TECHNOLOGY

SURVEY REPORTS

CFA Institute Research & Policy Center

Creating Value from Big Data in the Investment Management Process: A Workflow Analysis

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Executive Summary

We are now in the third wave[1] of a technology-inspired revolution that began approximately half a century ago. The central points of this wave are complex systems that combine hardware, software, data storage, and connectivity in multiple ways to facilitate innovative approaches to using profuse, multifaceted streams of data. This wave continues to fuel the expansion of the financial sector, increased sophistication of financial products, and intensified transaction speeds (e.g., high-frequency trading).

The dynamic nature of AI and big data technologies necessitates a comprehensive and updated assessment of AI use in the investment industry. From February to April 2024, we conducted an in-depth study of how investment professionals used AI and big data technologies in their respective workflows. We also set out to understand the key risks, challenges, and opportunities facing the industry related to AI/big data use. We undertook this effort with both a cross-sectional global survey of CFA Institute members (the quantitative component) and a series of roundtable sessions that drew international panels of C-suite executives, industry practitioners, and regulators (the qualitative component).

This report represents the outcome of these two elements. We found that although the use of AI and big data technologies was notably lower when compared with legacy tools such as Microsoft Excel and market databases, investment professionals were increasingly turning to AI and big data tools

[1]The first wave of IT, which took place during the 1960s and 1970s, automated individual activities such as order processing and bill paying (Porter and Heppelmann 2014). The emergence of the internet during the 1980s and 1990s unleashed the second IT-driven wave by facilitating integration across activities and among geographically distributed firms and customers (Porter and Heppelmann 2014).

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and techniques to facilitate their workflow activities. More than two-thirds of investment professionals across the occupational spectrum were keen to develop their AI and other technical skills to remain relevant in the same job and were confident that their employers would support their training.

This report provides a foundation for CFA Institute members, industry professionals, and regulators to discern the opportunities for workflow enhancement brought about by big data and AI tools. It offers a panoramic view of how the investment management industry is currently applying AI and big data tools. In a related project, the CFA Institute Automation Ahead series[2] provides practical, worked examples of how some of these technologies can be used to automate repetitive tasks and enhance investment processes. Given the symbiotic nature of these two projects, we suggest reading them in conjunction with each other.

[2]CFA Institute publications related to automation in the investment industry are available on the Research and Policy Center (RPC) site: https://rpc.cfainstitute.org/research/the-automation-ahead-content-series.

Key Takeaways

- **AI and Big Data Usage in Investment Management:** The report highlights a gradual increase in the adoption of AI and big data technologies across various job functions within the investment management industry, emphasizing their use in advisory, analytical, investment and decision-making, leadership, risk management, and sales and client management tasks.
  - **Multihoming:** Investment professionals often juggle multiple technologies for similar tasks. For instance, in data visualization, Python and other data visualization tools such as Tableau are almost equally popular among respondents. This result may imply the beginning of an industry transition from a single-tool (or single-homing) strategy—where Excel is used for substantially all aspects of data processing—to a "best of all worlds" multihoming strategy, where users employ various platforms/technologies to optimize their workflows.
  - **Technological Intensity:** Our technological intensity matrix captures both the rate and frequency of technological use by individuals (see Exhibit 6). Overall, the intensity of use of GenAI, Python, SQL, other programming languages, and other data visualization technologies fell within the moderate band of our technological intensity matrix: Between 20% and 39% of investment professionals (*rate of use*) reported using these technologies daily (*frequency of use*). However, 47% of investment professionals reported using other data visualization tools daily for data visualization tasks, reflecting a technological intensity in the moderately high quadrant of the matrix.
  - **Regional Usage Patterns:** AI and big data technologies are primarily used for data analysis and visualization across all regions. Average usage rates of the technology tools covered in this study were highest for these workflows:
    - Data analysis: AI and big data technologies were used by 25%, 23%, and 24% of respondents, respectively, in the Americas, Asia Pacific, and Europe, Middle East, and Africa (EMEA) regions.
    - Data visualization: AI and big data technologies were used by 25%, 32%, and 23%, respectively, in the Americas, Asia Pacific, and EMEA regions. An average of 29% of investment professionals in the Asia Pacific region utilized these technologies for risk management.

- **Usage Across Occupational Groups:** Investment professionals across job groups use AI and big data technologies daily, mainly for data analysis, visualization, financial modeling, and risk management. GenAI, however, sees a split, with 49% of respondents using it daily and 42% weekly. In addition:
  - Python is a favorite tool for data analysis across various roles, with notable usage in analytical (46%), investment and decision-making (29%), leadership (33%), and risk management (41%) tasks.
  - ChatGPT is the GenAI technology of choice; it is used by at least 75% of respondents in all job/age groups and regions.

- **Challenges and Organizational Issues:** Key challenges to AI adoption include the complexity and opacity of AI models (the "black box" or explainability issue), data privacy concerns, and a skills gap resulting from too few individuals with enough knowledge in both finance and technology.
  - Organizational challenges also involve data quality issues and fragmented AI implementation efforts within firms.
  - For regulators, a lack of international coherence in regulatory approaches to AI policy poses an additional challenge.

- **Harnessing the Power of AI:** For firms and investment professionals, AI is not just a buzzword but a powerful tool that promises to revolutionize decision making, enhance efficiency, and drive profitability. Its advantages are manifold, encompassing improved forecasting, enhanced collaboration, democratization of financial advice, and bolstered regulatory oversight.

Introduction

In this report we assess, at a granular level, the technologies that investment professionals use in their work-related activities. We also seek to understand the key risks, challenges, and opportunities related to the use of these technologies by investment professionals and firms. For this purpose, we used a two-pronged research method in our information-gathering process. First, we conducted a global cross-sectional survey during the last two weeks of February 2024. Second, we conducted a series of roundtable discussions between March and April 2024 with investment professionals from around the world, including C-suite executives, learning specialists, practitioners, and regulators.

Why Are We Launching this Report?

This report extends our existing body of work on AI, big data, and machine learning as well as our Future of Work series.[3]

In March 2019, CFA Institute conducted a practice analysis survey to understand the state of adoption of different technologies in the workflows of analysts, portfolio managers, and private wealth managers (CFA Institute 2019a). At that time, we found that most of these investment professionals were not using AI and big data applications in their spheres of business activity.

However, a 2022 qualitative study (Wilson 2023) suggested that digitization and digital transformation may have created the impetus for investment professionals to use AI—in particular, open-source technologies such as the Python programming ecosystem—to optimize their job functions.

Digitization refers to the process of converting information from analog (non-digital) to computer (digital) form. **Digital transformation** refers to organizational change that is prompted and shaped by rapidly changing and diffuse digital technologies (Hanelt, Bohnsack, Marz, and Antunes Marante 2021).

Continuing development of new technological tools, such as generative AI technologies, and the creation of synergies between new and old technologies, such as the recent embedding of Python libraries in Excel, provide investment professionals with the wherewithal to capitalize on the best of industry-relevant technologies. These recent developments highlight a need for a comprehensive and updated assessment of AI and big data usage in the investment industry. Our research aims to provide industry stakeholders with an overview of the tools and workflows for creating value from the multifaceted and prolific amounts of data generated in today's world, commonly referred to as "big data."

What Do We Cover in This Report?

