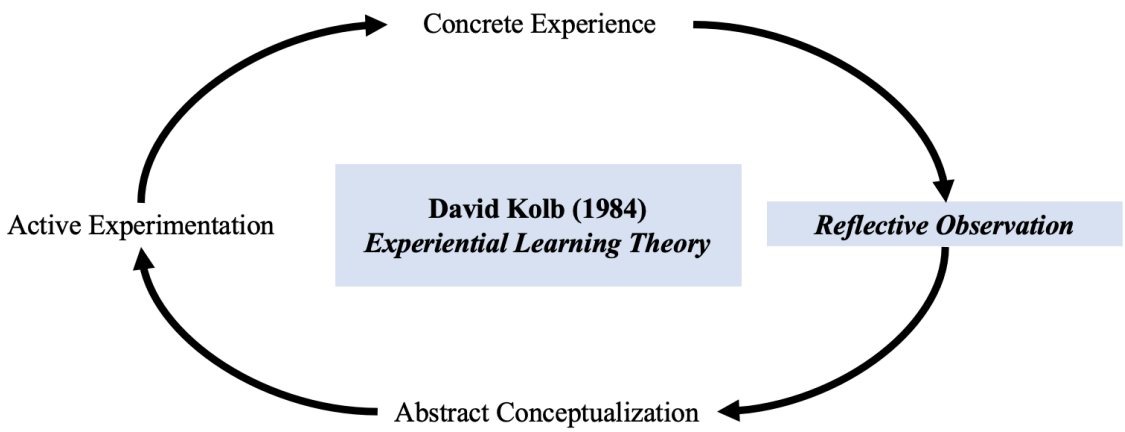

Figure 16. Reflective observation

The first *reflective observation* from leaders involved in this study dealt with the scale of change. Executives consistently cited that the changes underway are more extensive and pervasive than any individual industry or type of technology. The changes affect every aspect of society—from transportation to health care, from how large cities operate to how children are raised. Where prior periods of change may have impacted a particular sector, perhaps transportation, through the advent of a particular type of technology, like the steam or combustion engine, the current breadth of scientific advances is affecting the entire system simultaneously (Baden-Fuller & Morgan, 2010; Baden-Fuller & Mangematin, 2013; Brynjolfsson & McAfee, 2016; Friedman, 2016; Loucks et al., 2018).

Leaders also observed that the pace of change has been unprecedented compared to prior periods of societal change—with one executive referring back to the advent of language, or the move from hunter-gatherer to agrarian society, neither of which involved the rate of change as the 4IR does. Recent advances in an extensive array of fields dwarf earlier periods of change. For illustrative purposes, the scientific revolution of ancient

Arabia, circa 786-1258 C.E. (Common Era), lasted several hundred years, and the industrial revolution of the late 1800s and early 1900s lasted several decades. Yet the equivalent degree of change is currently transpiring in a matter of years (Chui & McCarthy, 2018; Loucks et al., 2018; Lund et al., 2019).

Leaders also reflected on the degree to which their level of comfort and effectiveness leading large-scale change programs have matured over the course of the past several years (Besenbacher et al., 2019; Chui et al., 2018; Renjen, 2019). Their reflections were consistent with the existing literature. McKinsey Quarterly conducted a survey in 2018 entitled *The Cornerstone of Large-Scale Technology Transformation* which involved over 500 CEOs across industries. It reinforced what financial services leaders in this study suggested, namely that leaders believe there is as much as 50% potential for increased value as a result of disruptive technologies, yet their organizations and workforces are struggling with the identification, application, and delivery of solutions at scale and at a fast enough pace (Bender, Henke, & Lamarre, 2018). Part of the issue appears to be a lack of common understanding of what is meant by the terminology (e.g., artificial intelligence, internet of things [IoT]). This lack of definitional clarity creates a misalignment among leadership teams (Chui & Malhorta, 2018; McWaters, 2018).

> When business people talk about AI, they typically are not talking about a particular technical approach or a well-defined school of computer science, rather they are talking about a set of capabilities that allows them to run their business in a new way. At their core, these capabilities are almost always: a suite of technologies, enabled by adaptive predictive power and exhibiting some degree of autonomous learning, that have had dramatic advances in our ability to use machines to automate and enhance. (McWaters, 2018, p. 11)

Leaders progressed from a state of initial hesitancy, seeing unclear and ambiguous outcomes, to having a greater sense of control for how to best support the changes underway in the nature of work (Besenbacher et al., 2019). Executives observed that they are increasingly more comfortable with particular forms of cognitive technology (e.g., RPA, NLP) and are progressing their foundational knowledge for those they have not yet successfully scaled (e.g., machine learning) (Holden & Smith, 2016; Kark et al., 2019; Loucks et al., 2018). A large part of this increasing comfort was attributed to the progress their organizations have made with enterprise governance, having established a preliminary set of guidelines, standards, and controls to oversee these cognitive technology capabilities effectively at scale (Murphy et al., 2019; Schwab, 2019). This is consistent with findings from other studies, including those exploring other industries like telecommunications or consumer products where enterprise-level governance over cognitive technologies is starting to mature (Besenbacher et al., 2019; Chui & Malhorta, 2018; Daecher et al., 2018; Ford, 2018; Renjen, 2019).

Another *reflective observation* shared by many executives in this study, which was reinforced by the current literature, was how the financial services ecosystem will continue to evolve and center around technology—not finance—with new providers, different partnerships, and shifts in the supplier landscape (Daecher et al., 2018; Kansu & Parker, 2018; Renjen, 2019). “Every company is now a tech company and every employee a technologist…[which] is particularly relevant as the line between business and technology organizations continue to blur” (Briggs & Buchholz, 2019, p. 9). At the heart of providing effective financial services and products in the 4IR is enabling technology breakthroughs in cloud and quantum computing, which will be equally as

important as any finance-specific innovation—like new trading or portfolio diversification techniques (Briggs & Buchholz, 2019; Crevier, 1993; Loucks et al., 2018; Tang, 2019).

> The cloud gives us the ability to achieve rapid scale and elasticity of computing power exponentially beyond our own capacity. This will be especially relevant as we scale our artificial intelligence efforts. The cloud platform is agile and flexible. It offers access to data sets, advanced analytics and machine learning capabilities beyond those internal to our firm. It increases developer effectiveness by multiples. And certain tasks, such as testing code and provisioning compute power are automated. (Dimon, 2019a, p. 34)

Leaders also made *reflective observations* about the nature of change, which has not been gradual but rather a dramatic reshuffling of how consumers procure financial products and services. Most notable has been the pace at which entire institutions have been disrupted due to the power of digital capabilities (e.g., mobile), allowing niche players (e.g., in the payments space) to enter the marketplace and upend established institutions in a matter of months. Leaders made similar observations to executives cited in other studies, for example, observing that blockchain will be the next digital disruptor for the financial services ecosystem, altering the composition of the institutions and workforces that comprise the sector (Brainard, 2018; Daecher et al., 2018; Renjen, 2019).

Leaders also reflected on the ways in which the nature of work within the sector has changed over the last couple of decades, with work having become less routine and activities more complex and creative (DiChristina & Meyerson, 2019; Loucks et al., 2018; Loucks et al., 2019). They observed that most roles now require the ability to lead business model change—across people, processes, and technology—with design thinking (Baden-Fuller et al., 2013; Baden-Fuller et al., 2010; Bodrozic & Adler, 2018). One leader described how the emergence of functions like DevOps (Development Operations)

or Site Reliability Engineering (SRE) provide examples of newer roles that have been formed to provide additional levels of process redesign and continuous improvement energy within the technology and operations functions of financial services.

> The future of work is not just about how many jobs could be lost and gained. Technology is altering the day-to-day mix of activities associated with more and more jobs over time. The occupational mix of the economy is changing, and the demand for skills is changing along with it. Employers will need to manage large-scale workforce transformations that could involve redefining business processes and workforce needs, retraining and moving some people into new roles, and creating programs for continuous learning. This could be an opportunity to upgrade jobs and make them more rewarding. The choices that employers, make will ripple through the communities in which they operate. (Lund et al., 2019, p. 1)

In the front office, leaders had *reflective observations* about how technological advances have also dramatically changed the nature of human work activity. Trading, for example, no longer requires physical proximity to the stock exchange to execute a trade. Client service in retail banking has also changed dramatically due to digital advances, with many more services consumed electronically, requiring less involvement from the traditional human workforce—like tellers, branch managers, or customer service representatives. These changes in the nature of the business result in changes in the underlying work for those supporting the industry. For example, branch support staff are held to much different expectations in the 21st century to cross-sell products and services, and interact with clients in a much more dynamic, creative, and customized way, than they were a decade ago when their roles were much more straightforward and repetitive and involved less stakeholder management (McWaters, 2018). According to Volini et al. (2019):

> The use of artificial intelligence, cognitive technologies and robotics to automate and augment work is on the rise, prompting the redesign of jobs in a growing number of domains. The jobs of today are more machine-powered, data-

> driven then in the past, and they also require more human skills in problem-solving, communication, interpretation and design. (p. 28)

This is consistent with existing literature. For instance, Deloitte's *Second Annual AI in the Enterprise Survey*, which involved 1,900 Information Technology (IT) and line of business (LOB) executives, from seven countries (Australia, Canada, China, Germany, France, the United Kingdom, and the United States), 80% of respondents believe that their human workforce will be augmented by AI technologies to produce new ways of working, and AI will support their employees to make better decisions while enhancing their performance and satisfaction levels (Loucks et al., 2019, p. 15). These changes in the future of work are happening across several dimensions. The *work* activities themselves are evolving, who does the work—or the *workforce*—is changing, and where work is being performed—or the *workplace*—is also adapting (Kark et al., 2019) (see Figure 17).

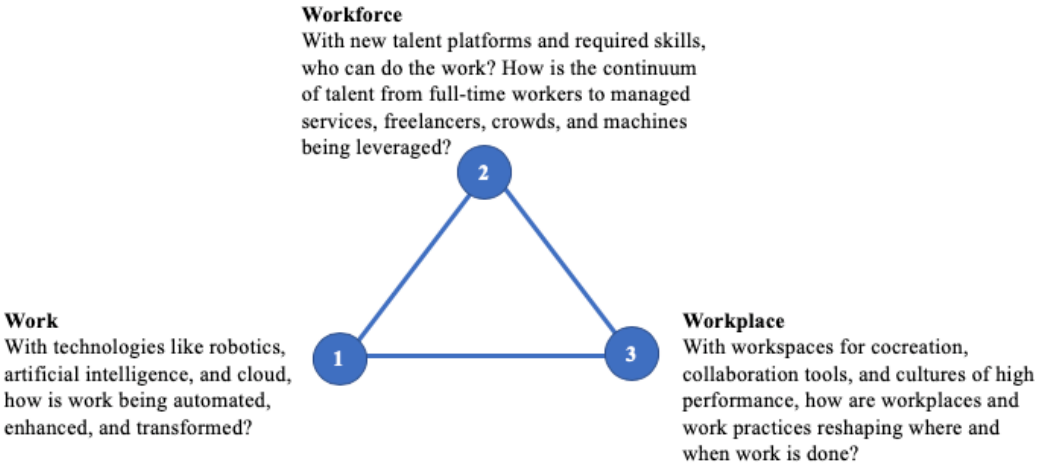

Figure 17. The future of work (adapted from Kark et al., 2019, p. 8)

As technology continues to be an integral part of day-to-day operations within financial services, *work* is evolving toward greater human-machine collaboration. How

do people, robots (bots), and algorithms work together to be most effective? Technology teams are starting to do this by moving away from project- and process-based delivery to more outcome-based delivery. They are creating value with the business much closer to the customer—providing a much more human and meaningful work experience for the workforce (Bentley et al., 2018; Hagel et al., 2018; Schwartz et al., 2019).

The composition of the *workforce* and who is involved in the financial services delivery model is changing as well. Jobs, roles, talent, skills, and the resulting organizational structures required have been adapting which force changes in employment models. Some of these involve the gig economy and crowdsourced talent, with less traditional full- or part-time salaried employment scenarios (Abbatiello et al., 2018; Agarwal et al., 2018).

The *workplace* itself is also changing, with less focus on location and more on relationships. Workspaces are designed to maximize collaboration, productivity, and co-creation. Across geographic locations, virtual offices, coworking spaces, and traditional office space, there is a seamless integration of technologies to allow humans and machines to collaborate to facilitate business outcomes (Kark et al., 2019).

Leaders involved in this study observed that the talent most in demand in this new era are those able to navigate complexity with critical thinking, creativity, and empathy. This talent is adept at working in teams, comfortable in failing quickly to reapply learning, and perseveres in the face of adversity. Executives observed that finance-specific skillsets, while still important, need to be combined with STEM capabilities to actually redesign and improve the way a particular financial activity transpires. This is consistent with the literature which suggests that demand for these unique skills remains

high and supply low (Kao & Vankatachalam, 2018; Keywell, 2017; Stolzoff, 2018). There is a limited pool of talent from which executives are competing to source skills, not only against peer financial institutions but against leading technology firms. Financial services leaders observed that finding ways to continue to differentiate themselves remains challenging, and the ability to compensate effectively remains one of the primary incentives allowing the sector to compete for STEM talent (Abbatiello et al., 2018; Agarwal et al., 2018; Volini et al., 2019).

Executives were equally critical in their reflections on their own role supporting the workforce transition required, which was consistent with the literature. McKinsey Global Institute's 2019 study on the *Future of Work in America* suggested a growing disparity geographically between locations with more well-educated talent and public-private partnerships and investments, and those without.

> Analysis of 315 cities and more than 3,000 countries shows that the United States is a mosaic of local economies with widening gaps between them. Twenty-five megacities and high-growth hubs, where 96 million people live, have generated most of the nation's job growth since the Great Recession. These are the nation's most dynamic places, with high-growth industries, many high-wage jobs, and young, educated workers. By contrast, 54 trailing cities and roughly 2,000 rural counties, collectively home to 78 million people, have older and shrinking workforces, higher unemployment, and lower educational attainment. Between these extremes are thriving niche cecities and a larger 'mixed middle' with modest economic growth; 94 million people live in these segments.
>
> These diverse starting points affect whether communities will have the momentum to offset automation-related displacement. The same 25 cities and peripheries that led the post-recession recovery could capture 60 percent of US job growth through 2030. The next wave of automation will affect occupations across the country, displacing many office support, food service, transportation and logistics and customer service roles. At the same time, the economy will continue to create jobs, particularly roles in healthcare, STEM field and business services.
>
> Communities need to prepare for this wave of change, focusing in particular on job matching and mobility, skills and training, economic development and job creation, and support for workers in transition. They can draw on a common toolbox of solutions, but the priorities vary from place to place.

> Without bold, well targeted interventions, automation could further concentrate growth and opportunity. But these trends are not set in stone. It is possible to turn this period of technological change into an occasion to create more rewarding jobs and build better learning systems and career pathways. The United States needs the energy and ingenuity of its private and public sectors, as well as local coalitions working on the ground in communities. A fresh commitment to investing in people and places can lift up more Americans from coast to coast. (Lund et al., 2019, p. vi)

Leaders involved in this study did not believe their institutions have been doing enough proactively or systemically to establish the kinds of programs to build the future skills their business requires. They reflected that despite their shortcomings, if they do not step up to lead the charge, it is unlikely to come from other sources (e.g., educational institutions, government agencies). They critically observed that the business community regularly sets the pace for change, with nonprofit, government, and educational institutions quickly looking to partner and follow suit. Thus, financial services executives feel a sense of obligation and responsibility for further action. What are the resulting *abstract conceptualizations* financial services leaders have established?

Interpretive Category #3: Abstract Conceptualization

The third interpretive category focuses on the third stage of Kolb's *experiential learning* framework which involves *abstract conceptualization* (see Figure 18). What are the theories financial services leaders formed to explain their observations? What modifications are there to existing frames of reference?

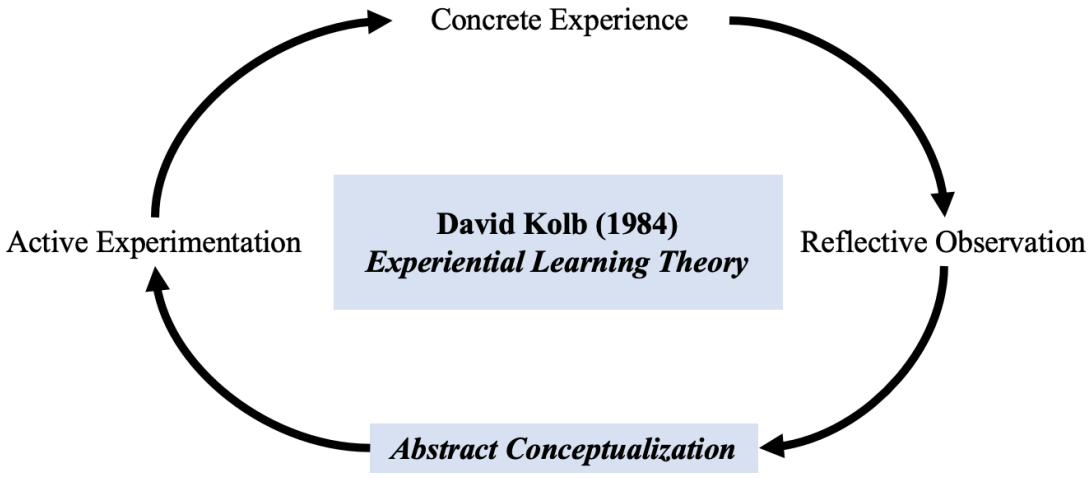

Figure 18. Abstract conceptualization

In contrast to relying on direct experience, leaders are also making sense of reality through classification schemes, using layers of concepts to understand how pieces of information relate to one another—by drawing abstractions. "The word 'percent' was absent from books in 1900. By 2000 it appeared about once every five thousand words" (Epstein, 2019, p. 44). Use of new concepts to convey ways of thinking is a critical human capability. At the start of the 4IR with the use of new disruptive technologies, financial services leaders are only beginning to establish an entire suite of new concepts to create meaning from their experiences.

The first new *abstract conceptualization* discussed by executives during this research involved redefining the value proposition of the financial services business. Leaders believed the future of the sector is technology—not finance—and that traditional lines of distinction between "the business" and "technology" will continue to disappear. This is consistent with leaders in other sectors who similarly described the future of every business being centered around technology (Briggs & Buchholz, 2019; Kark et al., 2019).

This is resulting not just in a reconception of how a financial services institution is organized to deliver a product or service, but how that organization partners with its suppliers, vendors, and other providers in the marketplace to provide an entire platform and ecosystem of products and services (Dickson et al., 2018; Friedman & Canaan, 2018; Kansu & Parker, 2018). The entire stakeholder value chain for financial services is being reconceived and connected in new ways, unlocking potential value while disrupting the status quo.