In recent years, CFA Institute has published several reports that consider big data and AI in the investment industry. "Investment Professional of the Future" (CFA Institute 2019b) discussed key roles and skills for future investment teams against the backdrop of technological transformation. "AI Pioneers in Investment Management" (CFA Institute 2019a) described how some investment organizations were incorporating artificial intelligence and big data into their investment processes. And the CFA Institute report "Future State of

[3]CFA Institute publications related to the future of work in the investment industry are available on the RPC site: https://rpc.cfainstitute.org/en/themes/insights/future-of-work.

the Investment Industry" (Preece, Munson, Urwin, Vinelli, Cao, and Doyle 2023) outlines the transformative potential of AI and big data technologies.

In this report, we extend these avenues of research to assess the degree to which investment professionals use AI and big data technologies to perform their workflow tasks, the obstacles that may impede organizational efforts to adopt these technologies, and the opportunities associated with using these technologies as they relate to firm strategy, individual professional development, regulation, and collaboration. Specifically, in our survey and/or roundtable sessions (as indicated in italics), we focused on the following research questions:

1) How do investment professionals use AI technologies on the job? (*survey*)
2) What key issues motivate the use of AI technologies in the investment management industry? (*survey and roundtable*)
3) What challenges or obstacles may impede investment professionals in the use of AI technologies? (*survey and roundtable*)
4) What are the regulatory issues and/or concerns regarding the use of these technologies by investment professionals? (*roundtable*)
5) What opportunities do AI technologies present to the investment management profession? (*roundtable*)

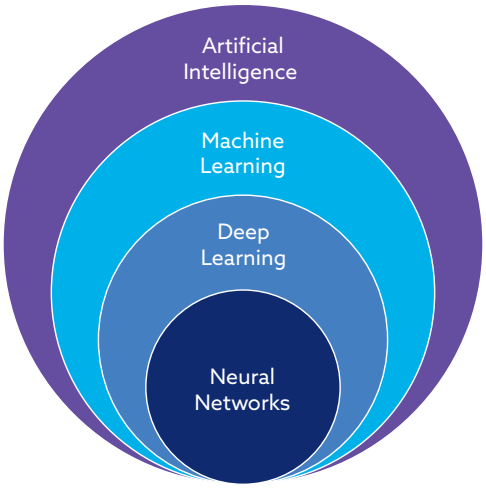
AI and Big Data Applications in Investment Management

Artificial intelligence (AI) refers to the capability of a machine or computer to imitate intelligent human behavior or thought, such as learning, interacting with the environment, problem solving, and decision making (Rai, Constantinides, and Sarker 2019). AI is the impetus behind smart, connected products, such as Amazon's Alexa or Apple's Siri, that are seamlessly interwoven into the fabric of our everyday lives. Although the term debuted at a 1956 summer conference at Dartmouth College, the field of AI may trace its roots even earlier. For instance, as Rescorla (2020) discusses, Alan Turing (1950) argued that the question "Can machines think?" should instead be, "Can a machine be linguistically indistinguishable from a human?" The Turing test (TT) investigates the latter hypothesis: The computer "passed" the test if a human judge was unable to correctly determine, more than 50% of the time, whether responses to the questions were from a human player or a computer. Turing's view was that because our cognitive abilities are finite, they can be replicated by a machine (Rescorla 2020).

AI and Connection to ML, DL, and NNs

AI systems incorporate a number of technologies in order to operate, such as machine learning, deep learning, and neural networks. **Machine learning (ML)**

Exhibit 1. Relationship Structure within an AI System



Source: Wilson Drakes (2021).

is a subset of AI that uses a sequence of actions (algorithms) to make predictions or decisions without human intervention. **Deep learning (DL)** is a form of machine learning using algorithms that work in layers inspired by the structure and function of the human brain—that is, **neural networks (NNs)**. NNs that consist of three or more layers (input layer, output layer, hidden layers) are classified as DL algorithms. Some of the layers in the neural networks are hidden, which is where the computational processing takes place. Thus, the greater the number of hidden layers, the greater the computer's ability to process larger and more complex sets of data (Wilson Drakes 2021).

Perhaps the simplest way to think about AI, ML, DL, and NNs is to think of them as Russian nesting dolls: Each technology is a component of the previous one. Accordingly, ML is a subfield of AI; deep learning is a subfield of ML; and NNs constitute the backbone of DL algorithms (Kavlakoglu 2020). **Exhibit 1** presents a graphical illustration of these relationships.

Methodology

We used a mixed-method approach to this study, consisting of quantitative and qualitative elements. The quantitative component was a global cross-sectional survey sent to an opt-in pool of CFA Institute members.[4] The survey ran from 14 February to 1 March 2024. We invited 59,314 members to participate and received between 104 and 569 valid responses (not every question needed to be answered to submit the survey form), for a response rate of 0.2%–1.0% and a margin of error of ±4.0%.

[4]For an explanation of key survey terms, please see the Glossary of Survey Terms.

For the qualitative component, we held a series of roundtable discussions between March and April 2024. We designed four distinct groups of roundtables to elicit the unique perspectives of regulators, executives, practitioners, and learning specialists regarding the key drivers, challenges, and opportunities associated with the use of AI and big data technologies. Participants in the regulatory roundtable sessions were diversified in terms of geographic and institutional representation. Roundtable sessions were conducted under the Chatham House Rule to preserve participant confidentiality. Thirty participants across 10 roundtable sessions provided valuable insights for this report.

Many of the survey questions were in multiple response format; that is, participants were invited to select more than one response. As a result, the total of all responses for a multiple response question is greater than 100%.

Survey Participant Demographics

Given the demographic characteristics of most survey respondents, we conclude that the "average" survey respondent (based on the distribution of responses) is a seasoned investment professional from the Americas region (United States, Canada, or Mexico) who is:

- 44 years old,
- a CFA charterholder with a master's degree,
- in middle management, and
- has approximately 17 years of experience in the investment industry.

Further demographic details follow, including illustrations.

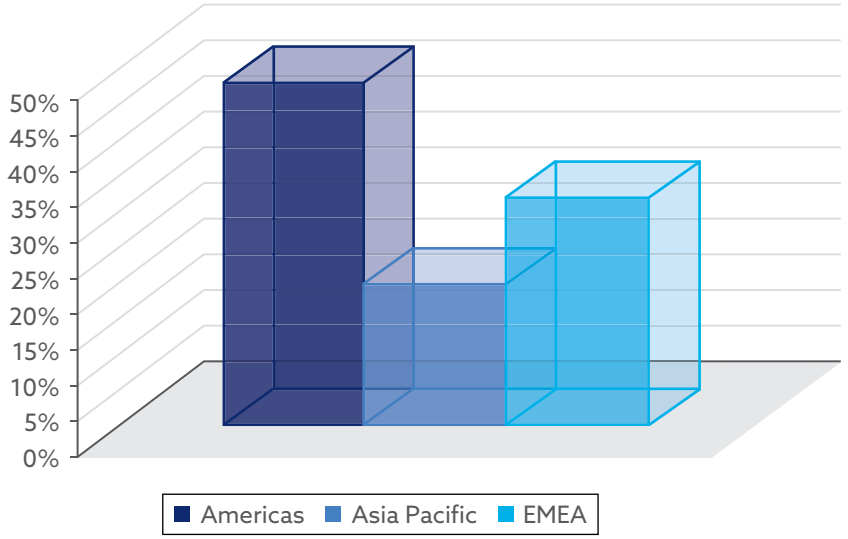
Regional Distribution

Although most respondents were from the Americas, we received substantive representation from other regions:

- 274 from the Americas (48%)
- 182 from Europe, the Middle East, and Africa (EMEA) (32%)
- 113 from Asia Pacific (20%)

The proportion of responses from EMEA is broadly consistent with its share of the CFA Institute member demographic. The proportion of respondents from Asia Pacific, however, is 13 points higher than its proportion of the overall membership. By contrast, the representation of the Americas region is 9 points lower than its share of the overall membership. **Exhibit 2** illustrates the geographic distribution of respondents.