In tandem with this reconception of the nature of the business, executives are forming new conceptual understandings of the underlying technologies driving the change—from natural language processing to machine learning. Individual leaders are at different stages of comprehension, evolving their understanding about each type of technology (e.g., the power of blockchain) while simultaneously forming new conceptualizations of how the full suite of cognitive technologies can best provide value (e.g., approaches to utilize them systemically for the enterprise). As a result, leaders are being forced to establish new approaches toward governance and oversight as the sheer power of AI requires new ways of thinking about risk management and controls (Loucks et al., 2018; Renjen, 2019).

Historically, the financial services industry has been highly regulated, but the introduction of cognitive technology is forcing new conceptual frameworks for risk mitigation. For example, leaders discussed how they are having to grapple with the potential that an automated algorithm denies someone a loan or a mortgage based on patterns of existing data which are based on past data and, therefore, prior human decisions. The historical data may be biased as a result, based on the biases of the

individual making the previous decisions (e.g., racial bias) upon which the algorithm is learning. A substantial amount of work is underway within the legal, compliance, and regulatory affairs departments of the leading financial services institutions to redefine risk frameworks and control guidelines and standards associated with the broad use of artificial intelligence within the industry (Murphy et al., 2019; Schwab, 2019).

Another area requiring leaders to establish new conceptual frameworks is execution delivery. Leaders described needing innovative new approaches to deliver complex change programs at the pace and scale demanded in the 4IR. Prior periods of large-scale enterprise technology adoption, like Enterprise Resource Planning (ERP) implementations with software companies like SAP, or Customer Relationship Management (CRM) implementations with software companies like Salesforce, are not entirely comparable to the current type of change because of the breadth of interrelated technology capabilities across myriad business processes. This has forced leaders to reconceive traditional program delivery approaches (Schatsky et al., 2018).

Due to the increased use and prevalence of emerging technologies, leaders involved in this study have also been faced with reconceiving work itself. Automation and cognitive technologies change the capabilities required of the human workforce. Leaders involved in this study were consistent with existing literature in describing a skills challenge; being able to redefine the skillsets needed for the 21st century. The McKinsey Global Institute estimates that by 2030, 375 million workers globally and more than 30% of the workforce in the United States will need to upgrade their skills considerably (Manyika et al., 2017).

Executives felt new theoretical constructs are required to redesign the roles, responsibilities, and decision rights for an era of increased human-machine collaboration. Key notions like having an agile approach and mindset mean that traditional roles like a Project Manager or Business Analyst are declining, while new roles like Product Owner, Agile Portfolio Manager, and Digital Strategist have emerged. The increased focus on adaptive, multidisciplinary execution has meant that roles like Systems Engineers are declining, while Cloud Architects, Data Scientists, and DevOps Engineers are on the rise. These new roles help establish the technology architecture of financial services firms, gain insight from the firms' data, and deliver user-friendly experiences for clients and customers. Leaders can not only design the new roles while providing clarity on the type of organizational structures required to support these new disciplines but conceive of new approaches to transition the workforce through reskilling efforts. This was consistent with the literature.

> Recoding work for the future demands a new approach: not just rewriting job descriptions but starting with a broader canvas and composing the work so it can take advantage of machines, workers in alternative work arrangements [e.g., gig or crowdsourced workers] and unique human capabilities such as imagination, curiosity, self-development, and empathy. This constrains with traditional approaches to creating job descriptions which have been defined by a narrow set of skills, activities and tasks…. A job canvas on the other hand take as more expansive, generative and meaningful view. In the future, work will be defined by: the outputs and problems the workforce solves, not the activities and tasks they execute, the teams and relationship people engage and motivate, not the subordinates they supervise, the tools and technologies that automate and augment work to increase productivity and enhance value to customers, and the integration of development, learning and new experiences into the flow of work. (Volini et al., 2019, p. 31)

The emergence of new technology disciplines also means leaders are having to reconceptualize human-machine collaboration and the way in which cognitive technologies can supplement and complement human capabilities (Evans-Greenwood et

al., 2019; Guszcza, 2018; Guszcza & Scwhartz, 2019). Technology augmenting human work-activity is not a new concept in the 21st century. Tools—like the creation of writing instruments or the automobile—have been incremental progressions to augment human capability. Yet recent advances in cognitive technology are progressing far more quickly and with increasing levels of sophistication than prior periods (e.g., self-driving vehicles, drones, smart-cities, smart-homes) (Biggs & Buchholz, 2019; DiChristina & Meyerson, 2019; Harari, 2017; Hockfield, 2019).

The results of these changes in the nature of work have created a need for financial services leaders to establish new theories around human capital/talent management. Leaders interviewed discussed how their organizations need to define and manage a cohesive workforce strategy that is flexible enough for the varied workforce segments—employees, contractors, consultants, crowdsourced talent, robots. This is consistent with the literature that discusses how talent models must also provide the necessary set of experiences for external and internal talent to continually refine and enhance their capabilities through ongoing learning and development. Changes in technology and its effect on financial services business models have created a tremendous demand for continuous, lifelong development (Baden-Fuller et al., 2013; Baden-Fuller et al., 2010; Bender et al., 2018; Bodrozic et al., 2018). Leaders recognized that more than half of their workforce will require significant reskilling or upskilling in a matter of a few years (Manyika, 2017; Schwab & Samans, 2018).

One of the ways in which organizations are attempting to address this gap is to making learning more personal and integrated into work more tightly. This creates an opportunity to build robust work-centered learning programs, helping people consume

information and upgrade their skills in the natural course of their daily jobs. With mobile and wearable devices becoming omnipresent, and augmented and virtual reality becoming more mainstream, organizations are beginning to reconceptualize approaches to learning throughout the workday. This is consistent with the literature discussing how technology is playing a role in making learning more personal and targeted to the individual, delivered at convenient times and in convenient methods (Hart, 2019; Parmalee, 2019).

Beyond changes within financial services institutions, their leadership teams and their workforces, executives believed educators, administrators, and government officials must also reconceptualize education to prepare the next generation to take advantage of the plethora of opportunities enabled by technological change. This involves redefining the purpose of education, which has evolved based on the needs of society in the 20th century, not the 21st. In the 4IR, everyone will require a mix of technical and non-technical skillsets while considering how to use technology morally and ethically, leveraging disciplines in the humanities (e.g., philosophy, psychology, politics) (Abbatiello et al., 2018; Volini et al., 2019). Education entrepreneur Rohan Roberts (2018) stated in his book *Cosmic Citizens and Moonshot Thinking: Education in the Age of Exponential Technologies* and sentiment that was echoed by leaders in this study*:*

> Once we acknowledge that the purpose of education should be to develop upstanding cosmic citizens who will solve the problems of the world then we can focus on other priorities related to the purpose of education: to create individuals who are scientifically literate and can think critically, to create individuals who are self-reliant and can survive independently as adults, to promote creativity, kindness, innovation, collaboration and curiosity. (p. 8)

Leaders interviewed felt the principles of education and the associated act of educating must be dramatically reconceptualized to address the needs of the 4IR and the

exponential growth in an array of disciplines that are converging to change all aspects of life. American philosopher John Dewey (1944), while speaking in the middle of the 20th century about refining the education system for changes underway post-World War II, noted that "if we teach today's students as we taught yesterday's, we rob them of tomorrow" (p. 167). Executives felt similar changes were required for society in 2019. Rather than focusing on specialization, education should involve broadening the mind through conceptual, transferable knowledge. Tactically, this means computer science students should also study art history. But it is more extensive than this—everyone needs habits of mind that allow them to integrate and synthesize across disciplines. Leaders involved in this study were consistent with the literature in suggesting everyone needs to be involved in reconceptualizing education for the 4IR.

> A future of work that is broad-based and broadly accessible by the majority of people will require a range of purposeful interventions by government, the private sector and the civic sector. Society must renew its focus on workforce preparation so that more people can participate in new, higher-value activities. This is important not only for future generations but also for existing workers like to be displaced. Closing the existing skills gap will require both investments and changes in education and to our ideas about when education stops. Society needs to adopt a view of continuous learning and reskilling throughout a person's life, with emphasis on more demand-driven and vocation training and greater focus on team-based skills and cross-functional and disciplinary integration. (Farrell, 2019, p. 4)

Interpretive Category #4: Active Experimentation

The fourth interpretive category focuses on the fourth stage of Kolb's *experiential learning* framework, that of *active experimentation* (see Figure 19). This involves using new theories to solve practical problems and make decisions. How have financial services leaders applied new ideas to the world around them?

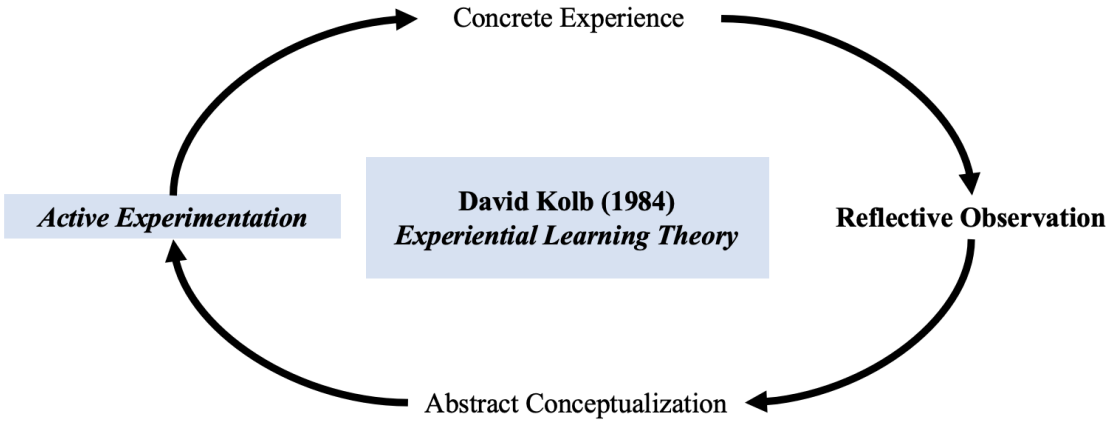

Figure 19. Active experimentation

The most notable form of *active experimentation* within financial services during the 4IR has involved piloting distinct forms of emerging technology in different parts of the business with the goal of improving operational efficiency, customer experience, and shareholder value. Leaders described how lessons learned from one pilot with a particular form of cognitive technology are analyzed to scale the capability more effectively in other areas of the business. Initial experimentation was cautious, with leaders settling on easy wins that provided explicit returns on investment, e.g., automating a business process to eliminate roles that resulted in direct headcount savings (Shiver, 2017; Varian, 2019). However, leaders have become increasingly comfortable with the opportunity associated with each technology and are therefore more willing to attempt more complex business activities (Schatsky et al., 2015; Schatsky et al., 2018).

Leaders have also been experimenting to determine which forms of cognitive technology have the greatest impact on which types of business activities. Certain capabilities—like natural language processing—are valuable in an array of areas, from the front office, supporting client-facing interactions and exchanges, to the back office,

supporting human resource (HR) and information technology (IT) service desks as they interact with employees. Other forms of more complex machine learning algorithms that analyze vast sets of data to detect patterns and reach decisions, however, have primarily been leveraged for the front office, in attempts to differentiate financial services firms from their competitors.

As experimentation into how cognitive technology can transform business activities is actively underway, a parallel opportunity is being explored to determine how new technology augments the human worker. Leaders explained *active experimentation* that was consistent with the literature; as more structured work activities became automated by machines, more creative and strategic work remained for the human workforce (Ringer et al., 2015; Guszcza, 2018; Guszcza & Schwartz, 2019). Roles are becoming redesigned, with real people operating in new capacities, actively experimenting with how to collaborate in new ways across physical, geographic, and machine-interface boundaries to deliver services to clients (Hagel & Wooll, 2019; Hagel, Wooll & Brown, 2018).

> As machines replace humans in doing routine work, jobs are evolving to require new combinations of human skills and capabilities. This creates the need for organizations to redesign jobs—along with their business and work processes—to keep pace. (Volini et al., 2019, p. 30)

Additional experimentation is underway with how organizations source and develop talent. Organizations have more options due to the open talent economy, expanding talent sources beyond salaried employees, traditional consultants, contractors, and managed service providers, to include gig workers and crowdsourced talent that complement robots and machines (Volini et al., 2019). This has provided new sources for critical skillsets required to deliver services and products to clients in new ways and at

lower margins. Organizations are experimenting with these new approaches to develop talent as a way to solve niche business problems (Argawal et al., 2018; Hagel et al., 2018).

Another area of *active experimentation* involves approaches to governing AI at the enterprise level. Executives indicated they have made progress over the past couple of years, determining how best to oversee the application and ongoing use of cognitive technologies. Participants described similar approaches where their organizations identify hundreds of potential use cases across different business processes and functions, which are then whittled down to determine which to pursue, which providers to partner with, which underlying technology platforms to utilize, and similar governance questions. This was consistent with the literature where, for example, Deloitte's *Second Annual AI in the Enterprise Survey* of over 2,000 C-Suite executives in the private and public sector, reinforced a positive correlation between organizations that consider ethics of disruptive technology and their growth rate. Organizations that were being deliberate about putting policies, procedures, and metrics in place to govern their success with AI were also realizing faster adoption rates (Loucks et al., 2019).

These efforts around governance have also led to experimentation around how best to utilize new cognitive technology tools to enable a radically safer financial system. Leaders discussed *active experimentation* through enhanced optical scanning and big data pattern recognition, then institutions are able not only to analyze independently and make decisions more rigorously and quickly, but partner with others within the broader ecosystem to do so—for example, to prevent money laundering and fraud.

Organizations are also experimenting with vendor partnerships and suppliers in new ways to establish more platform-based businesses (Brynjolfsson & McAfee, 2016; Daescher et al., 2018; Dickson et al., 2018; Friedman, 2016; Friedman & Canaan, 2018; McWaters, 2018). The entire stakeholder value chain in financial services is being connected in new ways through networks of people, information, and now things (e.g., IoT). These new partnerships are emerging in unique areas, from partnerships to share and leverage vast quantities of data for machine learning algorithms, to new service provider relationships as financial institutions refocus on their core capabilities, further outsourcing back-office activities. Most notable are partnerships forming directly around the cognitive technology solutions themselves, rather than those happening as a consequence of it (Friedman & Cannan, 2018; Kansu & Parker, 2018; McFarlane, 2019; McWaters, 2018; Tang, 2019). For example, the Interbank Information Network (IIN) was cited as a partnership between leading banks to utilize Blockchain for cross-border peer-to-peer payments, reaching beneficiaries faster and with fewer intermediary steps.

Finally, financial institutions are actively experimenting with reskilling. In some cases, this has resulted in launching investment initiatives with local governments or educational institutions to drive the kinds of digital literacy and workplace skills required for the future of the business (Argawal et al., 2018; Schwartz et al., 2017; Schwartz et. al., 2019; Volini et al., 2018). In other cases, this has resulted in more traditional internal upskilling through the design of new collaboration and cross-sharing structures or *active experimentation* events like hackathons to bring technologists together to work on solving complex problems (Bentley et al., 2018). This *active experimentation* has led

beyond individual learning for executives within the industry to larger systemic learning opportunities.

Interpretive Category #5: Incidental and Informal Learning

The fifth interpretive category transitions from individual learning to the larger enterprise learning environment. It involves the *incidental* and *informal* learning underway within the financial services industry during the 4IR. What is the degree of *incidental* and *informal* learning within the sector, and what is the impact?

Informal and incidental learning involves systemic, symbiotic growth and development. One of the forms this type of learning can take is through formal mechanisms, like structured training programs. However, more frequently than not, learning involves less structured engagement through *incidental* and *informal* means due to the dynamic settings within which people and ideas interact during the course of business (Kasl, Marsick, & Dechant, 1997; Marsick & Watkins, 2001). These research findings suggest that beyond learning underway for the individual leader, the financial services ecosystem—the leadership teams, their organizations, and the industry as a whole—is also doing a great deal of *informal* and *incidental* learning. See Table 12 for an overview of the types of *incidental* and *informal* learning underway during the 4IR.

Table 12

Incidental and Informal Learning Underway During the 4IR

Financial services leaders are learning:

- About the potential associated with various forms of disruptive technology (e.g., what is machine learning and how can it be used?)
- How to apply cognitive technology to the operations of their business to realize the most impact?
- How to design collaborative operating models as part of business-as-usual operations to support the human workforce partnering alongside cognitive technologies?
- How to govern and oversee cognitive technologies across the enterprise at scale?
- How to partner with vendors, suppliers, and others in the marketplace to create more platform-based ecosystems?
- How to build and maintain dynamic, sustainable talent models?

In 2019, the application of cognitive technologies within financial services is still in its infancy, with organizations starting to utilize these capabilities as recently as 2016 or later (Bruno et al., 2015; McWaters, 2018; McWaters & Glaski, 2017). Therefore, much of the systemic learning underway involves developing foundational understanding about these new disruptive technologies, and how to apply them to the business most effectively. This type of discovery is taking place informally, through early exposure. Yet very few organizations have deliberate, large-scale educational campaigns to upskill their workforce in a comprehensive way, across the broad suite of cognitive technologies available. Most executives agreed it would be beneficial to extend beyond *incidental* and *informal* learning toward a more structured workforce development program.

Another area where systemic learning is transpiring incidentally has been the application of cognitive technology, which some executives described as “the wild west”, echoing the early days of U.S. history where there was a connotation of a free-for-all, with limited rules, infrastructure, governance or oversight in the western part of the newly forming country. Different parts of an institution may invest in ways that are at

odds with one another, with some choosing to focus on particular forms of technology or with specific vendor partnerships, and other areas of the business choosing to be much more comprehensive, piloting a full suite of technologies, with a diverse set of partners. The learning that transpired as a result was *incidental*, with select segments of the workforce fortunate enough to have been exposed and other segments left without exposure. This has left a haphazard landscape. Most financial services organizations still did not have a clearly articulated vision for AI at the start of 2019, with stakeholders aware and buying into the rationale for transformation. Yet without clarity of vision and purpose, efforts to execute will remain disjointed, with leaders unaligned and moving in different directions.

Since initial attempts in 2016-2017, approaches to applying cognitive technologies have evolved to become more intentional, and therefore learning and development for the financial services workforce has started to become more formalized and comprehensive. However, it was not lost on the leaders interviewed how critical the early *informal* and *incidental* learning was that transpired within their institutions during the first couple of years of experimentation. It was a competitive differentiator, such that those organizations who were quick to experiment and adapt accordingly were more effectively positioned today than those which were slower moving.