Exhibit 2. Survey Respondents by Region



Age Group

The majority of survey participants (88%) were 28 to 59 years old. Of these, 291 (or 51%) identified as Millennials (28 to 43 years old), and 211 (or 37%) identified as Generation X (Gen X, 44 to 59 years old). Another 51 (or 9%) respondents were from the Baby Boomer generation (60 years old or older). Generation Z (Gen Z, 27 years old or younger) was the smallest group, accounting for 9 (or 2%) respondents. Seven respondents (1%) did not provide age-related information. **Exhibit 3** illustrates the distribution of respondents by age group.

Exhibit 3. Survey Respondents by Age Group

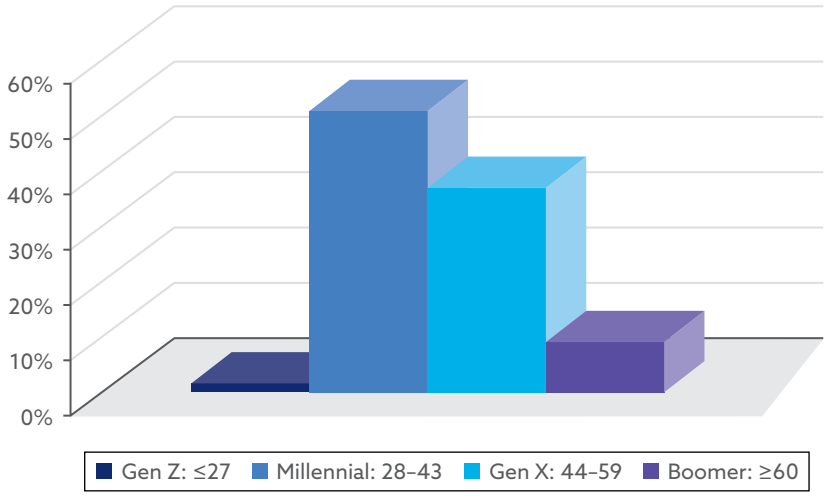
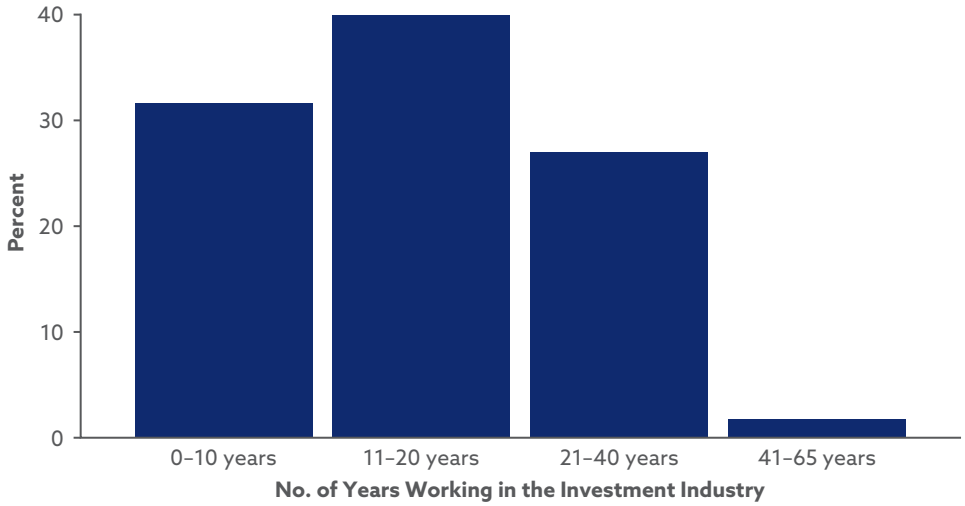


Exhibit 4. Number of Years of Investment Industry Experience



Number of Years Working in the Investment Industry

The level of industry experience was relatively well distributed among respondents. Individuals with between 11 and 20 years of work experience in the investment industry accounted for 40% of responses, and those with 10 years or less industry experience constituted 32% of the total respondents. Approximately 27% of respondents reported having 21 to 40 years of investment industry experience. **Exhibit 4** illustrates the distribution of respondents by years of experience.

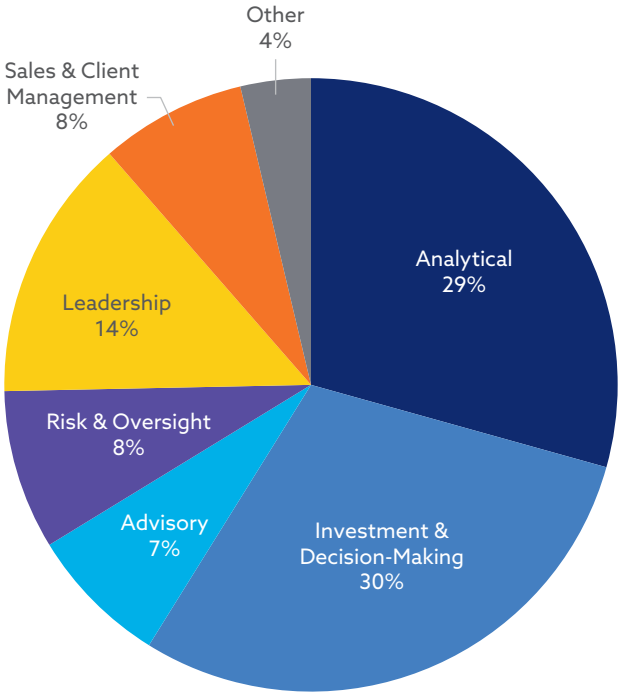
Occupational Categories

We categorized the occupations of survey respondents based on the six career skill zones identified in the Career Skills Framework:[5] advisory, analytical, investment & decision-making, leadership, risk & oversight, and sales & client management. The Career Skills Framework identifies the activities practitioners undertake within the investment process, together with the requisite knowledge and skills they need to succeed. We asked survey participants to select all workflow activities that they typically perform in the workplace. The top two or three workflow activities by job group are as follows:

- **Advisory:** business development and financial modeling
- **Analytical:** data analysis and financial modeling
- **Investment & Decision-Making:** investment strategy and portfolio construction

[5]CFA Institute, "Practice Analysis Annual Review" (23 June 2022), https://rpc.cfainstitute.org/en/research/surveys/practice-analysis-annual-review.

Exhibit 5. Survey Respondents by Occupational Category



- **Leadership:** data analysis, firm management/governance, and investment strategy
- **Risk & Oversight:** data analysis and risk management
- **Sales & Client Management:** business development and data analysis

As **Exhibit 5** indicates, most job roles (59%) were distributed between the analytical (29%) and investment & decision-making (30%) career zones. Leadership is the third-largest grouping, accounting for 14% of survey respondents.

How Do Investment Professionals Use AI Technologies in the Workplace?

A central objective of this study is to assess the degree to which AI and big data technologies are linked to the workflows of investment professionals. In this section, we illustrate the current level of technological intensity in the industry by evaluating the technologies investment professionals use in their workflow activities. In subsequent sections, we seek to ascertain the issues that may constrain greater use of these technologies. The workflow activities most frequently selected by survey respondents form the basis for the subsequent analyses.