Another area where *incidental* and *informal* learning occurred was after the organization successfully adopted a particular form of cognitive technology. Leaders explained how their organizations were forced to define and operationalize new ways of working in light of the new human-machine collaboration. As cognitive technology use automates and augments business processes, it changes the work activities themselves,

who does the work, and where the work is performed. Executives found the greatest value from symbiotic human-machine collaboration; yet operationalizing new engagement models between a machine learning algorithm and a set of traders, or an automated tax compliance robot and a financial analyst, requires redefining the set of activities performed by each party. This requires new levels of design thinking to identify the ways in which machines can supplement and complement humans in the provisioning of a business activity, service, or product. This type of organizational role redesign has been happening informally and incidentally, with leaders learning on the go (Bentley et al., 2018; Evans-Greenwood et al., 2017; Hagel et al., 2018).

As cognitive technologies become more prevalent, organizations are also grappling with how to govern and oversee these capabilities across the enterprise. This has brought with it another set of *informal* and *incidental* learning experiences. Since the financial services industry is heavily regulated, monitoring how new technologies are deployed and controlled is critical. Use of a new algorithm to support loan or mortgage origination may drive greater efficiency in the business, but until appropriate controls are demonstrated, its use may be biased in one way or another and therefore limited until appropriate risk management and controls can be demonstrated. The ethical aspects of how to best deploy and utilize these technologies are therefore an area where leaders are seeking to evolve beyond *informal* and *incidental* learning toward more formal approaches—as are the regulators and industry oversight organizations (Murphy et al., 2019; Schwab, 2019).

Another area where organizations have had to learn informally involves how best to form ecosystems, partnerships, and platforms (Dickson et al., 2018).

> New financial services ecosystems are emerging in Asian countries, building apps on top of existing technology platforms such as WeChat (e.g., Taikang Life). WeChat acts as the interoperability layer, connecting customer data with financial institutions, as well as [financial] institutions to each other. As they grow in size, these platforms become critical elements at the center of these ecosystems, while the financial services providers are interchangeable based on customer preferences. (McWaters, 2018, p. 43)

The 4IR has not only meant changes for how individual institutions are organized to deliver a product or service, with humans working alongside machines, but it has meant changes in the supplier, vendor, and provider marketplace. The entire stakeholder value chain for a financial services institution has changed with new platforms of connected partnerships. Institutions are learning how to partner with one another through *incidental* and *informal* experiences, reshaping their business. Teams are having to take chances on establishing new relationships, embracing new joint ventures, and collaborating with partners in entirely new ways (Friedman & Canaan, 2018; Kansu & Parker, 2018).

Finally, organizations are learning incidentally and informally about what partnerships and investments with educational and public sector institutions will prove the most impactful. The future of learning and human development involves moving beyond discrete disciplines to interdisciplinary problems, beyond mastery of content to connecting content to life situations and productive action (Hart, 2019; Parmalee, 2019). Creating the right mixture of partnerships between the public and private sector to refocus learning and development on tangible needs that will most serve society will help leaders move beyond *incidental* and *informal* experiences into more structured learning that scales (Harari, 2017; Schwab, 2018).

Summary of Discussion

David Kolb's (1984) view of the learning process as a continuous cycle which progresses developmentally, like a spiral, to greater levels of understanding, was a useful place to begin the synthesis and interpretation of this study's findings. Kolb's model helps to demonstrate how individual leaders are experiencing the changes underway during the 4IR and making sense of these experiences to drive action and inform future decisions. The continuum of individual leader perception—from the more concrete to the more abstract—and the way in which these leaders are choosing to process those experiences—either more actively or passively—offers insight for when one approach may be more meaningful than another. (See Figure 20 for David Kolb's continuum of perception versus processing.)

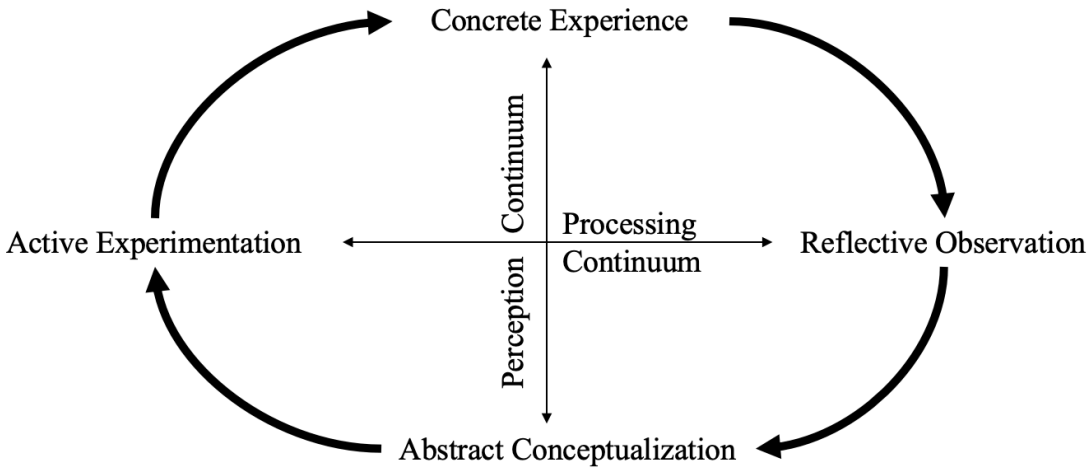

Figure 20. Perception vs. processing continuum

In Kolb's framework, learning can begin at any of the four stages, and this research provided ample examples of learning beginning at each stage on an array of critical issues. Ultimately, the most useful takeaway is the level of relevance and soundness of

Kolb's framework for analyzing and gaining insight into the type of executive learning transpiring in 2019 during the 4IR.

While Kolb's framework was useful for analyzing the experiences of specific leaders involved in this study—the learning theory of Victoria Marsick and Karen Watkins (2001) were equally useful to provide insight into the larger systemic dynamics affecting the financial services workforce more holistically. *Incidental* and *informal* learning through the work of Victoria Marsick and Karen Watkins demonstrated how integrated learning about cognitive technologies, and how best to leverage these emerging capabilities, is into the daily routines of the organizations themselves. The degree of *incidental* and *informal* learning that is unconscious and linked to the development of others is far more extensive within leading financial services organizations than any formal training and development programs. Marsick and Watkins's *incidental* and *informal* learning theory provided a useful lens with which to synthesize and interpret the learning and development underway during the 4IR.

Contributions to the Literature

This research explored the intersection of three marketplace trends converging in 2019—(a) the future of the financial services industry during the 4IR, (b) the use of cognitive technologies within the operations of the business, and (c) the implications for the future of work and human-machine collaboration. Only limited academic literature has thus far addressed the intersection of these topics, in particular leveraging individual learning theories as a foundation to help accelerate workforce transformation. This research was an effort to create an academic context for further research to this end.

Furthermore, this study has the benefit of providing situated research that is embedded in the financial services industry at a point in time in 2019, with insight from those directly in leadership roles grappling with a phenomenon in real time. It is among a limited set of academic research available from within the industry, exploring the modern challenges and opportunities associated with cognitive technology adoption. It also has the unique characteristics of having in-depth qualitative interview data which provided a rich source of insight from these leaders, their departments, and organizations, and as a result, how each individual leader's experience is similar or different from his or her peers. This research is unique in exploring the impact of the 4IR on human-machine collaboration from the vantage points of those in positions to steward the change journey.

Additionally, the findings from this research demonstrated that foundational learning theories—like Kolb's (1984) *experiential learning* framework and Marsick and Watkins' (2001) *incidental* and *informal* learning theory—are still relevant to how humans learn when confronted by modern phenomena. The key principles of these theories—from how individual leaders learn through *concrete experiences* to critically reflect, abstractly conceptualize, and actively experiment, to how groups of individuals learn *informally*, systemically—are prevalent in 2019 in how financial services leaders and their leadership teams are learning and leading. This research suggests that there is increasing opportunity to revisit these foundational learning theories for a new era, in the 4IR, by conducting additional first-hand academic research.

VI—CONCLUSIONS AND RECOMMENDATIONS

Overview

In 2019, human history has reached one of its more pronounced inflection points. The fourth industrial revolution (4IR) is similar in magnitude to other periods of dramatic societal change, like humanity's shift from hunter-gather to agrarian living, the advent of language for verbal and written communication, or the stand-up of the city-state (*polis* in ancient Greek). As with these prior large-scale transitions, the 4IR at the start of the 21st century has brought a great deal of uncertainty and ambiguity, with notable scientific advances across a broad and disparate set of fields simultaneously, from the materials sciences (e.g., 3-D printing) to the computer sciences (e.g., artificial intelligence), that have created new questions and opportunities for charting humanity's course. This research sought to understand how these larger contextual trends were influencing leaders within the financial services sector. Specifically, how they were learning from their experiences utilizing an emerging set of disruptive cognitive technologies—like robotic process automation, natural language processing and machine learning—to shape the future of their business.

Ultimately, the findings suggest that these financial services executives are optimistic about the potential for customers and shareholders to benefit from the use and adoption of cognitive technology within their business operations. Leaders shared powerful examples where distinct forms of cognitive technology were already being utilized to improve and enhance the financial services ecosystem. They explained the challenges related to redesigning work within the sector, and the type of skills most in-

demand as a result of these changes, as well as the challenges they've encountered finding, filling and developing candidates for the new roles and work activities required. Executives acknowledged that to fully materialize the potential of these powerful technologies, greater effort will be required systemically to support a successful transition – not only for their own workforce but for society overall.

In a matter of approximately three years, since early 2016, financial services leaders have seen their organizations progress from having limited strategic direction for how to leverage cognitive technologies to support the future of their business, to having hundreds of chat bots and machine learning algorithms operating around the globe in alignment with a clear AI investment strategy. This rapid proliferation of powerful new technologies has changed human-machine collaboration within the sector by redefining the nature of work, leaving leaders responsible for stewarding a large-scale workforce transition.

Conclusions

The financial services industry is still in the early stages of generating value from the use and application of cognitive technologies, having started in earnest as recently as 2016. As a result, while there is a high degree of confidence in the potential of these capabilities, benefits realization has not fully come to fruition. There has been variability in the impact associated with each technology, with the most notable variations appearing based on the area of the business (front- vs. back-office), geography (Americas vs. APAC), and the institution's financial health (those still recovering from the post-2008 financial crisis vs. those fully recovered). Leadership teams are also grappling with the potential value associated with these technologies, and the tactics for how best to deploy

them. Part of the challenge involves clarity around the implications for the workforce. Executives indicated there has been an absence of systemic talent management practices to address the implications for dramatic shifts in work-activities—and therefore skills—required of the human labor force. Executives believe that the greatest potential for value creation involves the symbiotic collaboration between the human workforce and machines yet mobilizing around this ambition, and what it means for the design of roles and talent management practices, is still in its early stages.

Leaders also discussed how there has been a shortage of critical skills available in the marketplace over the past decade to support the demand within financial services, and that this shortage of skills is getting worse. Despite decades of growing demand for certain capabilities, a large number of roles within the industry continue to go unfilled because of gaps in supply. These supply gaps are attributed in part to an outdated formal education system that is unable to move quickly enough at modifying approaches to learning and development to meet the fast pace at which skills become outdated and new skills required. The burden is therefore placed on niche, innovative educational non-profits and startups (e.g., edX, Udacity) or more systemically on employers to utilize reskilling as a mechanism to solve for the gap in talent supply. Yet workforce reskilling is only happening for limited roles and for select capabilities. There do not appear to be strong examples of systemic, enterprise- or industry-wide reskilling underway. As a result, there is ambiguity around who will address the growing gaps between talent supply and demand.

Beyond dramatic reform required of the education system, there are wider societal considerations. The transformation underway due to the use of cognitive technologies in

the 21st century is bringing dramatic change to all sectors of society, from transportation to consumer products, healthcare to energy. With the fundamental dynamics of every sector in the midst of change, many of the challenges faced by the financial services sector are consistent with other industries. This leaves a scale and scope of change that demands public policy, and significant public-private partnership to catalyze societal transition. Yet executives indicated there has not been enough progress to accomplish this. The following outlines key conclusions of this study.

RQ1: How do leaders within financial services experience the increased use of innovative cognitive technologies (e.g., RPA, AI) within the business model of the sector?

Conclusion #1: Business model change during the 4IR possesses similar characteristics to prior periods of large-scale industrial transformation. The primary differences being the pace and scale—even faster, even more widespread. The early 21st century has brought the continued evolution of the financial services business model, including a move toward more platform-based businesses. Digital technologies have reshaped the business models of a wide range of industries, from finance to media and retail. They allow for the creation of platforms, which can scale quickly by shifting production outside of themselves, so they have no or minimal marginal costs. As a result, they can scale as fast as they can add partners (e.g., Facebook which does not produce its own content or Airbnb which does not own its rooms). This research noted how the 4IR has brought new platformed-based business models to financial services (e.g., Apple Pay), changing the traditional ecosystem of partners, suppliers and customers within the industry.

In conjunction with these changes in the financial services ecosystem, individual institutions are evolving their internal operations to apply cognitive technologies to traditional business processes, thereby automating or augmenting work activities historically performed by the human workforce. The result of both these internal operational changes due to cognitive technology adoption, and the industry's broader shift toward more platformed service delivery, is a dramatic change in the way financial services and products are procured, delivered and consumed. These changes are similar to prior shifts in the industry's operating model during the 20th century, for example, with the advent of capabilities like the automated teller machine (ATM) in 1967. However, the current changes are happening much more quickly across a much broader set of business activities.

Conclusion #2: The financial services industry remains aggressive in its adoption of cognitive technology, and a leader relative to other sectors in finding creative, unique applications. The financial services industry has been an innovation leader over the decades, from the advent of credit cards in 1946 to the start of electronic trading in 1969. This innovative leadership has remained true in the 21st century as well, as the sector aggressively scaled cognitive technology beginning in early 2016, forming joint ventures, partnerships, acquisitions, and through the hiring of top talent. The nature of the financial services business—making investment and capital allocation decisions—affords the industry a leg-up to other sectors in financing its own approaches to disruptive technology. In this sense, incumbent financial institutions involved in this research mainly compete against one another and technology start-ups – like FinTechs – to establish and maintain products and services that are meaningful for their customers.

Leveraging the power of new capabilities like artificial intelligence has allowed these institutions to amplify their insights and offerings. For example, leveraging a customer's own transaction data for analytics via a machine learning algorithm to recognize patterns, and provide proactive financial advice. Leaders in this study indicated that this laser-like focus on innovating faster and smarter will remain a critical priority over the next decade as the industry seeks to lead from the front in the use, application and adoption of cognitive technologies. The only other industries and sectors with similar capital positions and experience to drive the degree of transformation underway are government funded military efforts or large technology firms (e.g., Microsoft, Apple). So financial services leaders will be called upon as a leader in the 21st century for moving not only the industry, but society, progressively forward.

Conclusion #3: Financial services executives are settling into their roles, stewarding business model transformation, but could benefit from more systemic scaffolding and support systems. While cognitive technologies present financial services institutions—and businesses more generally—with an opportunity for significant productivity gains, they also bring unique challenges. Implementing an array of disruptive technologies effectively across disparate global business processes requires an array of orchestration and collaboration. Further governing that implementation in a way that ensures effective controls and oversight in alignment with varied location-specific regulatory expectations is equally difficult. For example, constraints related to the increased use of AI, like data privacy, create a complex set of requirements for the institutions and leadership teams utilizing them. While executives are developing more familiarity with these capabilities and their constraints, understanding the full set of

implications takes time, and there are not a lot of supporting resources available to support them. Stewarding the change journey is further challenged by the large group of stakeholders involved—from customers, shareholders, vendors, suppliers, location-specific regulatory agencies, and the institution's own workforce. Each constituent is in their own stage of understanding cognitive technologies and their implications, making it even more challenging to keep this large network of stakeholders aligned around a complex transformation agenda. Additional support systems that provide both formal and informal resources will be useful aids as executives steward large-scale transformation.

RQ2: How do leaders understand and interpret the changes in workforce roles, responsibilities and required skillsets as a result of the increased use of cognitive technologies?

Conclusion #4: Skills are the new currency of the labor market and should be used to inform talent management practices. A consistent theme that emerged from executives involved in this research is the urgent demand for talent, skills and capabilities that are in smaller and smaller supply. Skills that have seen the sharpest increase during the 4IR include both technical skills like engineering and computer science, and soft-skills like communication and critical thinking. These skills are the new currency of the labor market. The rise of disruptive technology has transformed the nature of work, leading to the automation of activities and the emergence of new kinds of roles and responsibilities with humans utilizing cognitive technologies to augment or supplement their actions and decision-making processes. Using skills as the new currency of the labor market also offers a new way to determine qualifications where other mechanisms—like degrees—have become outdated by the time they are obtained.

The rising prominence of skills as the currency for delivering impactful talent management practices means leaders need to utilize capability profiles to determine future career paths for people in occupations that are declining/disappearing while aligning learning opportunities to equip them for positions that are new and emerging. Since individuals accumulate knowledge, skills and competencies through formal and informal avenues, executives have to foster ongoing skill development. Establishing deliberate efforts to cultivate and sustain in-demand skillsets, while projecting forward future skill needs and proactively supporting their development, will be essential for executives looking to maximize the potential of its workforce in the 4IR.

RQ3: How do leaders perceive the learning and development required to transition to this new human-machine collaboration model, and what obstacles are they experiencing?

Conclusion #5: Large-scale approaches to workforce reskilling are limited despite leadership's adamant agreement around their importance. As technology develops at an accelerated pace, tasks that were once reserved for humans are increasingly carried out by machines, causing an impact on jobs and skill requirements for those roles which remain. This type of role-based change is of a size, scale and pace that is unprecedented within the financial services industry previously, creating a burning platform for deliberate, intentional workforce transition programs. Yet this study, and the existing literature suggest there has been limited investment in coordinated efforts—at the individual financial institution level, at the level of public-private partnerships, or at the level of informal and formal educational system reform. While individual financial institutions have targeted programs for select workforce segments, as noted by examples

in this study where innovative reskilling is underway, these efforts do not comprehensively address the breadth stakeholders involved. This leaves large segments of the current workforce vulnerable to changes that are already impacting their work, without any transition support or vision for the future.

Part of the learning leaders suggested as most impactful are opportunities that offer cross-functional partnership—both internally within the institution's functional domains, and with externally with other institutions. This breakdown of historic siloes creates the benefit of bringing together diverse competencies in new ways, to deliver unique solutions to the marketplace. Internally, this cross-functional collaboration involves more diverse teams that better integrate technical and engineering talent with experienced financial professionals who have deep domain expertise. Externally, this involves partnerships with vendors, suppliers, regulators and even competitors to establish new platformed ecosystems that allow for the use and exchange of information for more informed, efficient and tailored decision-making (e.g., sharing of data for fraud prevention).

Conclusion #6: Business is leading from the front in stewarding educational and public policy reform to support this period of societal transition. The private sector increasingly sees its business model transformation as a driving force for larger societal changes underway. Industry leaders view cross-sector partnerships as critical to success in this period of transition, given the degree to which all aspects of society have become interconnected through ecosystems and networks. The solutions required in the 4IR are of a breadth and depth, for example, to address the growing changes in workforce skill requirements, that demand breaking down historical boundaries to create new

collaboration models. Collectively, leaders believe they need to create a shared, compelling vision that fosters human collaboration with machines. Working together, this partnership between the business and educational community, or business and public policy community, can establish new methods for delivering innovative approaches toward workforce reskilling. In some cases, public policy reform that incentivizes the right behaviors is required. In other cases, what is required involves better alignment between the demands of a particular industry and the way in which educational institutions prepare students for filling that demand. The 4IR will continue to expect the for-profit business community to play a role of catalyst, igniting the type of broader change required.

Recommendations for Practice

The findings from this research suggest that financial services executives have an opportunity to deliver significant impact for their firms, and the entire financial services value chain from customers to suppliers to society at large, as they transform their business model through the adoption of cognitive technology in the 4IR. From the way in which these technologies are implemented, to the governance mechanisms, talent strategies and human-machine collaboration models that are employed, leaders have an opportunity to utilize creative approaches to shape the future of the sector for years to come. The following outlines key areas of opportunity for executives within financial services in the 21st century.

Recommendation #1: Understand skills in demand

At the center of the changes underway in the nature of work is a shift in the types of skills and capabilities required of the human workforce. As cognitive technologies

become more promising, they are supplementing and complementing activities performed by humans. There are questions related to skillset demand that leaders should consider, including: What are the skills most in demand currently? How will in-demand skills evolve over the next year? Two years? There are also questions related to skillset supply that leaders should understand, including: Who has these skills currently? How have the skills been developed? Over what timelines? Through what experiences? Creating clarity on the answers to these questions will provide a roadmap for how skill demand will evolve over time, and the types of concrete actions that will help develop the needed supply to meet that demand. Current skills in demand are varied, and their shelf-life is brief; so, the key for executives in the 4IR will be establishing a continuous feedback loop between the needs of the marketplace and the practices put in place to develop workforce skills. Recent efforts to address the limited supply of critical skills have been unsuccessful so leaders will need bold, creative approaches to make skills the center of their talent practices.

Recommendation #2: Steward more deliberate approaches to organizational and role redesign that creates intentional experiences for human-machine collaboration and learning

One consistent theme from executives interviewed was that the 4IR does not involve the replacement of humans in the provisioning and distribution of financial services. Executives do not believe humans will be removed entirely, if for no other reason than to accommodate regulatory expectations. Algorithms are already able to analyze large quantities of data and recognize patterns that would go undetected through human analysis. This additional insight provides more informed decision-making for the

human workforce. Additionally, while cognitive technologies will fully replace some of the functions' humans have traditionally performed, there are several areas where human capability is still a differentiator—for example, the ability to be creative and generate meaning from experiences. Due to their processing power, computers are far more effective at calculations and pattern recognition. Cognitive technologies can perform more routine work, freeing up humans to be more engaged and derive meaning from their work. For example, in 2019 big-picture strategic thinking still remains the unique capability of human brain power. The results for financial services organizations seeking to realize productivity gains from these new symbiotic human-machine operating models is to more deliberately perform organizational and role redesign that foster greater human-machine collaboration.

One opportunity is through the increased use of on the job learning that is informal and incidental. Practical experience is still a significant share of adult learning, so executives play a pivotal role in fostering the kind of environment for it to occur organically. Adults learn from interacting with colleagues, solving real business challenges. Thus, a working culture that encourages innovation through peer learning programs and autonomy at work are key to connecting employees with resources and knowledge networks to foster continuous, informal learning.

Executives also have an opportunity to customize learning so that the power of offline and online learning with virtual and augmented reality is at play. MOOCs have improved the scalability and reach of adult learning. However, uptake on these types of learning opportunities is not evenly disrupted in the adult population. Emerging technologies like virtual reality may be useful to aid in learning objectives, by helping

professionals who use physical skills in order to solve problems, like surgeons, nurses, electricians and firefighters. In the financial services sector, this can be useful for simulation-based learning—for example preparing for a cyber-attack. Yet as of 2019, financial services organizations have not deliberately redesigned roles, teams or entire business functions. Attempts at intentional design for increased human-machine collaboration have been at best haphazard, occurring in select pockets of the business for select roles. Going forward, executives within the financial services sector should utilize deliberate organization and role redesign to create intentional exposure and experiences for individuals and teams with new forms of cognitive technology.

Recommendation #3: Increased partnership between businesses and educational institutions to shape meaningful continuous learning and reskilling programs

One of the opportunities that emerged through this research was for those in leadership positions within business and educational organizations to more effectively partner to address the large-scale workforce transformation underway in the 4IR. Executives indicated there has not been a great amount done thus far to establish the direct connections between marketplace demand from the business community, and the development of qualified talent supply through the educational community. Customized programs that better marry demand for critical skillsets with supply of qualified talent are needed. There were a wide range of opportunities cited, from early childhood education, to changes in the curriculum that make it more digitally fluent. Some leaders discussed the need for robust and respected technical and vocational educational opportunities, as well as a cultural imperative to incentivize life-long learning, with the transfer of ownership and accountability to the individual for his/her organic growth and

development. Examples like educational reform that provide credential opportunities, with shorter timeframes than traditional degree programs, will help qualify individuals for skills that are currently in-demand but may have a brief shelf-life. This also allows the workforce to re-skill regularly, as trends and needs change. Leaders were not without ideas for the ways in which educational reform could better support their immediate business needs, as they are well aware that many children entering the education system today will have jobs that don't yet exist and for which their education will fail to prepare them.

The resulting need is for greater collaboration between the business community and the educational sector to ensure learning efforts not only meet current demand but are flexible enough to adapt more real-time to future demand. Learning needs to be available on-demand through virtual, online platforms, as the pace of day-to-day life has sped up considerably in the 21st century. Educational opportunities need to follow suit, with more modularized, accessible, digital and virtual learning options. Formal and informal educational settings—from universities, to community centers, and vocational training centers—should flex traditional approaches toward education policy and adapt to the new reality of learning and development. Learning that is more fluid, accessible to diverse groups, and modularized for easy consumption are prerequisites in the 4IR. The educational environment must also change, so society culturally values curiosity, creativity, and imagination, and intentionally fosters these attributes for continuous, life-long learning. As leaders within and outside of the formal education sector embrace the pace of change in the 4IR, they will have no choice but to innovate in the ways they educate and prepare the next generation.

Recommendation #4: Increased public policy to incentivize individual and collective behavior for continuous learning

The degree to which learning will need to become intertwined with day-to-day life for ongoing human development in the 21st century, requires public policies that support and incentivize decisions, actions and behaviors accordingly. The 21st century will involve society valuing lifelong learning from an early age, with a culture that reinforces and supports it. Part of this involves a new degree of individual accountability and ownership for ongoing personal growth. Another part involves public policy support for resources that aid adults in developing new skills so they can mobilize around different professional trajectories.

To accomplish public policy that will drive desired outcomes in the 4IR, it is helpful to disentangle the responsibilities of diverse stakeholders. There are varied needs of individual learners, businesses, unions, universities, K-12 institutions and the like which require strategies that harmonize their interests. Equally, each group of stakeholders has an important role to play in delivering on the agreed upon solutions. Government is well positioned to establish the infrastructure and regulatory foundations—by ensuring quality assurance of educational programs, setting curricula and standards for skill development, promoting equality of access, and putting in place social safety nets. Leadership from those in positions to shape public policy will aid individuals and communities with the changes underway during the 21st century.

Recommendations for Future Research

While ample research has been conducted to explore the future of financial services, the rise of cognitive technologies, and the future of work, research that

examines the intersection of the three areas is limited. Additional research that explores the intersection of cognitive technology and its impact on the workforce, with a particular lens toward financial services, would therefore be beneficial. Similar research exploring the phenomena in other industries would also be valuable in order to draw comparisons around how the phenomena is unfolding similarly or differently. Additionally, new research has the potential to be expand initial findings included as part of this study, with a much larger sample size (e.g., sampling thousands of executives) over longer time horizons (e.g., a decade) to measure the degree of change more quantitatively.

Furthermore, research that explores similarities and differences with how various cognitive technologies impact human behavior and influence the future of work will also be valuable. For example, how are the use cases with RPA similar/different from NLP and what does it mean for the future of skill development? There is also an opportunity to delve further into how adult learning theories from the 20th century can be refined in light of new collaboration models between humans and machines in the 21st. For example, do humans learn differently when their decision-making processes are supplemented by machine learning algorithms? Finally, additional research is needed into the future of work within the financial services sector to identify the kind of concrete actions required from both the private and public sector to support a smooth societal transition.

Recommendation #1: Explore the future of work in more depth within individual sectors of the economy, and develop a cross-sector analysis based on patterns and themes

In-depth research exploring the implications for the future of work within the financial services sector—and for each sector of the economy—would be beneficial to

appreciate the nuance of each business, and the patterns that may arise across them. In 2019, most academic research around the future of work due to cognitive technology adoption is generic and only beginning to become sector-specific. Leaders within financial services are grappling with some important, distinct challenges compared to retail or healthcare. The potential ramifications and consequences for applying cognitive technology vary—both in terms of severity and frequency—and the resulting controls and governance differ as well. Yet there is not a lot of in-depth financial services sector specific insight available. Additional research that analyzes each sector would help inform where it is appropriate to utilize cognitive technologies, as well as the ways in which human oversight and governance are still required to best optimize these capabilities.

Recommendation #2: Explore the nature of human-machine collaboration within digitally native FinTechs as a point of comparison to larger, incumbent financial institutions

While this study focused on executives at leading, global financial services institutions, these organizations came of age in a pre-digital era. As a result, they have legacy operating processes, technology infrastructure, and workplace practices that have had an influence on the extent to which cognitive technology adoption, and symbiotic human-machine collaboration emerged, evolved and progressed. Comparatively reviewing FinTechs—financial services firms that have come of age with technology as the foundation of their operating model (e.g., Stripe, Braintree)—would serve as a valuable point of comparison. The perspective from leaders at these firms would provide

additional insight into the kind of tactics being utilized to foster meaningful collaboration between the human workforce and the portfolio of emerging cognitive technology.

Recommendation #3: Explore human-machine collaboration and learning opportunities through analysis of targeted work-activities

Research is only beginning to explore how machines can augment and supplement the human workforce in the delivery of financial services. The focus of most literature thus far has involved a particular form of cognitive technology—like machine learning—and how a particular stakeholder has started to interact with it. The research has an opportunity to go farther in exploring each business process at the center of the financial services delivery model (e.g., trading or investment advising) and observing the ways in which each cognitive technology can play a role in supplementing human contributions. Illustrative questions include: How does the effective (vs. ineffective) application of AI improve financial advisor quality and timeliness? What are the ways in which AI enhances client experience? Research should become much more targeted to particular financial services roles, drawing comparisons across institutions and teams, to demonstrate who is doing what more effectively than others, and why. The active experimentation underway within each department, line of business and institution deserve much more in-depth analysis, as a rich source of data. This review will provide more clarity on the ways in which humans can continue to leverage cognitive technology for the most profound impact.

Recommendation #4: Additional in-depth academic research is warranted with larger sample sizes, over longer time horizons

Given the emerging nature of the topic, there is limited research with large sample sizes over prolonged periods of time. Additional research that reviews a larger sample of financial services institutions and leaders would allow for more quantitative analysis, which is helpful for deciphering cause and effect relationships between the variables at play. Additionally, this study was conducted at a point in time in 2019. Further research that explores how these trends fluctuate over time will provide another level of insight. For instance, collecting data in 2016, then again in 2020, 2025 and 2030 to see how the nature of work, roles and human-machine collaboration has in fact evolved within the sector.

Moreover, most relevant research that has been carried out thus far has not been done in an academic setting. Most of the research that is looking at these changes is being led by management consulting firms and think tanks (e.g., McKinsey, World Economic Forum). This topic could benefit from further academic institutional sponsorship, and not solely from a computer science or engineering lens, but through better integration of the engineering, business and public policy implications. This cross-disciplinary approach is something educational institutions have an opportunity to do well given the broad disciplines they represent and the depth of their expertise in each. That knowledge could then be utilized to more actively inform decision-making by those in professional practice (e.g., financial services executives) and in public policy roles (e.g., government leaders).

Recommendation #5: Explore the extent of single- vs. double-loop learning within financial services organizations during the 4IR

In the 1970s, business theorists Chris Argyris and Donald Schön combined organizational theory and adult learning principles to establish the notion of *single- vs. double-loop* learning. They utilized three key concepts—*governing variables, action strategies,* and *consequences*—to suggest that people have mental maps which they use to inform how to act, plan, implement, and review past actions. Argyris and Schön suggested that when teams encounter problems, their initial reaction is to seek another *action strategy* that works within the confines of the existing *governing variables* (or mental maps). Those *action strategies* have *consequences* and, based on the *consequences*, individuals and teams modify future *action strategies* to adjust. This experience is *single-loop* learning; the team is continuing to operate within the same *governing variables* of the larger system.

Argyris and Schön sought to create organizations that moved beyond *single-loop* learning toward *double-loop* learning by questioning the *governing variables* themselves. For Argyris and Schön, *double-loop* learning occurs when the *consequences* associated with a particular *action strategy* lead the individual, team, and organization to reconceive their *governing variables*, establishing entirely new ways of thinking, behaving, and interacting (Argyris & Schön, 1974, 1978, 1998). Argyris and Schön's model for *single-* vs. *double-loop* learning is a useful framework to analyze the extent of systemic learning underway in the 4IR as financial services institutions adopt cognitive technology.

Findings from this study suggest that the financial services ecosystem may be gradually progressing from *single-* to *double-loop* learning as individuals and

organizations grapple with transforming the operations of their business. However, additional research would be useful to collect tangible data to support this hypothesis. To-date, many of the *actions* taken by leaders illustrate what is commonly referred to as *single-loop* learning, best characterized by repetitive patterns of behavior generated from learning from the *consequences* associated with actions taken within the confines of existing *governing variables.* Leaders have been adopting cognitive technology and attempting to prepare their workforce for the future of work in the 4IR, adjusting based on the *consequences* of past *actions*. When *double-loop* learning is at play, organizations critically analyze the *governing variables* involved, attempting creative new approaches toward future action. (See Figure 21 for an overview of the difference between *single-* and *double-loop* learning.)

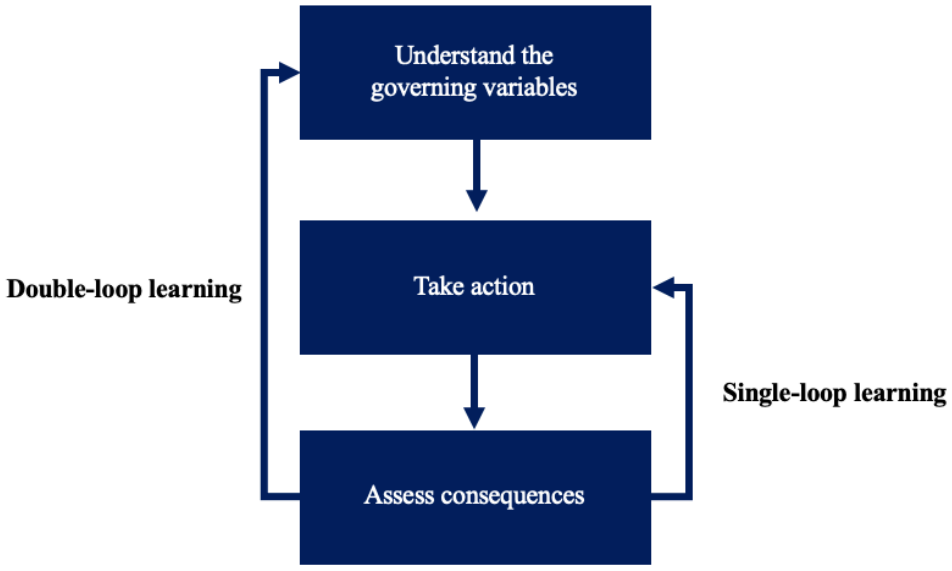

Figure 21. Difference between single- and double-loop learning

In 2019, it appears financial services organizations are beginning to move beyond transactional *single-loop* learning, to become less constrained by existing *governing*

variables—be they regulatory constraints, or legacy infrastructure challenges. This is critical because the human workforce is still by far the largest cost base on most balance sheets—certainly for the financial services industry. For illustrative purposes, a leading global financial services institution may spend roughly tens of billions on human capital, and roughly one-fifth of that amount on technology, and one-fifteenth of that amount on real estate. (These figures are rough estimates based on a review of annual reports noted in the references.) This means that despite the power and prevalence of disruptive technologies, there is still a disproportionate amount of expenditure on human capital, compared to technology. Therefore, dedicated focus on enhancing human learning could drive greater returns on that investment, yielding exponential benefits for the enterprise and financial services ecosystem systemically.

Double-loop learning requires that growth and development take place on multiple levels simultaneously. It requires an appreciation for the *governing variables* at play within the organization or broader sector-wide ecosystem—and the ability to use those governing variables to inform the type of action taken. Sometimes this even requires reevaluating policies, processes or standards as part of changing the systemic dynamics at play. Based on the research findings of this study, there are a number of *governing variables* affecting the ability for financial services institutions to adopt cognitive technologies, including: business cases, maturity of related technologies in the marketplace (like cloud computing), availability of talent with the right skillsets, availability of data for models and algorithms to utilize, and legal and regulatory limitations.

Utilizing regulatory constraints as an example of a current *governing variable* industry executives face, it is useful to see how the financial services ecosystem has evolved to more advanced forms of *double-loop learning.* Leading organizations, as illustrated by the interviews with a number of executives, have started to learn how to work within the confines of the existing regulatory environment to apply disruptive new technologies, while still protecting customers, shareholders and the general public. By challenging the premises of certain constraints and collaborating with regulators, these organizations appear to have critically analyzed the legal landscape to experiment with creative solutions. However, during the first few years of cognitive technology adoption in 2016-2017, the notion of a regulatory *governing variable* was not even under consideration, as leaders were more consumed with basic levels of understanding associated with the potential of cognitive technologies, let alone their implications for multi-year strategic plans. In these early years, it appears most organizations were operating with *single-loop learning*. As the confidence of leadership teams with underlying cognitive technology capabilities has grown, it appears financial services organizations have begun to identify and assess the *governing variables* at play to utilize their newfound understanding to inform future decisions and actions thereby utilizing the principles of *double-loop learning* (Renjen, 2019; Schwab, 2019).