Technological Intensity

Technological intensity assesses the degree to which investment professionals use the following five technologies on the job: GenAI, Python platform, SQL, other programming languages, and other data visualization technologies.

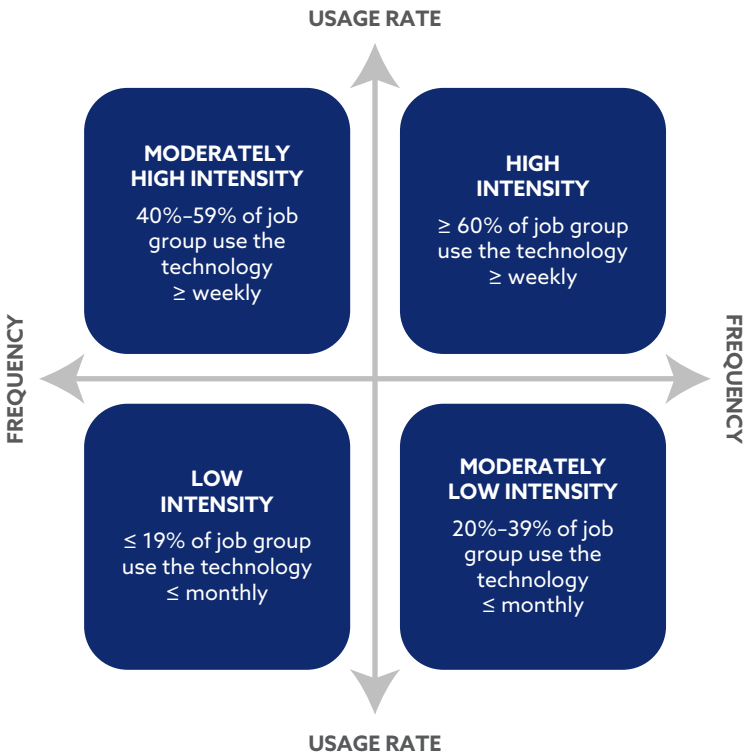
Our definition of technological intensity encapsulates two elements:

(i) *rate of use (or usage rate)*: the percentage of respondents who use a particular technology in their work activities

(ii) *frequency of use*: the percentage of respondents who use their selected technologies on a daily, weekly, monthly, or quarterly basis

For any technology, a higher level of technological intensity is associated with a higher percentage of individuals who use that technology *and* at a higher frequency (e.g., weekly vs. monthly). We present a technology intensity matrix in **Exhibit 6**. In the matrix, the "greater than or equal to" sign (≥) refers to individuals who use their chosen technologies *at least* weekly (also includes technologies that are used daily). Conversely, the "less than or equal to" sign (≤) indicates a usage frequency that is *at most* monthly (also includes technologies that are used quarterly).

Exhibit 6. Technological Intensity Matrix



Usage Rate

We asked respondents to identify the platforms/technologies they used in their chosen workflow activities. **Exhibit 7** shows the proportion of respondents using GenAI, Python, SQL, other programming languages, and other visualization technologies in selected workflow activities.

As expected, the Excel platform was used most frequently across all technologies, ranging from 67% of respondents for investment idea generation to 95% for valuation activities. Given the report's objective—to assist the investment profession in understanding the opportunities for workflow enhancement using AI and big data technologies—we focus our analysis on technologies other than Excel. We chose this approach partly because of Excel's limitations with managing big data and partly because use of Excel may decline with the uptake of technologies and technology platforms more suited to the increasing volumes of multifaceted data being used in the investment process. We seek to track the trajectory of the various alternatives to Excel to provide guidance in the investment management process.

Exhibit 7. Rate of Use: Proportion of Respondents Using Selected Technologies, by Workflow

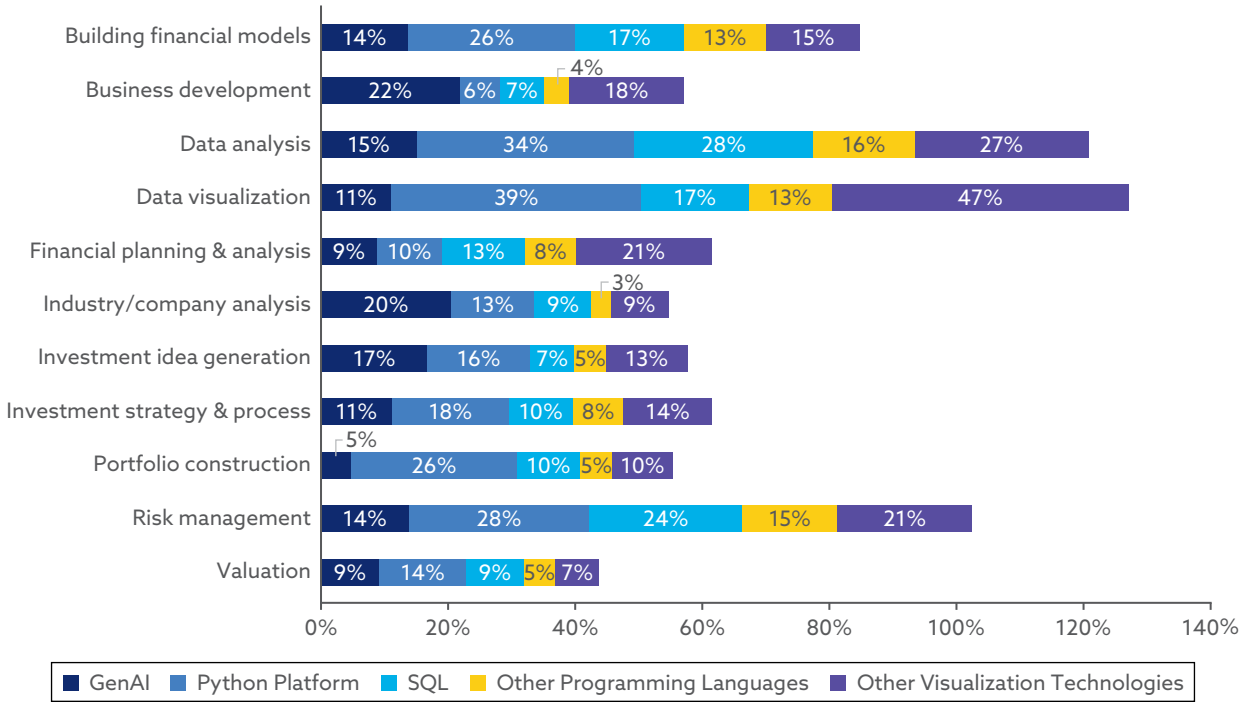


Exhibit 7 underscores the point that use of these technologies is not mutually exclusive: The overall percentages for some of the listed workflows sum to greater than 100. This result is indicative of a user multihoming strategy, in which an individual concurrently uses multiple platforms and/or technologies.

Multihoming allows users to leverage the strengths of different technologies: Using different tools for workflow tasks can enhance overall efficiency and encourage adoption of specialized technologies (Barua and Mukherjee 2021). For example, a portfolio manager may use Python to extract data files from index providers, upload the files to an SQL database, use Python to optimize the portfolio, and display the results in Excel or Tableau. By providing alternatives if one technology fails, multihoming also helps mitigate the risks associated with relying on a single technology. This strategy also helps reduce the cost of switching to a new technology because users can try out a new platform or tool without fear of losing access to the current technology.