Another example in this study that suggests the progression of financial services organizations progressing from *single-* to *double-loop learning*, involved recognizing another *governing variable*—the role and importance of enterprise oversight for large-scale technology deployment. *Single-loop learning* appears to have occurred in the early stages of cognitive technology adoption, where organizations were not effective at

scaling a broad set of disruptive technology quickly enough across disparate and distinct lines of business. Analyzing the *governing variables* at play led to refinements and modifications in organizational rules, policies and practices that were no longer supporting the desired goals. This is consistent with the literature, where new vendor partnerships and agreements had to be established, new internal working groups and councils had to be stood-up, new oversight responsibilities assigned, and new standards put in place to permit certain types of investment and deployment, and to prohibit others (McWaters, 2018; O'Halloran & Griffin, 2019). This appears to be a progression on the part of the organization toward *double-loop learning.*

Two of the other more notable areas where financial services organizations demonstrated examples of *double-loop learning* involve changes in the nature of work performed by humans, and changes in the underlying talent management practices utilized to support the workforce. Leaders are having to redesign how humans interact with machines to perform financial services activities. Yet traditional approaches to business process reengineering are no longer entirely useful in designing symbiotic roles, responsibilities, hand-offs and decision-rights for human and machine collaboration (Abbatiello et al., 2018; Bentley et al., 2018; Evans-Greenwood et al., 2017; Hagel et al., 2018; Hagel & Wooll, 2019). For example, the boundaries between decisions made through pattern recognition from an algorithm, and the role of a human in overseeing that decision to test its potential biases, offers insight into the unique challenges involved in designing new ways of working. Creative approaches to how humans and cognitive technologies work alongside one another, supplementing and complimenting each other's

natural capabilities in the execution of a trade, servicing of a client, or issuing of a loan, have been required (Hagel & Wooll, 2019; Schwartz et al., 2018).

> The technological advances of today are affecting the future of work in three key ways: by scaling and speeding up human capabilities, by substituting labor with machines, and by enabling new ways to access and supply labor. (Farrell, 2019, p. 1)

According to Deloitte's *2019 Human Capital Trends* report, 80% of respondents rated leadership as a high priority for their organization, but only 41% thought their organization was ready or very ready to meet the requirements of the future (Volini et al., 2019). Executives interviewed shared that there is an outsized focus on near-term optimization of current operating environments rather than true redesign of roles for the future (Hagel et al., 2018; Hagel & Wooll, 2019). When done effectively at the institution- and sector-level this has been a great example of systemic *double-loop learning*.

Each of these more recent advancements within the industry illustrate potential examples of a progression from systemic *single-* to *double-loop learning* which are worth exploring in more depth through additional research. These are examples of systemic learning that are not linear, but instead offer multi-dimensional growth for each individual organization and the entire sector. They also offer insight into how leaders can influence the future of work for the current workforce, and for generations to come.

Recommendation #6: Conduct further investigation into partnership opportunities for educational institutions and the business community

Business leaders have expressed the urgent need for educational reform that provides the kind of workforce reskilling required in the 4IR, yet there is limited research showcasing ways in which industry leaders are experimenting with new educational

institution partnerships to pursue these ends. Further investigation into some of the more innovative efforts underway between business leaders and educational institutions around the globe will provide insight into the variety of workforce reskilling models, and the benefits of each. This could provide executives in business with more tangible examples of successful partnerships, and educational institutions with similar reassurance of the effectiveness of such programs.

Recommendation #7: Explore the role public policy can play to influence desired behaviors and incentives conducive to the 4IR

The rapid pace of change across all sectors of society has become a new normal for the 21st century, and it requires a level of individual accountability and ownership for our individual and collective future. Individual accountability, motivation and drive are critical for life-long learning and additional research that explores which types of incentives encourage these desired behaviors. One idea noted was establishing individual learning accounts – similar to approaches taken to incentivize retirement savings through investment instruments like 401Ks. Similar incentives for the private sector to reinforce the importance of lifelong learning could be beneficial to encourage reskilling. Similar research that analyzes which type of partnerships between businesses and educational institutions are yielding the greatest impact will be helpful to inform public policy decisions and actions.

Revisiting Assumptions

It is helpful for a researcher at the conclusion of a study to revisit their original assumptions. The primary assumption held at the start of this study was that participants would be open and candid during the data collection process, directly informing the

meaningfulness of findings. Fortunately, participants were willing to openly share their experiences—with both enthusiasm and frustration—during data collection.

At the onset of the study, the researcher was also hopeful that cognitive technologies would continue to have a positive impact for individual institutions, the entire financial services sector, and for society at large. Based on the findings from this study in 2019, indications are that these technologies have had a positive impact for customers, shareholders, suppliers and other stakeholders affiliated with the industry.

Finally, the researcher believed at the beginning of this study that there would be inevitable challenges with the increased application of cognitive technologies and human-machine collaboration, for example, related to ethics and governance (Bostrom, 2014). But the researcher operated from a position of optimism that these barriers could be overcome if well-articulated and understood. It seems that this remains an area of opportunity for focus as leaders seek to scale cognitive technology adoption, while simultaneously supporting their workforces through significant reskilling. There is not yet a common level of understanding associated with the technologies nor is there a common vision for driving systemic change. Gaining a collective understanding and developing alignment around a common vision will be crucial to advancing cognitive technology in a productive manner for society at large.

Personal Reflections

This research arose out of a personal passion, given the researcher's professional proximity to the topic of inquiry. Having spent two decades working within the financial services industry leading the transformation of its business model, the researcher found great joy in having the opportunity to translate informal observations and conversations

from professional practice into a more formal academic study. The researcher also has an appreciation for the expansiveness of the overlapping phenomena involved in this study—each proving to be a significant area for further inquiry in and of themselves. There is great humility as a result, for the small contribution this research may make to knowledge within the field.

Ultimately, the researcher is immensely grateful for the openness, candor and creativity of the participants involved in this study, who have helped shape the dialogue for generations to come. The researcher also has her own sense of personal responsibility to meaningfully shape the future of work for the sector. Given her unique position operating within the sector during this time of change, the researcher is particularly keen to design human-machine collaboration in a way that recognizes that which is uniquely human, while remaining sustainable for the long-term. In the end, the researcher holds an immense amount of gratitude for having been fortunate enough to conduct this study, playing a small role in informing future action.

REFERENCES

Abbatiello, A., Boehm, T., & Schwartz, J. (2018). No collar workforce: Humans and machines in one loop—collaborating in roles and new talent models. *Tech Trends 2018: The Symphonic Enterprise.* Dallas, TX: Deloitte University Press.

Agarwal, D., Bersin, J., Lahiri, G., Schwartz, J. & Volini, E. (2018). *The Rise of the Social Enterprise: 2018 Global Human Capital Trends.* New York, NY: Deloitte Insights.

American Association of Community Colleges (AAC). (2018). *Fulfilling the American dream: Liberal education and the future of work.* Washington, DC.

Argote, L. (2013). *Organizational learning.* New York, NY: Springer.

Argyris, C., & Schön, D. (1974). *Theory in practice: Increasing professional effectiveness.* San Francisco, CA: Jossey Bass.

Argyris, C., & Schön, D. (1978). *Organizational learning: A theory of action perspective.* Reading, MA: Addison Wesley.

Argyris, C., & Schön, D. (1996). *Organizational learning II: Theory, method and practice.* Reading, MA: Addison Wesley.

Azhar, M. Q. (2015). *Toward an argumentation-based dialogue framework for human-robot collaboration* (Order No. 3724595). Available from ProQuest Dissertations & Theses Global. (1722272273). Retrieved from http://eduproxy.tc-library.org/ ?url=/docview/ 1722272273?accountid=14258

Baden-Fuller, C., & Mangematin, V. (2013). Business models: A challenging agenda. *Strategic Organization, 11*(4), 418-427.

Baden-Fuller, C., & Morgan, M. S. (2010). Business models as models. *Long Range Planning, 43*(2-3), 156-171.

Barro, S., & Davenport, T. (2019). *People and machines: Partners in innovation.* Boston, MA: MIT Sloan Management Review.

Bass, A. S. (2018, March 31). GrAIt expectations: Artificial Intelligence is spreading beyond the technology sector, with big consequences for companies, workers and consumers. *The Economist,* 9-12.

Bastos, J. L., Duquia, R. P., González-Chica, D. A., Mesa, J. M., & Bonamigo, R. R. (2014). Field work I: Selecting the instrument for data collection. *Anais Brasileiros de Dermatologia, 89*(6), 918-923. http://doi.org/10.1590/abd1806-4841.20143884

Bender, M., Henke, N., & Lamarre. (2018). *The cornerstones of large-scale technology transformation.* New York, NY: McKinsey Quarterly.

Bentley, M., Dollar, B., Dharmaraj, J., & Levitt, S. (2018). *The Humbotic imperative.* Retrieved from https://www2.deloitte.com/us/en/pages/deloitte-analytics/articles/the-humbotic-imperative.html

Besenbacher, F., Buckley, N., Cotteleer, M., Goddijn, H., & Grossman, M. (2019). *Success personified in the Fourth Industrial Revolution: Four leadership personas for an era of change and uncertainty.* New York, NY: Deloitte Insights.

Bhatia, R. (2018) *Here's How India Needs to Prepare for the Age of AI. Analytics India,* retrieved from: https://www.analyticsindiamag.com/here-how-india-needs-to-prepare-the-age-of-ai/

Bloomberg, L. D., & Volpe, M. (2016). *Completing your qualitative dissertation: A road map from beginning to end* (3rd ed.). Thousand Oaks, CA: Sage.

Bodrozic, X., & Adler, P. S. (2018). The evolution of management models: A neo-Schumpeterian theory. *Administrative Science Quarterly, 63*(1), 85-129.

Bostrom, Nick. (2014). *Superintelligence: Paths, Dangers, Strategies.* Oxford, UK: Oxford University Press.

Bouée, P. O., & Warner, L. J. (2018). *Credit Suisse Investor Day 2018: Utilizing technology.* Zurich, CH: Credit Suisse.

Brainard, L. (2018). *What are we learning about Artificial Intelligence in financial services.* Philadelphia, PA: Fintech and the New Financial Landscape.

Briggs, B., & Buchholz, S. (2019). *Tech trends 2019: Beyond the digital frontier.* New York, NY: Deloitte Insights.

Brinkmann, S., & Kvale, S. (2015). *InterViews: Learning the craft of qualitative research interviewing* (3rd ed.). Thousand Oaks, CA: Sage.

Brown, J., & Duguid, P. (2000). Organizational learning and communities of practice: Toward a unified view of working, learning, and innovation. In *Knowledge and communities* (pp. 99-121). Palo Alto, CA: Xerox Research Center and Institute for Research on Learning.

Bruno, G., Lee, A., Blake, M., & McWaters, J. (2015). *The future of financial services*. Zurich, Switzerland: World Economic Forum.

Brynjolfsson, E., & McAfee A. (2016). *The second machine age.* New York, NY: Norton.

Cadell, C. (2017). *Google AI beats Chinese master at ancient game of Go.* Beijing, China: Reuters.

Cardenas-Navia, I. & Fitzerald, B. K. (2015). The broad application of data science and analytics, *Change, 25, 32.*

Chui, M., Kamalnath, V., & McCarthy, B. (2018). *An executive's guide to AI.* San Francisco, CA: McKinsey.

Chui, M., & Malhotra, S. (2018). *AI adoption advances, but foundational barriers remain*. New York, NY: Deloitte Insights.

Chui, M., Manyika, J., Miremadi, M., Henke, N., Chung, R., Nel, P., & Malhotra, S. (2018). *Notes from the AI frontier: Insights from hundreds of use cases*. New York, NY: McKinsey Global Institute.

Clegg, S. R., & Bailey, J. R. (Eds.). (2008). *International encyclopedia of organization studies* (Vols. 1-4). Thousand Oaks, CA: Sage. doi:10.4135/9781412956246

Corbat, M. L. (2019). *Citi: 2018 annual report.* New York, NY: Citigroup.

The Council of Economic Advisors. (2018). *Addressing America's Reskilling Challenge.* Washington, DC.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Crevier, D. (1993). *AI: The tumultuous search for artificial intelligence*. New York, NY: Basic Books.

Crossan, M., Lane, H., & White, R. (1999). An organizational learning framework: From intuition to institution. *The Academy of Management Review, 24*(3), 522-537. Retrieved from http://www.jstor.org.eduproxy.tc-library.org:8080/stable/259140

Cutter, C. (2019, July 11). *Amazon to retrain a third of its U.S. workforce: As technology reshapes roles, the online retailer plans to train 100,000 workers in new skills from machine learning to nursing.* New York, NY: *The Wall Street Journal*. https://www.wsj.com/articles/amazon-to-retrain-a-third-of-its-u-s-workforce-11562841120?tesla=y

Daecher, A., Sniderrman, B., Holdowsky, J., Cotteler, M., Mahto, M., Hanley, T., Murphy, T., Rutgers, V. (2018). *Industry 4.0 paradox: Overcoming disconnects on the road to digital transformation.* New York, NY: Deloitte Insights.

DeFrancesco, D. (2019). *Morgan Stanley is rolling out an AI chatbot to research clients early next year. Wall Street thinks the tech could save $ billion annually.* Businessinsider.com.

De Houwer, J., Barnes-Holmes, D., & Moors, A. (2013). What is learning? On the nature and merits of a functional definition of learning. *Psychonomic bulletin & review*, *20*(4), 631-642.

Deng, I. (2017). *China's AI industry gets the most funding but lags the US in key talent.* Beijing, China: *South China Morning Post*.

Dewey, J. (1944). *Democracy and Education.* New York, NY: Macmillan.

Dewey, J. (2007). *Experience and education*. New York, NY: Simon and Schuster.

DiChristina, M. & Meyerson, B. (2019). *Top 10 Emerging Technologies 2019.* Geneva, Switzerland: World Economic Forum.

Dickson, R., Lisachuk, H., Ogura, A., & Cotteleer, M. (2018). *Growing internet of things platforms.* London, UK: Deloitte Insights.

Dimon, J. (2019a). *Chairman and CEO letter to shareholders.* New York, NY: JPMorgan Chase & Co.

Dimon, J. (2019b). *JPMorgan Chase makes $350 million global investment in the future of work.* New York, NY: JPMorgan Chase & Co. Retrieved from https://www.jpmorganchase.com/corporate/news/pr/jpmorganchase-global-investment-in-the-future-of-work.htm

Edmondson, A. C., Dillon, J. R., & Roloff, K. S. (2007). 6 three perspectives on team learning: outcome improvement, task Mastery, and group process. *The academy of management annals*, *1*(1), 269-314.

Epstein, D. (2019). *Range: Why generalists triumph in a specialized world.* New York, NY: Riverhead Books.

Evans-Greenwood, P., Lewis, H., & Guszcza, J. (2017). *Reconstructing work: Automation, artificial intelligence and the essential role of humans*. Dallas, TX: Deloitte University Press.

Everhard, J. (2019) *How Can Government Help Us Plan for the Future of Work in the AI Age?* Forbes, retrieved from: https://www.forbes.com/sites/johneverhard/2019/01/31/how-can-governments-help-us-plan-for-the-future-of-work-in-the-ai-age/#6c22eb936b58

Fairbank, R. D. (2018). *2018 annual report: Welcome to banking reimagined.* Maclean, VA: Capital One.

Ferreri, E. (2018). Oh, the places you could go—with a Ph.D. *Duke Today.*

Fiol, C. M., & Lyles, M. A. (1985). Organizational learning. *Academy of Management Review, 10*(4), 803-813.

Ford, Martin. (2018). *Architects of Intelligence: The truth about AI from the people building it.* Birmingham, UK: Packt Publishing Ltd.

Friedman, S., & Canaan, M. (2018). *Closing the gap in Fintech collaboration: Overcoming obstacles to a symbiotic relationship.* New York, NY: Deloitte Center for Financial Services.

Friedman, T. (2016). *Thank you for being late: An optimist's guide to thriving in the age of acceleration.* New York, NY: Farrar, Straus & Giroux.

Gewertz, C., Herold, B., Sawchuk, S. & Sparks, S. D.(2019). *Special Report: Schools and the Future of Work.* Education Week, retrieved from: https://www.edweek.org/ew/collections/schools-and-future-of-work/index.html

Guszcza, J. (2018). *Smarter together: Why artificial intelligence needs human-centered design.* London, UK: Deloitte Insights.

Guszcza, J. & Schwartz, J. (2019). Superminds: How humans and machines can work together. *Deloitte Review, 24.* New York, NY: Deloitte Insights.

Hagel, J., Brown, J. S., & Wooll, M. (2018). *Redefine work: The untapped opportunity for expanding value*. Silicon Valley, CA: Deloitte Insights.

Hagel, J., & Wooll, M. (2019). *What is work?* New York, NY: Deloitte Review.

Harari, Y. N. (2017). Reboot for the AI revolution: As artificial intelligence puts many out of work, we must forge new economic, social and educational systems. *Nature, 550*(1), 324-327.

Hart, J. (2019). *Modern workplace learning 2019.* London, UK: Centre for Learning & Performance Technologies.

Hockfield, S. (2019). *The age of living machines.* London, UK: W.W. Norton.

Holden, J. P., & Smith, M. (2016). *Preparing for the future of artificial intelligence.* Washington, DC: Executive Office of the President, National Science and Technology Council Committee on Technology.

Huber, G. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science, 2*(1), 88-115. Retrieved from http://www.jstor.org.eduproxy.tc-library.org:8080/stable/2634941

Johal, S. & Araya, D. (2019) *Work and social policy in the age of artificial intelligence. Brookings Institute,* retrieved from: https://www.brookings.edu/blog/techtank/2017/02/28/work-and-social-policy-in-the-age-of-artificial-intelligence/

Kansu, M. & Parker, G. (2018). *Transitioning from services to platforms: The financial services industry.* Boston, MA: The MIT Initiative on the Digital Economy. https://www.db.com/newsroom_news/Whitepaper_MIT_financial_services_platform.pdf

Kao, Y. F., & Venkatachalam, R. (2018). *Human and machine learning.* Taipei, Taiwan: Institute of Management Studies.

Kark, K., Briggs, B., Terzioglu, A., & Puranik, M. (2019). *The future of work in technology.* New York, NY: Deloitte Insights.

Kasl, E., Marsick, V. J., & Dechant, K. (1997). Teams as learners: A research-based model of team learning. *The Journal of Applied Behavioral Science, 33*(2), 227-246.

Kasriel, S. (2018). *The future of work won't be about college degrees, it will be about job skills.* CNBC, retrieved from: https://www.cnbc.com/2018/10/31/the-future-of-work-wont-be-about-degrees-it-will-be-about-skills.html

Kayes, A. B., Kayes, D. C., & Kolb, D. A. (2005). Experiential learning in teams. *Simulation and Gaming, 36*(1), 1-25.