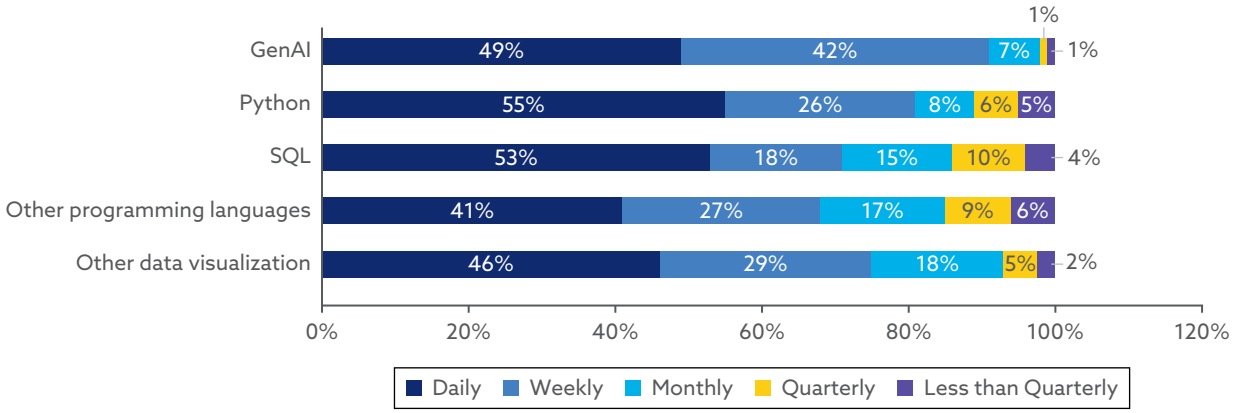
Accordingly, Exhibit 7 indicates the relative propensity of investment professionals to use one technology vis-à-vis other technologies within a multihoming environment. Some highlights follow:

- *GenAI*: GenAI technologies were used mainly for tasks related to business development (22%) and industry/company analysis (20%).
- *Python platform*: The Python platform was primarily used for data analysis (34%) and data visualization tasks (39%).
- *SQL and other programming languages*: SQL and other programming languages (OPL), such as C, Java, MATLAB, and R, were used mainly for risk management (SQL: 24%; OPL: 15%) and data analysis (SQL: 28%; OPL: 16%).
- *Other data visualization technologies*: Investment professionals mostly used other data visualization tools, such as Tableau and Power BI, for data visualization tasks (47%) as well as for data analysis (27%).

Frequency of Technology Use

Exhibit 8 illustrates the frequency with which participants used GenAI, Python, SQL, other programming languages, and other data visualization technologies in their work-related activities. Predominantly, investment professionals reported using the technologies daily in their workflows. The exception was GenAI: An almost equal proportion of respondents reported using this class of technologies on a daily (49%) or weekly (42%) basis. The lower frequency may be related to the limited adoption of GenAI models in the sector because of several challenges, including the complexity and relative opacity of these models, data privacy and protection concerns, as well as the fact that GenAI use cases are still evolving (OECD 2023).

Exhibit 8. Frequency of Technology Use: Selected Technologies



Overall Technological Intensity

The following summary is based on the main workflow activities for which the five technologies were used, as discussed in the section on "Usage Rate." Overall, the technology usage rate fell mostly within the moderately low quadrant of the matrix (i.e., used by 20%–39% of respondents). The overall frequency of use, however, was high: Respondents reported using these technologies mostly on a daily basis (i.e., in the upper half of the quadrant). As a result, we characterize overall technological intensity as moderate, falling between moderately low and moderately high intensity.

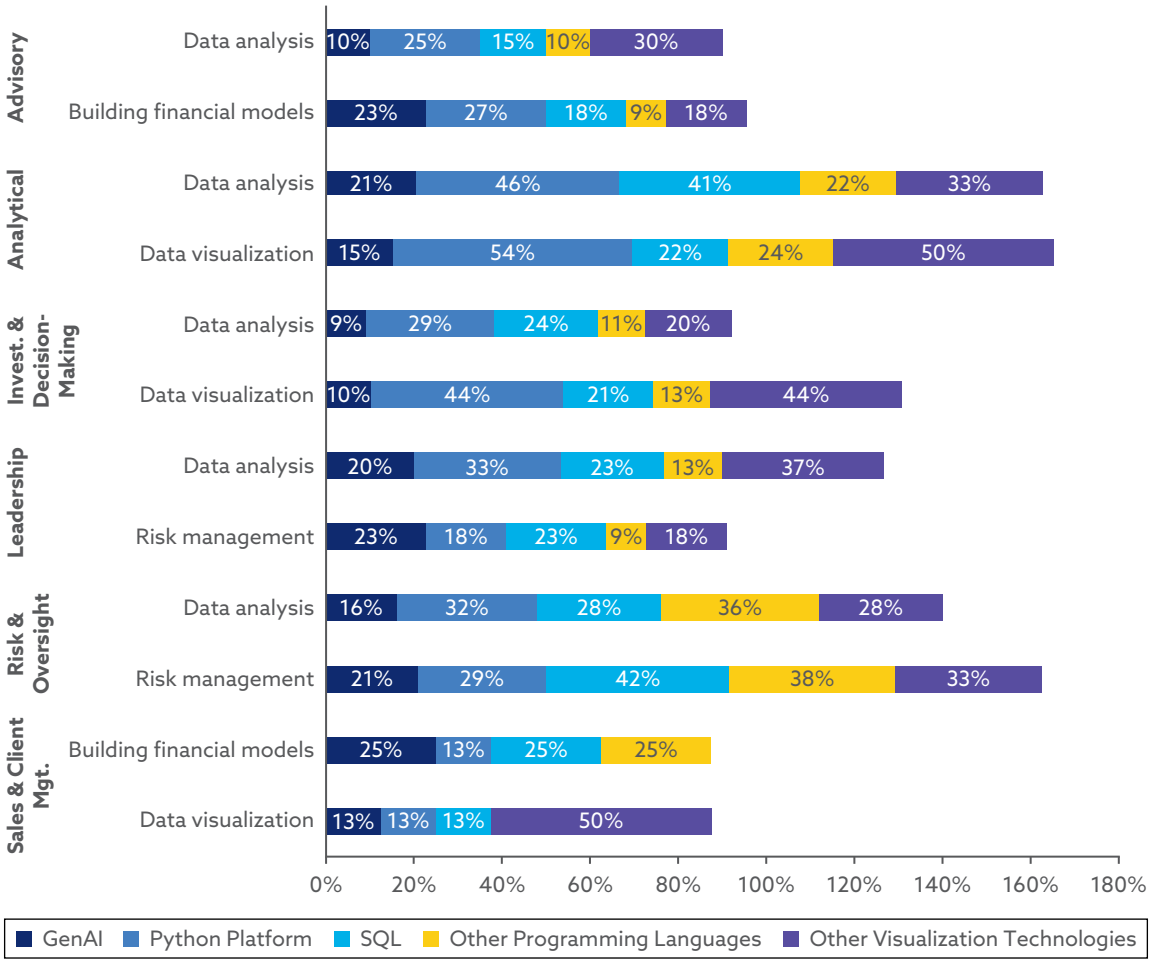
An exception comes from other data visualization technologies. With 47% of respondents using this technology group daily for their data visualization workflows, the technological intensity of other data visualization technologies fell within the moderately high quadrant of the matrix.

Technological Intensity by Job Group

An analysis by job group confirms that investment professionals used AI and big data technologies primarily for data analysis, data visualization, and, to a lesser extent, tasks related to financial modeling and risk management. **Exhibit 9** illustrates these findings. Data analysis was among the top two workflows in five out of the six job groups analyzed, and within data analysis, Python is the most popular platform (consistent with the findings shown in Exhibit 7).

The results also indicate evidence of multihoming by investment professionals. For example, Python and other data visualization technologies were used in almost equal measure for data visualization workflows by professionals in the

Exhibit 9. Rate of Technology Use by Job Group



Note: Each bar shows the proportion of respondents using a given technology in the top two workflows for each of the six job groups (see "Occupational Categories" in the "AI and Big Data Applications in Investment Management" section).

Analytical and Investment & Decision-Making job groups. Specifically, 50% and 54% of professionals in Analytical roles used other data visualization technologies and Python, respectively, in their data visualization workflows. An equal proportion of professionals in Investment & Decision-Making (44%) used other data visualization and Python tools.

Frequency of use was also high across job groups. For example, investment professionals in the two largest job groups (Analytical and Investment & Decision-Making) reported using AI and big data technologies predominantly on a daily or weekly basis. Weekly or daily use for the Analytical group ranged from 74% of respondents using Python to 89% using GenAI technologies. For those in Investment & Decision-Making, daily or weekly use ranged from 65% using other programming languages to 96% using Python.

Use of GenAI Technologies

In this subsection, we specifically examine the prevalence of GenAI use among investment professionals. We asked survey participants, "Which generative AI tool(s) do you most use?" ChatGPT was the most popular, used by 86% of survey respondents who use GenAI tools, followed by 34% of respondents who used Microsoft Copilot. Few participants used either Bloomberg Copilot or GitHub Copilot.

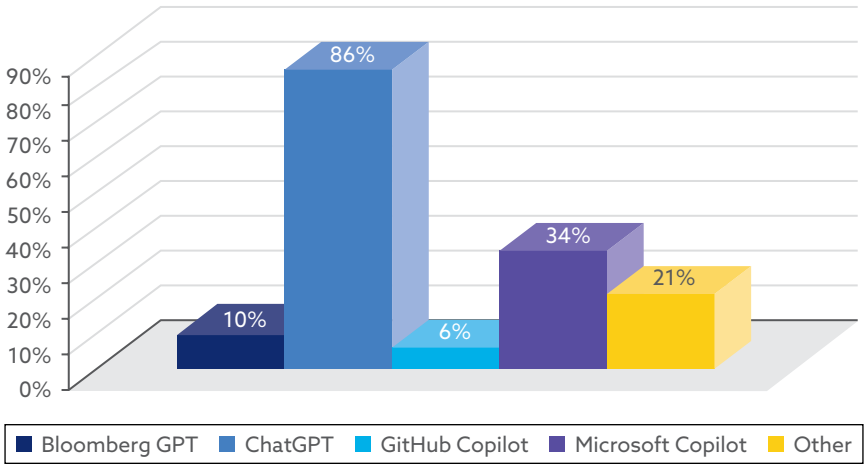
As **Exhibit 10** indicates, ChatGPT was the GenAI technology of choice overall. Subsequent exhibits also detail its dominance across occupational, generational, and regional categories, where ChatGPT was selected by:

- 75% or more of respondents in all job groups,
- 83% or more of respondents in all age groups, and
- 84% or more of respondents in all jurisdictions.

The second top GenAI technology choice varied. Microsoft Copilot was frequently the second most employed GenAI technology. It was used by:

- more than a quarter of professionals in Advisory, Analytical, Investment & Decision-Making, and Risk & Oversight job groups;
- at least one-third of professionals in the Gen X and Millennial generational categories; and
- more than a quarter of professionals in the Americas, Asia-Pacific, and EMEA regions.

Exhibit 10. GenAI Technologies Most Used



Notably, 100% of Gen Z professionals reported using both ChatGPT and BloombergGPT on the job.

Exhibits 11–13 illustrate our findings by job group (Exhibit 11), generation (Exhibit 12), and region (Exhibit 13).

Exhibit 11. GenAI Technologies Most Used, by Job Group

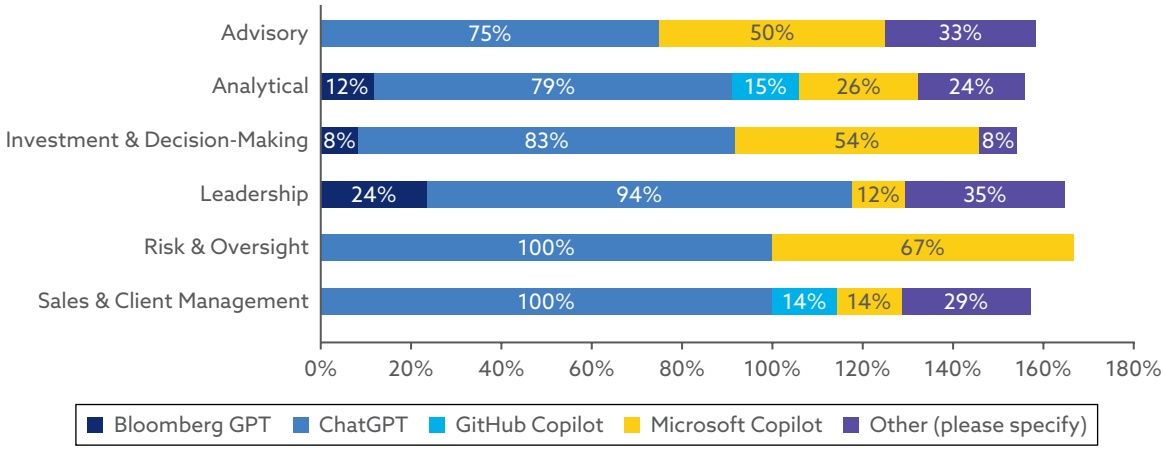
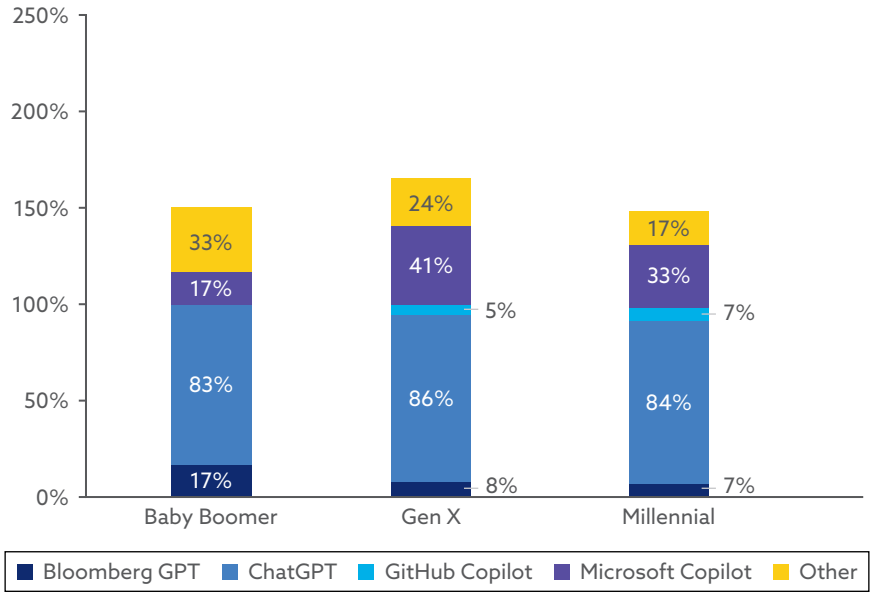
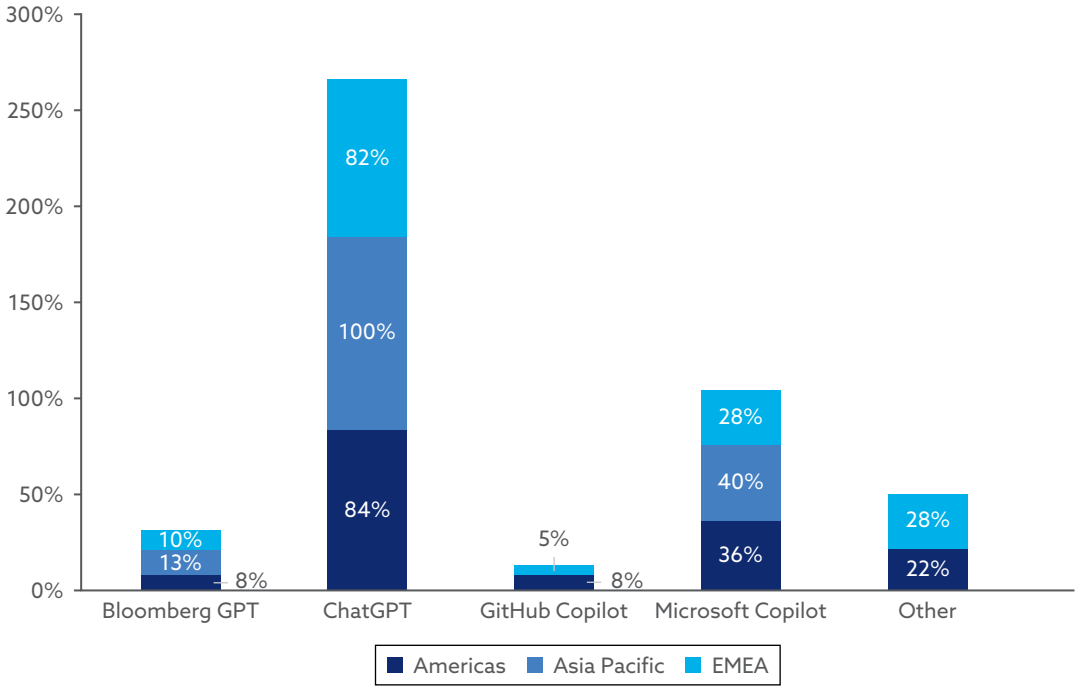