Keywell, B. (2017). *The Fourth Industrial Revolution is about empowering people, not the rise of machines*. Zurich, CH: World Economic Forum.

Kim, B. (2015). *Interactive and interpretable machine learning models for human machine collaboration* (Doctoral dissertation, Massachusetts Institute of Technology).

Kolb, D. A. (1983). Problem management: Learning from experience. *The Executive Mind.* San Francisco, CA: Jossey-Bass.

Kolb, D. A. (1984). *Experiential learning: experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D. A. (1999). *Learning style inventory, version 3.* Boston, MA: TRG Hay/McBer Training Resources Group.

Kolb, D. A., & Fry, R. E. (1974). *Toward an applied theory of experiential learning*. Cambridge, MA: MIT Sloan School of Management.

Kolb, D. A., & Yeganeh, B. (2011). *Deliberate experiential learning: Mastering the art of learning from experience.* Cleveland, OH: Case Western Reserve University.

Lee, S. (2017). *Essays on organization design and organizational learning* (Order No. 10607467). Available from ProQuest Dissertations & Theses Global. (2007561349). Retrieved from http://ezproxy.cul.columbia.edu/login?url= https://search-proquest com.ezproxy.cul. columbia.edu/docview/2007561349? accountid=10226

Leech, B. L. (2002). Asking questions: Techniques for semistructured interviews. *PSOnline,* 665-668. www.apsanet.org

Lewis, M. (2016). *The Undoing Project.* New York, NY: W. W. Norton.

Loucks, J., Davenport, T., & Schatsky, D. (2018). *State of AI in the enterprise.* New York, NY: Deloitte Insights.

Loucks, J., Hupfer, S., & Jarvis, D. (2019). *Future in the balance? How countries are pursuing an AI advantage.* New York, NY: Deloitte Insights.

Lowes, P., Cannata, F. R. S., Chitre, S., & Barkham, J. (2016). *Automate this: The business leader's guide to robotic and intelligent automation.* London, UK: Deloitte LLP.

Lue, R. A. (2019). *The Future of Work Is the Future of Higher Education.* Scientific American, retrieved from: https://blogs.scientificamerican.com/observations/the-future-of-work-is-the-future-of-higher-education/

Lund, S., Manyika, J., Segel, L. H., Dua, A., Hancock, B., Rutherford, S., & Macon, B. (2019). *The future of work in America: People, places, today and tomorrow.* New York, NY: McKinsey Global Institute.

Manyika, J., Lund, S., Chui, M., Brighin, J., & Woetzel, J. (2017). *Jobs lost, jobs gained: Workforce transitions in a time of automation.* New York, NY: McKinsey Global Institute.

Mapalala, M. J. (2017). *Examining the relationship between entrepreneurial orientation and organizational performance: The moderating role of organizational learning* (Order No. 10685330). Available from ProQuest Dissertations & Theses Global. (1977450896). Retrieved from http://ezproxy.cul.columbia.edu/login?url=https:// search-proquest-com.ezproxy.cul.columbia.edu/docview/1977450896? accountid=10226

Marshall, C., & Rossman, G. B. (2016). *Designing qualitative research* (6th ed.). Thousand Oaks, CA: Sage.

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. *New directions for adult and continuing education*, *2001*(89), 25-34.

Maxwell, J. (2013). *Qualitative research design: An interactive approach* (3rd ed.). Thousand Oaks, CA: Sage.

McCaffrey, T., & Spector, L. (2018). An approach to human-machine collaboration in innovation. *AI EDAM, 32*(1), 1-15.

McCarthy, J., Minsky, M., Rochester, N., & Shannon, C. E. (1955, August). *A proposal for the Dartmouth Summer Research Project on Artificial Intelligence*. Retrieved from http://raysolomonoff.com/dartmouth/boxa/dart564props.pdf

McFarlane, J. (2019). *Creating opportunities to rise: Barclays PLC annual report 2018.* London, UK: Barclays.

McGowan, H. E. (2019). *What If The Future Of Work Starts With High School?* Forbes, retrieved from: https://www.forbes.com/sites/heathermcgowan/2019/04/03/what-if-the-future-of-work-starts-with-high-school/#c9e0ab859645

McWaters, J. (2018). *The new physics of financial services: Understanding how artificial intelligence is transforming the financial ecosystem.* Zurich, Switzerland: World Economic Forum.

McWaters, J., & Glaski, R. (2017). *Beyond FinTech: A pragmatic assessment of disruptive potential in financial services.* Zurich, Switzerland: World Economic Forum.

Merriam, S. B., Caffarella, R. S., & Baumgartner, L. (2007). *Learning in adulthood: A comprehensive guide.* San Francisco, CA: Jossey-Bass Wiley.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook.* Thousand Oaks, CA: Sage.

Moynihan, B. (2019). *What would you like the power to do? 2018 annual report: A letter from the Chairman and CEO.* Charlotte, NC: Bank of America.

Murphy, T., Garg, S., & Sniderman, B. (2019). *Ethical technology use in the Fourth Industrial Revolution.* New York, NY: Deloitte Insights.

National Academy of Sciences, Engineering and Institute of Medicine (National Academies). (2007). Rising above the gathering storm. Energizing and employing America for a brighter economic future. Washington, DC: U.S. Government Printing Office.

O'Halloran, D. & Griffin, W. (2019). *Our Shared Digital Figure: Responsible Digital Transformation – Board Briefing.* Geneva, Switzerland: World Economic Forum.

O'Lawrence, H. (2017). The workforce for the 21st century. *Issues in Informing Science and Information Technology, 14*(1), 67-85.

Parmalee, M. (2019). *The workforce of the future: The skills challenge becomes more apparent.* Forbes. https://www.forbes.com/sites/deloitte/2019/01/22/the-workforce-of-the-future-the-skills-challenge-becomes-more-apparent/#7f198b101ea8

President's Council of Advisors on Science and Technology (PCAST). (2010). *Prepare and inspire: K-12 science, technology, engineering and math education for America's future.* Washington, DC: U.S. Government Printing Office.

Reeves, M., & Whitaker, K. (2018). *Competing on the rate of learning.* Boston, MA: BCG Henderson Institute.

Renjen, P. (2019). *How leaders are navigating the fourth industrial revolution.* New York, NY: Deloitte Review.

Ringer, M., Taylor, A., & Zablit, H. (2015). *Innovation in 2015.* Boston, MA: Boston Consulting Group.

Roberts, R. (2018). *Cosmic citizens and moonshot thinking: Education in an age of exponential technologies.* Bloomington, IN: AuthorHouse.

Robson, C., & McCartan, K. (2016). *Real world research* (4th ed.). New York, NY: John Wiley & Sons.

Rudel, T. K. & Hooper, L. (2005). *Is the place of social change accelerating?* Thousand Oaks, CA: Sage.

Saikia, A., & Hazarika, S. M. (2017). cBDI: Towards an architecture for human-machine collaboration. *International Journal of Social Robotics, 9*(2), 211-230.

Sandry, E. (2017). Creative collaborations with machines. *Philosophy and Technology, 30*(3), 305-319.

Scharf, C. (2019). *Letter to shareholders.* New York, NY: Bank of New York Mellon.

Schatsky, D., Muraskin, C., & Gurumurthy, R. (2015). *Cognitive technologies: The real opportunities for business.* Dallas, TX: Deloitte University Press.

Schatsky, D., Muraskin, C., & Gurumurthy, R. (2018). *Cognitive technologies: A technical primer.* Dallas, TX: Deloitte University Press.

Schwab, K. (2016). *The fourth industrial revolution: What it means and how to respond*. Zurich, Switzerland: The World Economic Forum. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

Schwab, K. (2018). *Towards a Reskilling Revolution: A Future of Jobs for All.* Geneva, Switzerland, World Economic Forum.

Schwab, K. (2019). *AI Governance: A Holistic Approach to Implement Ethics into AI.* Geneva, Switzerland: World Economic Forum.

Schwab, K., & Samans, R. (2018). *The future of jobs report 2018.* Geneva, Switzerland: World Economic Forum.

Schwartz, J., Collins, L., Stockton, H., Wagner, D., & Walsh, B. (2017). *The future of work: The augmented workforce. 2017 Global Human Capital Trends.* New York, NY: Deloitte University Press.

Schwartz, J., Hatfield, S., Jones, R., Anderson, S. (2019). *What is the future of work?* New York, NY: Deloitte Insights.

Selingo, J. (2019). *The future of work and what it means for higher education.* Emory University, retrieved from: http://quantitative.emory.edu/documents/news-articles/article-Future-of-Work-Part-I.pdf

Shiver, M. & Daquila, M. (September 25, 2017). *IDC spending guide forecasts worldwide spending on cognitive and Artificial Intelligence systems to reach $57.6 billion in 2021.* New York, NY: International Data Company (IDC).

Singer, N. (2019, January 24). The hard part of computer science? Getting into class. *The New York Times.*

Siqing, C. (2019). *Bank of China Limited: 2018 annual report.* Beijing, China: Bank of China.

Škerlavaj, M., Štemberger, M. I., & Dimovski, V. (2007). Organizational learning culture—the missing link between business process change and organizational performance. *International Journal of Production Economics, 106*(2), 346-367.

Smith, R. (1987). Learning from experience. *Journal of Philosophy of Education, 21*(1), 37-46.

St. Claire, A. B. (2015). *Coordinating social communication in human-robot task collaborations* (Doctoral Dissertation). Retrieved from the Digital Library of the University of Southern California.

St. Claire, A. B., & Mataric, M. (2015, March). How robot verbal feedback can improve team performance in human-robot task collaborations. In *Proceedings of the tenth annual ACM/IEEE International Conference on Human-Robot Interaction* (pp. 213-220). Portland, OR: ACM.

Stolzoff, S. (October 15, 2018). LinkedIn CEO Jeff Weiner says the biggest skills gap in the US is not coding. *Quartz at Work.* Retrieved from https://qz.com/work/1423267/linkedin-ceo-jeff-weiner-the-main-us-skills-gap-is-not-coding/

Stone, P., Brooks, R., Brynjolfsson, E., Calo, R., Etzioni, R., Hager, G., Hirschberg, J., Kalyanakrishnan, S., Kamar, E., Kraus, S., Leyton-Brown, K., Parkes, D., Press, W., Saxenian, A., Shah, J., Tambe, M., & Teller, A. (2016). *Artificial intelligence and life in 2030: One hundred year study on artificial intelligence.* Stanford, CA: Stanford University.

Strauss, V. (2017, October). *Why we still needf to study the humanities in a STEM world.* Washington, DC: The Washington Post.

Susskind, R. & Susskind, D. (2015). *The Future of the Professions: How Technology Will Transform the Work of Human Experts.* London, UK: Oxford University Press.

Tang, M. (2019). *Cloud computing: More than just a CIO conversation.* New York, NY: Deloitte Development LLC.

Tucker, M. (2018). *HSBC holdings PLC: Strategic report 2018.* London, UK: HSBC.

Universum. (2019). *US's most attractive employers 2019.* https://universumglobal.com/us-most-attractive-employers-2019/

U.S. Department of Education (USDOE). (1983). *A nation at risk: The imperative for educational reform.* Washington, DC: U.S. Government Printing Office.

Vanian, J. (2019, June 18). *Here's how much companies are spending on Artificial Intelligence: Eye on A.I.* New York, NY: Fortune. https://fortune.com/2019/6/18/business-leaders-artificial-intelligence/

Volini, E., Schwartz, J., Roy, I., Hauptmann, M., Van Durme, Y., Denny, B., & Bersin, J. (2019). *Leading the social enterprise: Reinvent with a human focus. 2019 Deloitte Human Capital Trends.* New York, NY: Deloitte Insights

Woolstenhulme, A. M. (2013). *Microfoundations of organizational learning, knowledge, and innovation* (Order No. 3594317). Available from ProQuest Central; ProQuest Dissertations & Theses Global. (1442475953). Retrieved from http://ezproxy.cul.columbia.edu/login?url=https://search-proquest-com.ezproxy.cul.columbia.edu/docview/1442475953?accountid=10226

Yin, R. K. (2014). *Case study research: Design and methods.* Thousand Oaks, CA: Sage.

Weber, A. A., & Ermotti, S. P. (2019). *UBS group AG 2018 annual report.* Zurich, CH: UBS.

Wikipedia (2019). *List of largest banks in the world.* Retrieved on March 31, 2019 from https://en.wikipedia.org/wiki/List_of_largest_banks

Zakaria, F. (2015, March). *Why America's obsession with STEM education is dangerous*. Washington, DC: The Washington Post.

Appendix A

Participant Informed Consent Form

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000

INFORMED CONSENT

Protocol Title: Workforce Implications Associated with the Rise of Artificial Intelligence in Financial Services During the Fourth Industrial Revolution

Principal Researcher: Denise Gayle Rotatori
+1-646-226-6028, dr2864@tc.columbia.edu

INTRODUCTION

You are invited to participate in this research study entitled "Workforce Implications Associated with the Rise of Artificial Intelligence in Financial Services During the Fourth Industrial Revolution: An Exploratory Interview." You qualify to take part in this research study because you are an executive within the financial services industry familiar with the increased use and application of cognitive technologies in the operations of the business. Approximately 12 people will participate in this study and it will take under 90 minutes of your time to complete over the course of two days.

WHY IS THIS STUDY BEING DONE?

This study is being done to determine how leaders within the financial services sector are experiencing the increased use and application of cognitive technologies within the operations of the business. It will consider specific questions like the perceptions of financial services leaders on the effects for roles and responsibilities as a result of increased use of cognitive technologies, and the experience of leaders supporting the workforce through the transition.

WHAT WILL I BE ASKED TO DO IF I AGREE TO TAKE PART IN THIS STUDY?

You will be asked to participate in a (i) survey questionnaire and a (ii) semi-structured interview. Specifically:

(i) Complete an electronic survey questionnaire that is comprised of 11 multiple-choice questions in English. You will do this via a URL link to a Google Form survey, which should take no more than 15 minutes.
(ii) Participate in a 1:1 semi-structured 60-minute telephone interview with the researcher in English, which will be recorded. The interview will involve 4 open-ended questions, with select follow-up probes (e.g., question 1, 1a, 1b).

If you decide to participate, the primary researcher will distribute the survey. Upon survey completion the researcher will reach out to schedule and conduct the recorded telephone interview.

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The interview will provide an opportunity to discuss your experience as an executive working within the financial services sector during the fourth industrial revolution (4IR) when artificial intelligence and other cognitive technologies are becoming more prevalent. This interview will be audio-recorded. After the audio recording is transcribed the audio recording will be deleted. If you do not wish to be audio-recorded, you will not be able to participate. The interview will take approximately sixty minutes. Your interview will be assigned a de-identified code in order to keep your identity confidential.

Interviews will be conducted over the telephone and it is encouraged that you are in a comfortable location without interruption for the 60 minutes. If you choose to participate, you will be notified at the start of the interview when the researcher is going to begin recording, and similarly at the end of the interview when recording has been stopped.

WHAT POSSIBLE RISKS OR DISCOMFORTS CAN I EXPECT FROM TAKING PART IN THIS STUDY?

This is a minimal risk study, which means the harms or discomforts that you may experience are not greater than you would ordinarily encounter in daily life. However, there are some risks to consider. For example, you may not be in a position to answer certain questions in as much depth as you may be inclined, e.g., to share confidential information about your organization or experiences. You do not have to answer any questions or share anything you are not in a position to talk about.

Any information that is shared will be kept confidential. The researcher is taking precautions to prevent anyone from discovering or guessing your identity, by using a de-identifying code instead of your name. Additionally, information will be stored on a password protected computer.

WHAT POSSIBLE BENEFITS CAN I EXPECT FROM TAKING PART IN THIS STUDY?

There is no direct benefit to you for participating in this study. Participation may benefit leaders working within the financial services industry, and those supporting the industry during this period of transformation (e.g., management consultants or those researching the changes).

WILL I BE PAID FOR BEING IN THIS STUDY?

You will not be paid to participate. There are no costs to you for taking part in this study.

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WHEN IS THE STUDY OVER? CAN I LEAVE THE STUDY BEFORE IT ENDS?

The study is over when you have completed the survey questionnaire and individual interview. However, you are free to withdraw from participating in the study at any point in time.

PROTECTION OF YOUR CONFIDENTIALITY

The researcher will be using electronic and digital records for the study and keep this information (including audio recordings) on a computer that is password protected. The audio recording will be transcribed for analysis, and the audio recording will then subsequently be destroyed. There will be no record matching your real name with your de-identifiable code.

Data collected during the research will be maintained for a minimum of three years after completion of the study, inline with regulatory expectations.

For quality assurance, the researcher, the study sponsor, and/or members of the Teachers College Institutional Review Board (IRB) may review the data collected from you as part of this study. Otherwise, all information obtained from your participation in this study will be held strictly confidential and will be disclosed only with your permission or as required by U.S. or State law.

HOW WILL THE RESULTS BE USED?

The results of this study will be published as part of the researcher's dissertation. Additional use of select findings may be utilized subsequently for journal articles and/or presented at academic conferences. However, results will only be used in aggregate and there will be no identifiable data. Your name or any identifying information about you will not be published.

CONSENT FOR AUDIO RECORDING

Audio recording is part of this research study. You can choose whether to give permission to be recorded. If you decide that you don't wish to be recorded, **you will not be able to participate** in this research study.

_____I give my consent to be recorded

_____
Signature

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INFORMED CONSENT

_____I **do not** consent to be recorded

_____
Signature

WHO MAY VIEW MY PARTICIPATION IN THIS STUDY

___I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College, Columbia University

_____
Signature

___I **do not** consent to allow written materials viewed outside of Teachers College, Columbia University

_____
Signature

WHO CAN ANSWER MY QUESTIONS ABOUT THIS STUDY?

If you have any questions about taking part in this research study, you should contact the researcher, Denise Rotatori, at +1.646.226.6028 **dr2864@tc.columbia.edu**, or faculty advisor, Dr. Lyle Yorks, at 1.212.678.3820 **yorks@exchange.tc.columbia.edu**.

If you have questions or concerns about your rights as a research subject, you should contact the Institutional Review Board (IRB) (the human research ethics committee) at 212-678-4105 or email IRB@tc.edu or you can write to the IRB at Teachers College, Columbia University, 525 W. 120th Street, New York, NY 10027, Box 151. The IRB is the committee that oversees human research protection for Teachers College, Columbia University.