Exhibit 12. GenAI Technologies Most Used, by Generation



Note: The GenZ category is omitted due to the low number of respondents to this question.

Exhibit 13. GenAI Technologies Most Used, by Region



AI Technologies in Investment Management: Organizational Issues

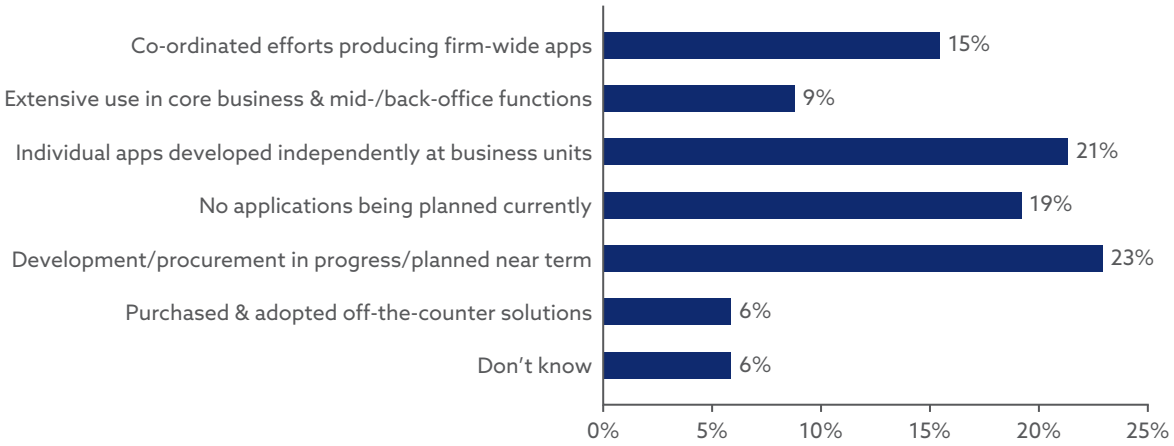
We now examine the impediments to the greater penetration of these technologies in the investment industry. We begin with investment professionals' perspectives on their organization's AI readiness, followed by some of the key obstacles that many organizations face in fully harnessing the power of AI and big data technologies.

The Organization's Experience with AI

We asked investment professionals what best described their organization's experience with implementing AI/GenAI and big data technologies. **Exhibit 14** summarizes the results. For slightly more than one-fifth of firms,[6] implementation was either underway or planned for the near future, whereas just under one-fifth had no current plans to use AI/big data applications. Many firms appeared to opt for a decentralized AI structure—21% of respondents indicated that individual AI/big data applications had been developed independently at various business units, compared with approximately 15%

[6]Although not directly comparable, a study published by HKIMR (2021), supported by CFA Institute, found a qualitatively lower level of firms planning to implement AI/big data applications. This finding suggests some organizational progress in further advancing the use of AI and big data technologies across different business functions.

Exhibit 14. Organization's Experience with AI/Big Data Technologies



who noted the opposite (namely, coordinated efforts producing firm-wide applications). Only 9% of respondents noted that their organizations used an extensive *and* integrated approach to AI/big data implementation—that is, across core business, mid-, and back-office functions.

Organizational Risks and Governance Issues

The following sections incorporate the insights from roundtable sessions convened with separate groups of (i) C-suite executives, (ii) learning and development specialists, (iii) industry practitioners, and (iv) regulators from around the world. We compare this feedback with the results of the survey to add depth and breadth to our analysis of some key organizational issues. **Exhibit 15** illustrates the survey results.

The top three organizational risks and governance issues from our survey were as follows:

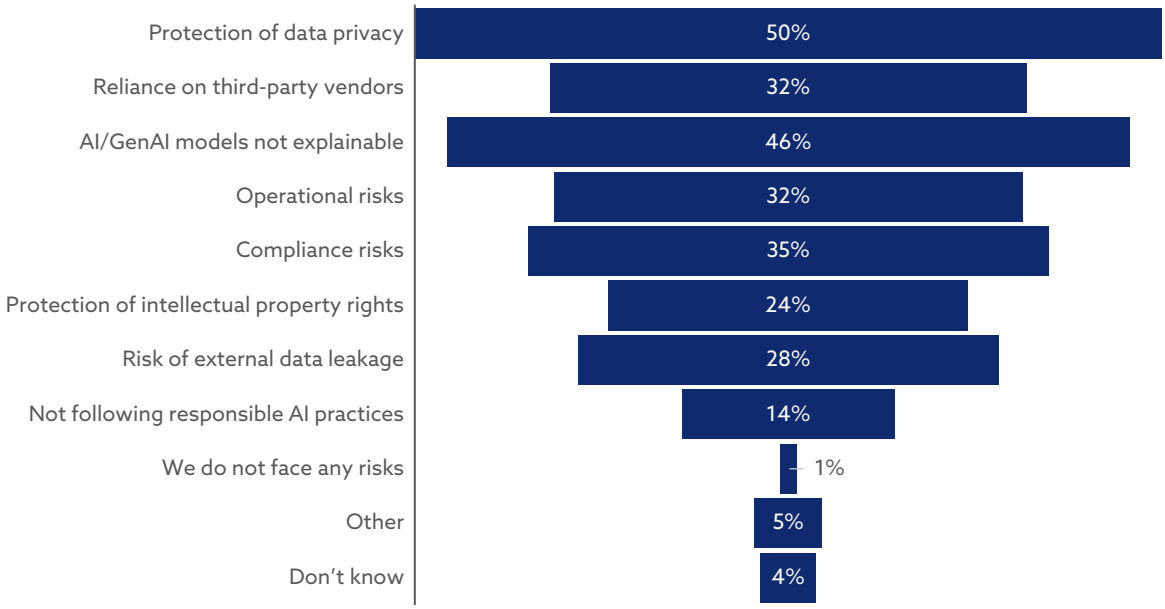
(1) Protection of data privacy (cited by 50% of survey respondents)