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PARTICIPANT'S RIGHTS

- I have read the Informed Consent Form and have been offered the opportunity to discuss the form with the researcher.
- I have had ample opportunity to ask questions about the purposes, procedures, risks and benefits regarding this research study.
- I understand that my participation is voluntary. I may refuse to participate or withdraw participation at any time without penalty.
- The researcher may withdraw me from the research at their professional discretion.
- If, during the course of the study, significant new information that has been developed becomes available which may relate to my willingness to continue my participation, the researcher will provide this information to me.
- Any information derived from the research study that personally identifies me will not be voluntarily released or disclosed without my separate consent, except as specifically required by law.
- Identifiers will be removed from the data. Your data will not be used in further research studies.
- I should receive a copy of the Informed Consent Form document.

My signature means that I agree to participate in this study:

Print name: _____ **Date**: _____

Signature: _____

Appendix B

Survey Questionnaire

Instructions: *Please complete the following brief survey in accordance with your professional responsibilities. Most of the questions are multiple choice, please select the most appropriate answer. For reference, an inventory of key terms has been provided at the end of the survey.*

Note: Definitions of key terms will be provided digitally via the survey tool. Definitions will be those articulated in the Key Terms section of Chapter I—Introduction.

#	**Question**	**Answer**	**Type**
SQ1	How large is your institution's workforce?	• 10,000-50,000 • 50,000-100,000 • 100,000-250,000 • 250,000+	Multiple choice; single selection
SQ2	How large is the workforce you are influencing with respect to cognitive technology transformation (e.g., your department and/or the functions you are responsible for)?	• <100 • 100-1,000 • 1,000-10,00 • 10,000-50,000 • 50,000+	Multiple choice; single selection
SQ3	Across approximately how many countries does your organization currently operate? *If you do not operate in a particular continent, please note.*	• <5 • 5-10 • 10-50 • 50+ [Free text field optional]	Multiple choice; single selection
SQ4	In what year did your organization begin to apply cognitive technologies to the operations of the business?	• 2010-2014 • 2015 • 2016 • 2017 • 2018	Multiple choice; single selection
SQ5	From your perspective and experience, approximately how many roles have been affected within your organization based on the application of cognitive technologies thus far?	• 0-100 • 100-1000 • 1,000-10,000 • 10,000-50,000 • 50,000+	Multiple choice; single selection
SQ6	From your perspective and experience, approximately how many roles do you think will be affected within your organization based on the application of cognitive technologies by 2025?	• 0-10 • 10-100 • 100-1000 • 1,000-10,000 • 10,000-100,000+	Multiple choice; single selection

#	Question	Answer	Type
SQ7	What type of cognitive technologies are the most prevalent within your department and/or function(s)?	• Robotic Process Automation (RPA) • Machine Learning • Deep Learning • Natural Language Processing (NLP) • Sensors, Device Connectivity and the Internet of Things (IoT) • Other form of cognitive technologies and artificial intelligence (AI) [Insert Name]	Multi-select; rank top 3
SQ8	What type of cognitive technologies are the most prevalent within your organization?	• Robotic Process Automation (RPA) • Machine Learning • Deep Learning • Natural Language Processing (NLP) • Sensors, Device Connectivity and the Internet of Things (IoT) • Other form of cognitive technologies and artificial intelligence (AI) [Insert Name]	Multi-select; rank top 3
SQ9	What are the most frequent barriers to cognitive technology adoption?	• Lack of clear AI strategy • Lack of talent with appropriate skillsets • Lack of leadership ownership and commitment • Lack of technological infrastructure • Functional silos constraining end-to-end solutions • Lack of available data • Under-resourced • Limited relevance of insights gained from AI • Uncertain or low expectations for return on AI investments	Multi-select; rank top 3
SQ10	How are you sourcing AI capabilities (e.g., building in-house and retaining employees)?	• Building AI capabilities in-house • Partnering with businesses or others (e.g., academic institutions) to find talent • Buying or listening capabilities from large technology companies • Retraining or upskilling internal talent • Buying capabilities from AI-focused startups • Crowdsourcing AI capabilities • Buying capabilities from professional services or system integrator firms • Acquiring other companies • Hiring external talent	Multi-select; rank top 3

#	Question	Answer	Type
SQ11	What is the scale of human collaboration with cognitive technologies in your organization?	• Very high (most roles) • High (more than 50% of roles) • Moderate (Some roles, in an organized way) • Low (Some roles, but ad-hoc and inconsistent) • Very low (minority of roles)	Multiple choice; single selection
SQ12	What are the top three things your organization will do next to enable more effective human-machine collaboration to scale cognitive technology?	N/A	Free text

Appendix C

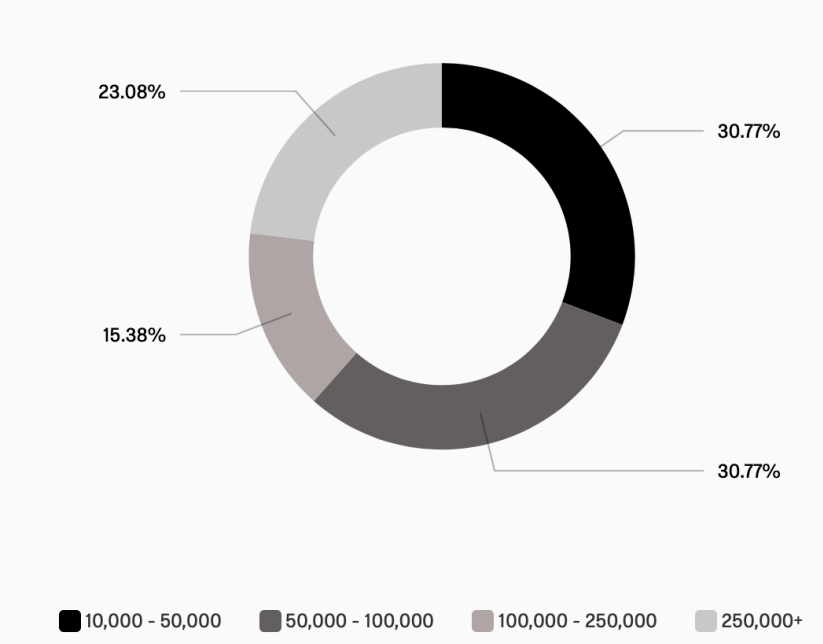
Interview Protocol

#	Question
IQ1	What is your experience of adopting and adapting to major cognitive technology disruptors changing the nature of the business (e.g., AI, RPA, machine learning)?
IQ1a	What are two the most significant moments you (and your team) have had learning to work with cognitive technologies in new ways?
IQ1b	What learning experiences from having collaborated with machines will you most carry forward to utilize in the future?
IQ1c	What partnerships, internally or externally, are you leveraging as a leader to address this challenge (e.g., supplier partnerships)?
IQ2	What particular areas of the business (e.g., front-office revenue generating, back-office operations) have been most affected to-date?
IQ2a	What types of work activity are you experiencing is being impacted most beneficially from the application of cognitive technologies?
IQ2b	In those examples you've just cited, what kind of increased human-machine collaboration is your department/ institution experiencing?
IQ2c	In what ways are you collaborating collectively with other leaders within your organization to address the transformation underway?
IQ3	How experienced is your workforce with respect to the major technology disruptors affecting the business (e.g., RPA vs. machine learning)?
IQ3a	How have the skillsets required evolved since adopting cognitive technologies?
IQ3b	How have the roles and responsibilities of your workforce changed since adopting cognitive technologies?
IQ3c	What has been your experience as a leader witnessing these changes in workforce skillsets and roles?
IQ4	How have you supported the workforce learning required to enable the transition?
IQ4a	What are two or three of the more significant efforts your leadership team has undertaken to assist in greater levels of adoption and human-machine collaboration?
IQ4b	What are some of the primary constraints and challenges your leadership team has encountered while supporting the workforce through this transition?
IQ4c	What kinds of new learning tools, approaches, methodologies are needed to support the new demands for adapting to increased human-machine collaboration?

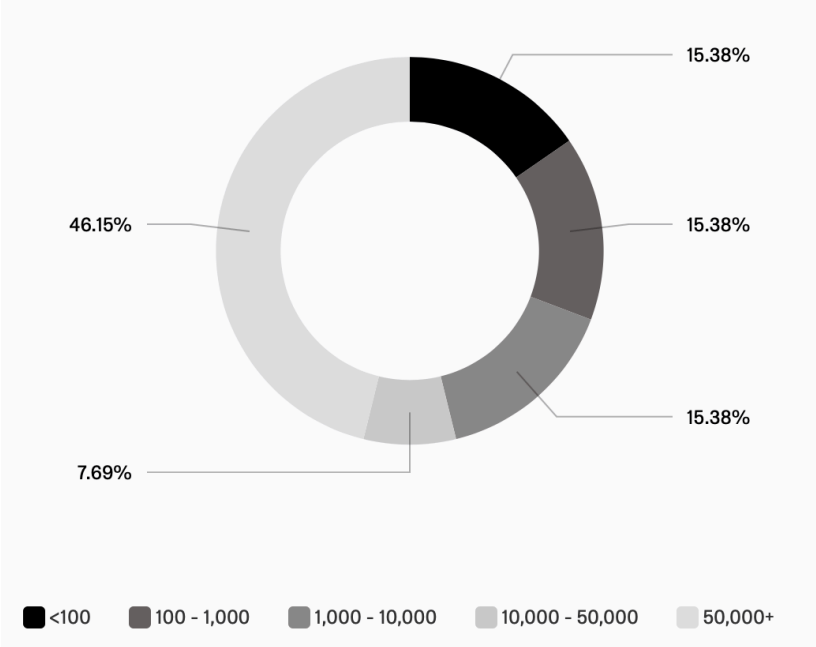
Appendix D

Detailed Survey Results

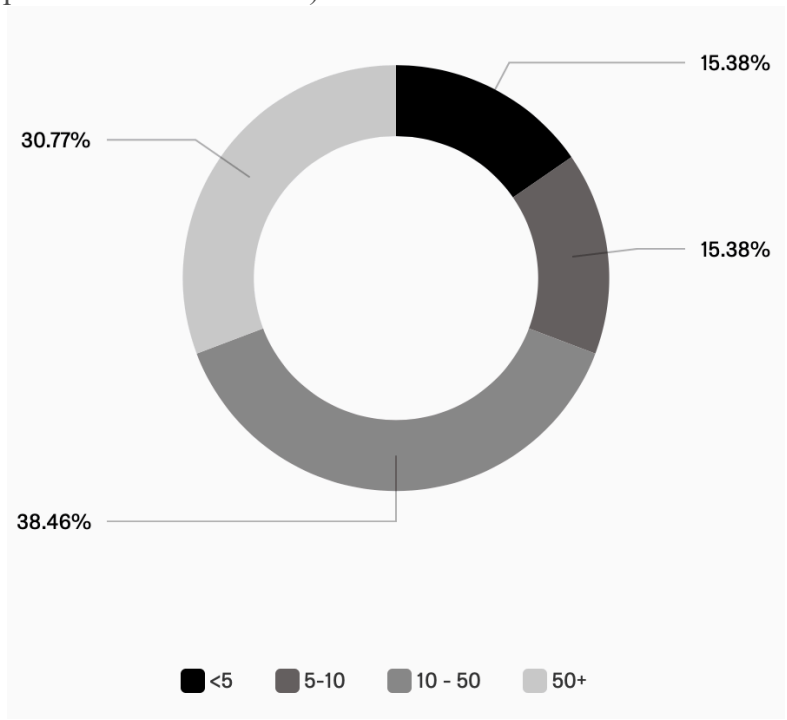
Question 1: How large is your institution's workforce? (Sample size = 12 executives)



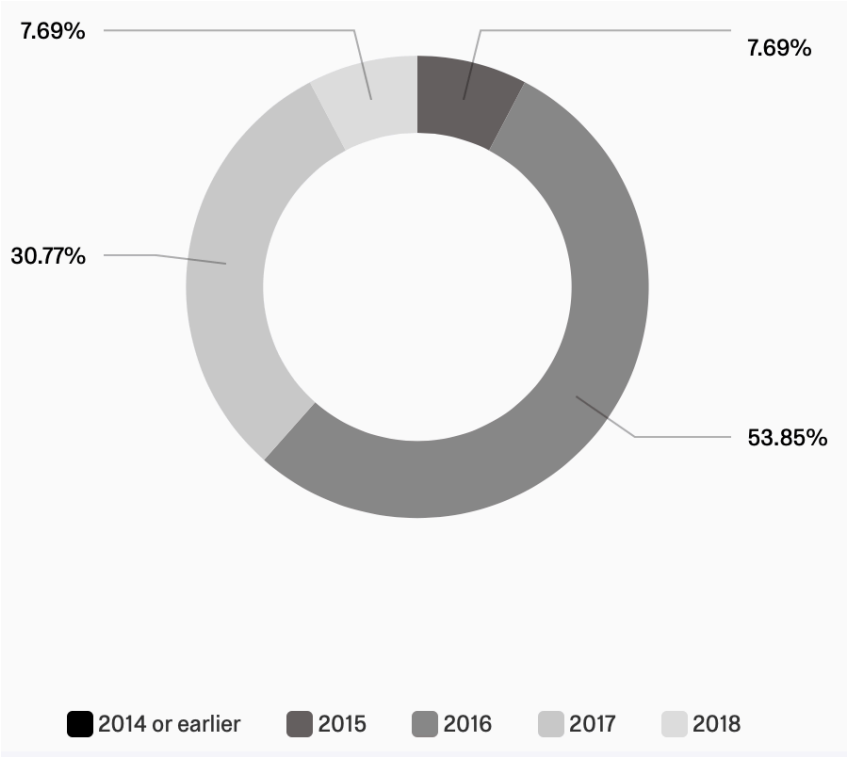
Question 2: How large is the workforce you are influencing with respect to cognitive technology transformation (e.g., your department and/or the function(s) you are responsible for)? (Sample size = 12 executives)



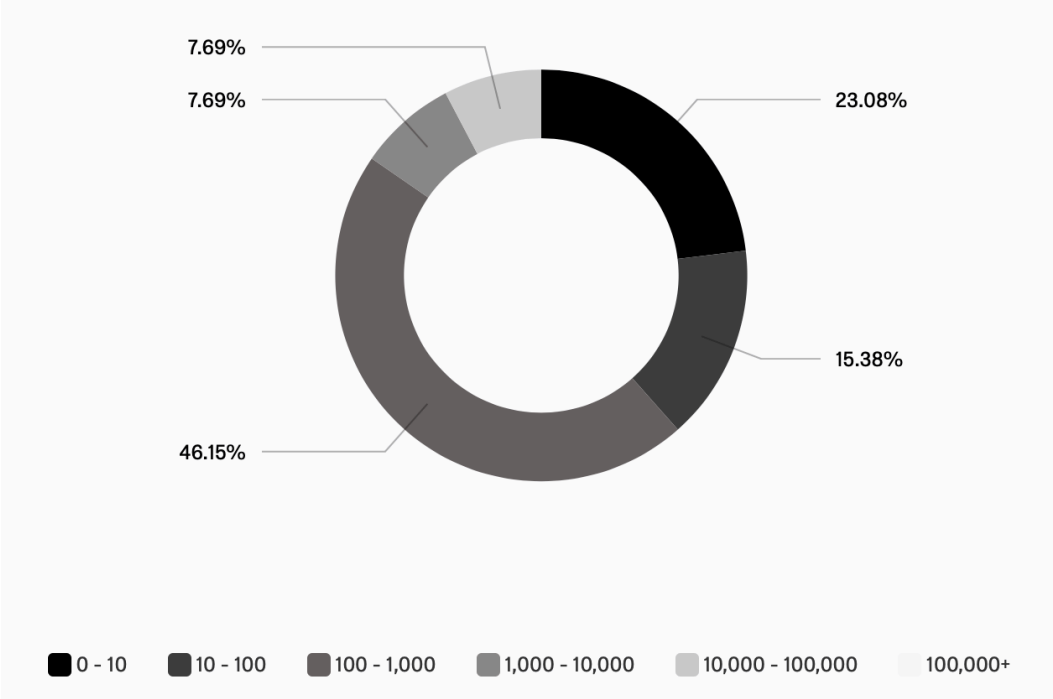
Question 3: Across approximately how many countries does your organization currently operate? (Sample size = 12 executives)



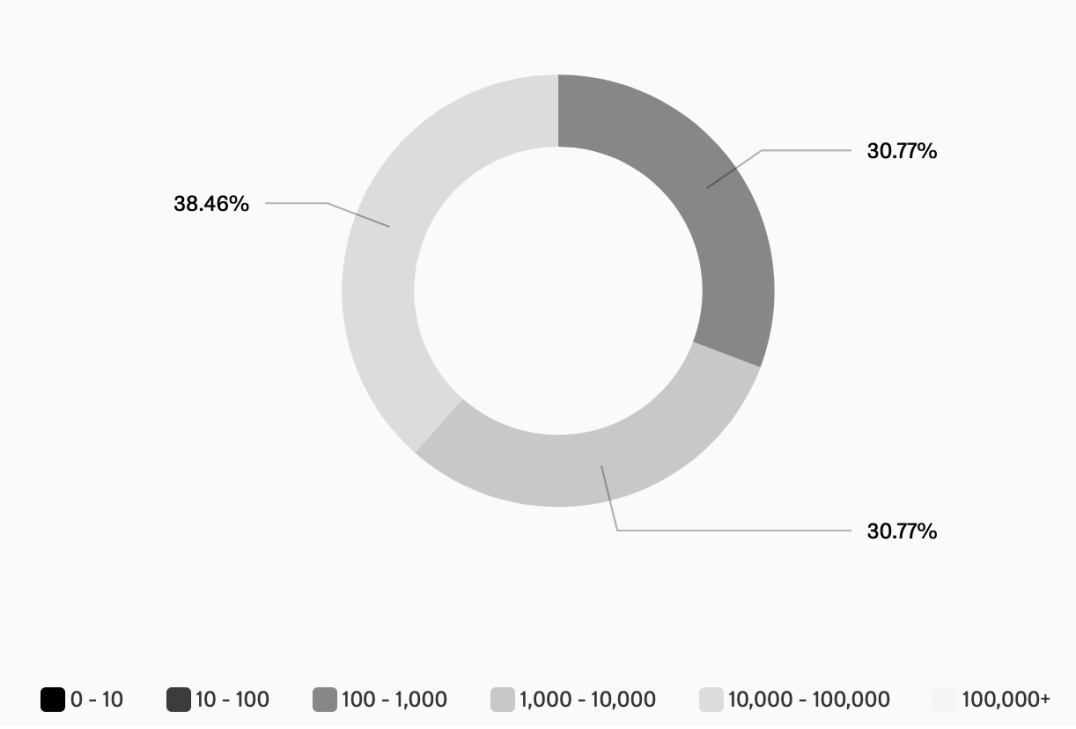
Question 4: In what year did your organization begin to apply cognitive technologies to the operations of the business?



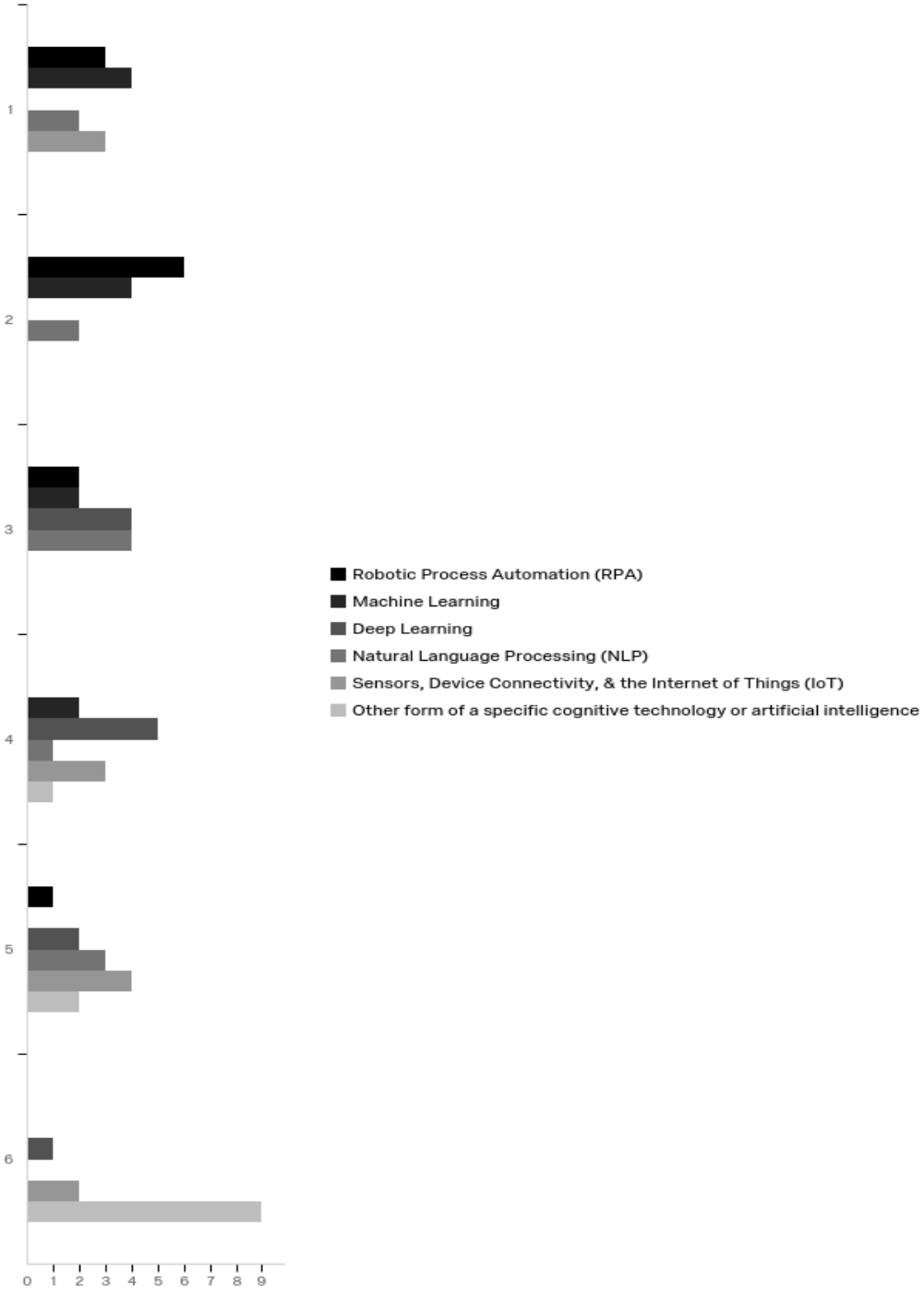
Question 5: From your perspective and experience, approximately how many roles have been affected within your organization based on the application of cognitive technologies thus far? (Sample size = 12 executives)



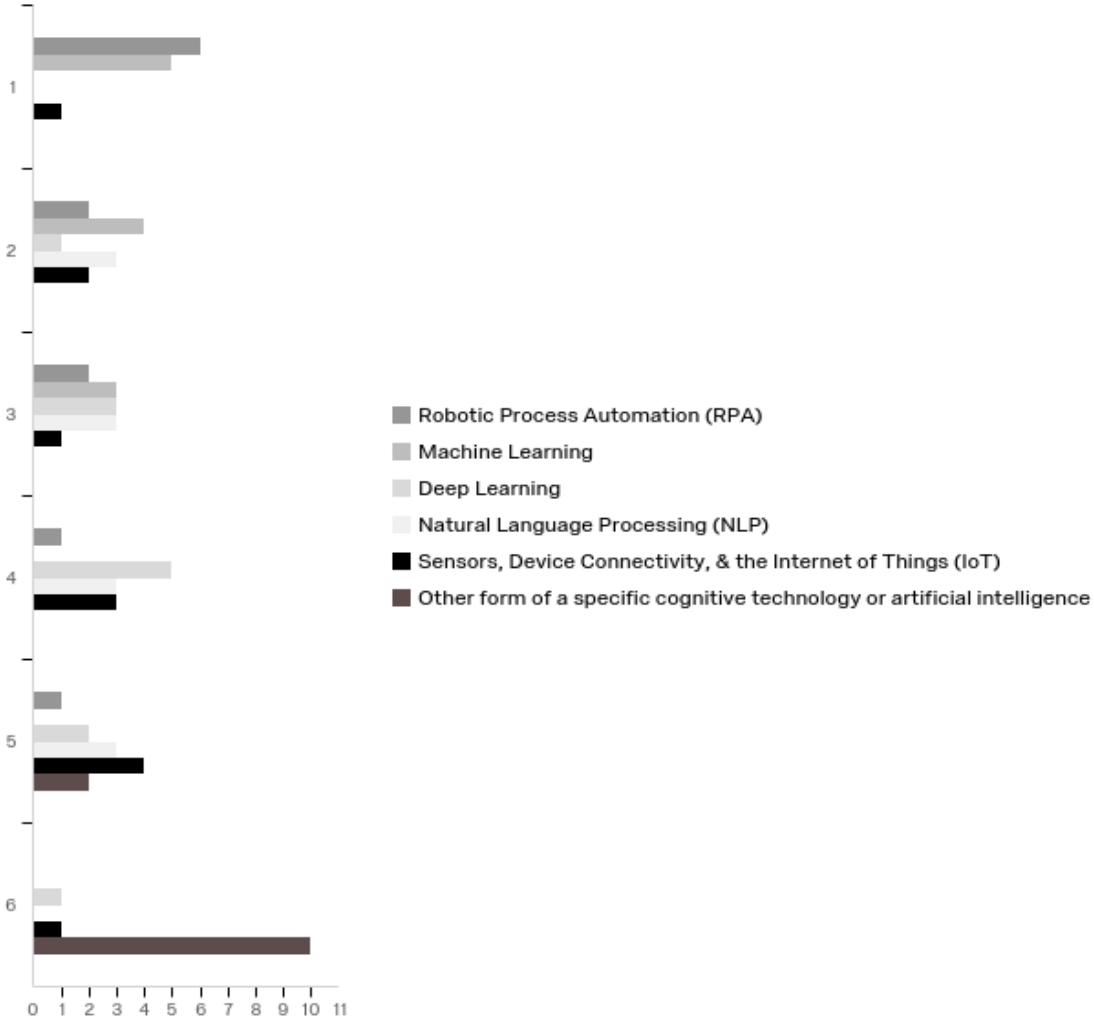
Question 6: From your perspective and experience, approximately how many roles do you think will be affected within your organization based on the application of cognitive technologies by 2025? (Sample size = 12 executives)



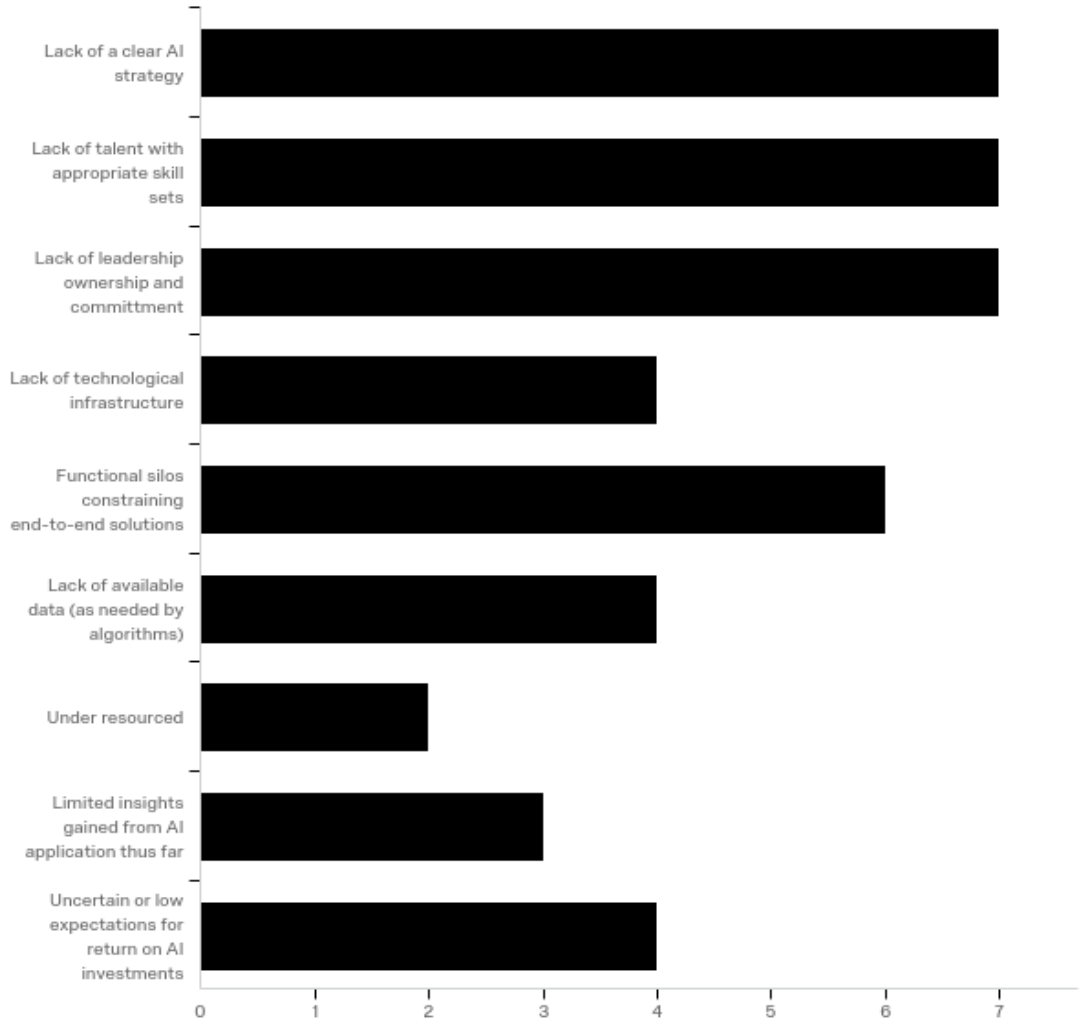
Question 7: What type of cognitive technologies are the most prevalent within your department and/or function(s)? (Sample size = 12 executives, ranking from 1 to 6)



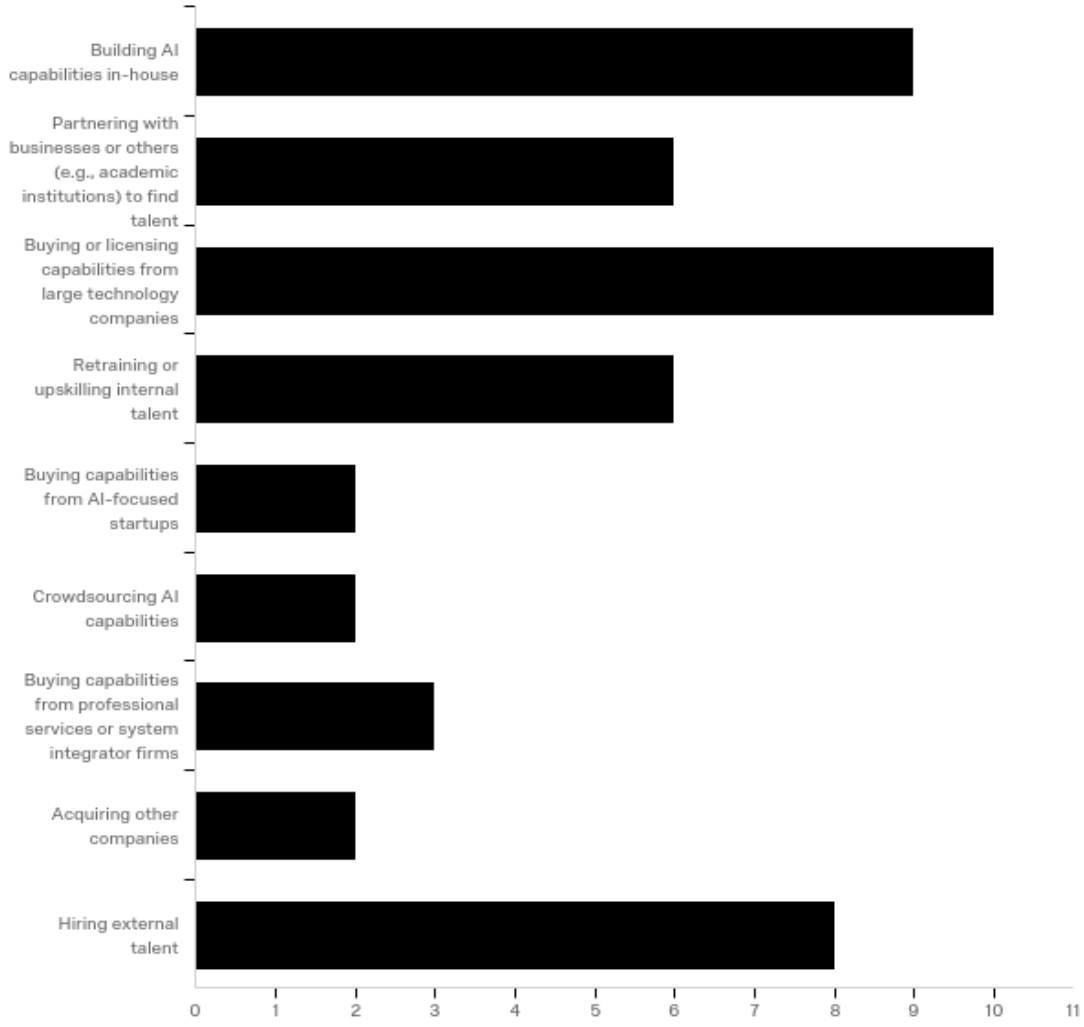
Question 8: What type of cognitive technologies are the most prevalent within your organization? Sample size = 12 executives, ranking from 1 to 6)



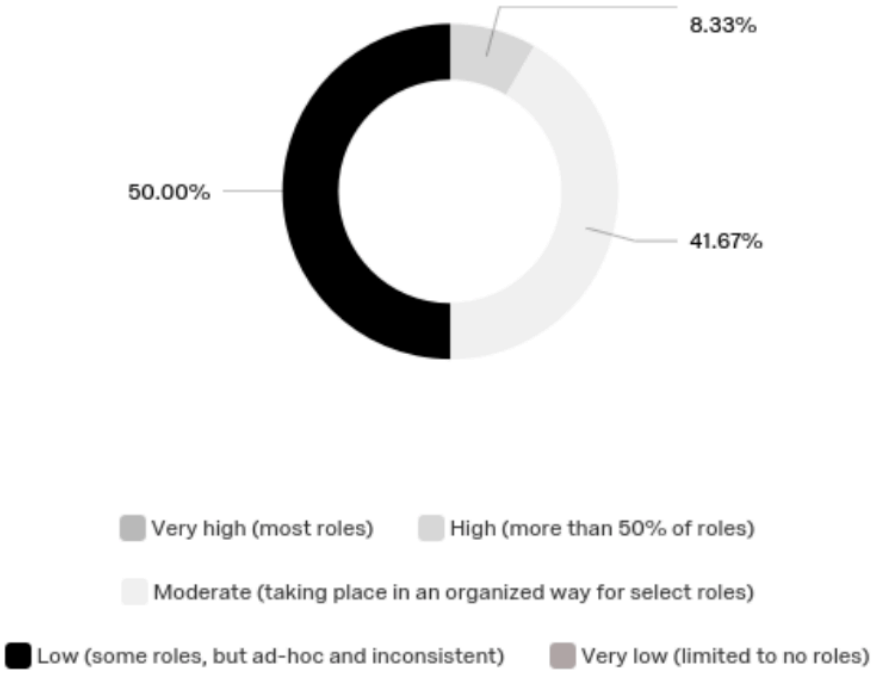
Question 9: What are the most frequent barriers to cognitive technology adoption? (Sample size = 12 executives, response allowed for selecting all that apply)



Question 10: How are you sourcing AI capabilities (e.g., building in-house and retraining employees)? (Sample size = 12 executives, response allowed for selecting all that apply)



Question 11: What is the scale of human collaboration with cognitive technologies in your organization? (Sample size = 12 executives)



Question 12: What are the top three things your organization will do next to enable more effective human-machine collaboration to scale cognitive technologies? (Sample size = 12 executives)

- Better scaled involvement from the workforce, better sharing of best practices across LOBs/departments, exploration of more elaborate forms of AI with governance controls
- It will have to lower our risk assessment process in order to get external technology approved. Although tagged as a priority, we may need to determine how and where they focus their efforts. Better understand the importance to either or both our internal employees and external customers.
- Raise awareness, provide infrastructure and frameworks to support, encourage innovation.
- Develop a coherent strategy, build internal resource skills, build strong underlying data and infrastructure
- I don't think this dimension is still fully thought through for our organization yet
- Better definition on what can/should be automated, investment heavily into IoT, sourcing specialized talent
- Post-migration to target data ecosystem, make the data easily accessible to DAs, BAs and Product Owners, create collaboration platforms to scale deep learning, instrument everything
- Hone strategy, continue investment
- Clear strategy for automation, with top down C-suite support, and with investments in human capital
- More consistent investment in the full suite of cognitive technologies from data science to IoT and ML; supplement with more coherent talent strategies to build internally or buy in the marketplace (e.g., through acquisitions)
- Better PR/communications around successes; making experiences from learning on the ground available to others quickly
- We don't yet have a coherent plan to support effective human-machine collaboration; we should start there