(2) AI/GenAI models that are not explainable, known as the "black box issue" (cited by 46% of survey respondents)

(3) Compliance risks (cited by 35% of survey respondents)

We note some variation from a regional perspective. Respondents in the Americas and Asia-Pacific regions cited the same top three issues and in similar proportions to the overall findings. Respondents in the EMEA region also considered AI explainability and data privacy protection to be two of their top three risks/governance issues but found reliance on third-party vendors and operational risks to be more of a concern than compliance risks.

Exhibit 15. Organizational Risks/Governance Issues



Data privacy protection was a key governance issue for all occupational groups (see **Exhibit 16**), as well as for members of the executive, practitioner, and regulatory roundtables. Roundtable participants believed the investment industry's use of vast amounts of big data raised data privacy concerns, such as using proprietary information to train large language models (LLMs). For instance, generative AI models—especially those based on LLMs—sometimes produced "hallucinations" (incorrect or misleading information). If the content used to train the model was not curated carefully or technical specifications such as degrees of randomness were not properly set, errors could propagate in model outputs. In the view of one practitioner, the result "will be garbage in, garbage out."

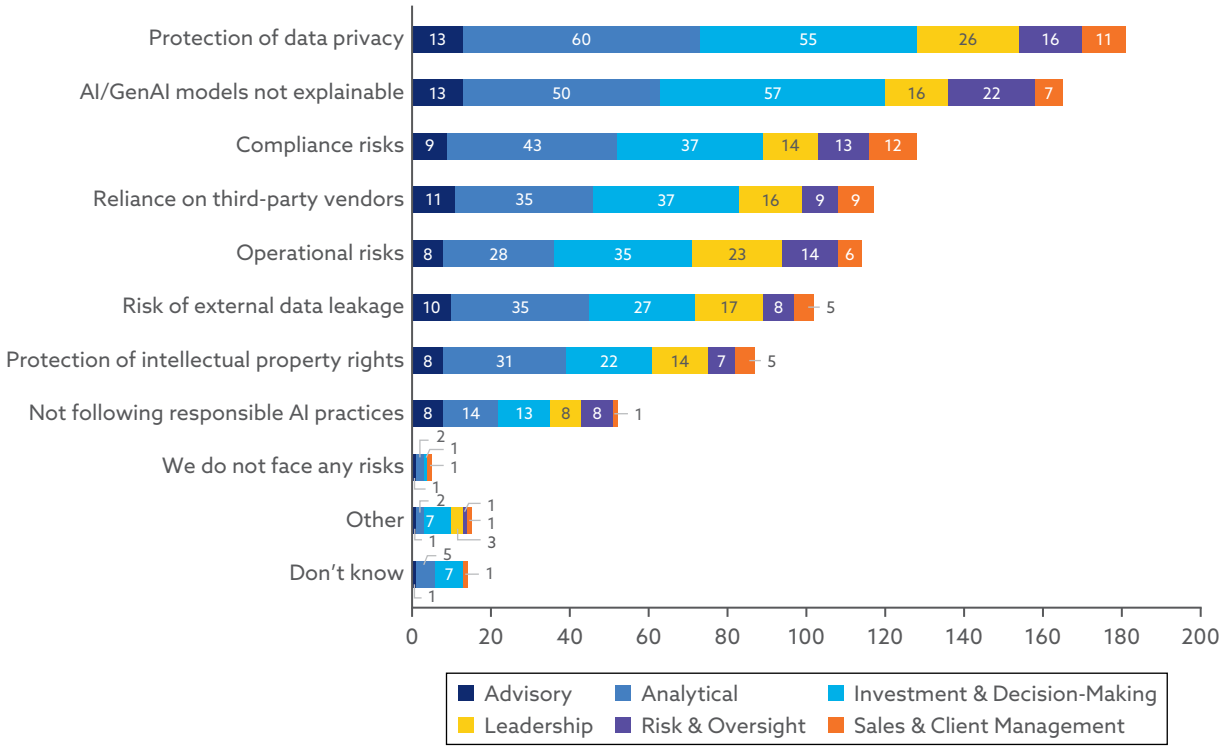
Another organizational risk was the inadvertent violation of customers' privacy through employees' indiscriminate use of AI. The foregoing issues made it more difficult to comply with data protection laws, such as the European Union's General Data Protection Regulation (GDPR).[7]

The black box issue was a significant concern for both survey and roundtable participants. As outlined in the Introduction, the issue is closely linked to the structure of AI systems: The more complex the system, the more difficult it is to understand the underlying rationale behind the AI-generated output.

The survey found that for most investment professionals (i.e., largely in roles related to Advisory, Analytical, Investment & Decision-Making, and

[7]See OECD, "Artificial Intelligence, Machine Learning and Big Data in Finance: Opportunities, Challenges and Implications for Policy Makers," OECD Publishing (11 August 2021). https://doi.org/10.1787/98e761e7-en.

Exhibit 16. Organizational Risks/Governance Issues, by Job Group (number of responses)



Note: The distribution of responses (by count) reflects the respondent demographic, with most respondents belonging to the Analytical or Investment & Decision-Making job groups (see also Exhibit 5).

Risk & Oversight), AI/GenAI models not being explainable posed a significant risk to organizations. Model explainability was essential to ensuring accurate and reliable AI models given their importance to a wide range of functionalities, including business development, portfolio construction, financial modeling, and risk management. It is understandable, therefore, that this concern resonated across the spectrum of occupational groups.

There was general consensus among participants in the executive, practitioner, and regulatory roundtables that complex deep-learning AI models (e.g., unsupervised machine learning models, such as LLMs) could lead to AI-generated outputs that are not explainable. In addition, the black box issue made it more difficult for regulators to assess a model's compliance with existing laws and regulations.

Although the risks related to algorithmic appreciation were outside the scope of the survey, the issue was raised at roundtable sessions. Algorithmic appreciation is a phenomenon that exists whereby individuals are more likely to follow recommendations they perceive to be generated by an algorithm over the recommendations of another individual. Algorithmic appreciation occurs

under many decision-making conditions and across a variety of estimation and forecasting tasks (Logg, Minson, and Moore 2019), and it may lead to user overconfidence in the AI-generated output. Participants in the executive and regulatory roundtables expressed that too many users were overconfident about the capabilities of generative AI technologies; by failing to recognize that GenAI was "simply a tool," users overlooked its limitations. From a regulatory standpoint, the presence of algorithmic appreciation increased the complexity of regulatory compliance, because regulatory supervision may have to extend beyond the individual to the technology itself.

Organizational Challenges

We asked investment professionals what, in their opinion, were the top three organizational challenges to adopting AI and big data technologies. Based on the survey results, the top three organizational challenges are as follows:

(1) A shortage of AI/GenAI and big data talent with proper training and experience (41% of respondents)

(2) Data quality and governance issues (41% of respondents)

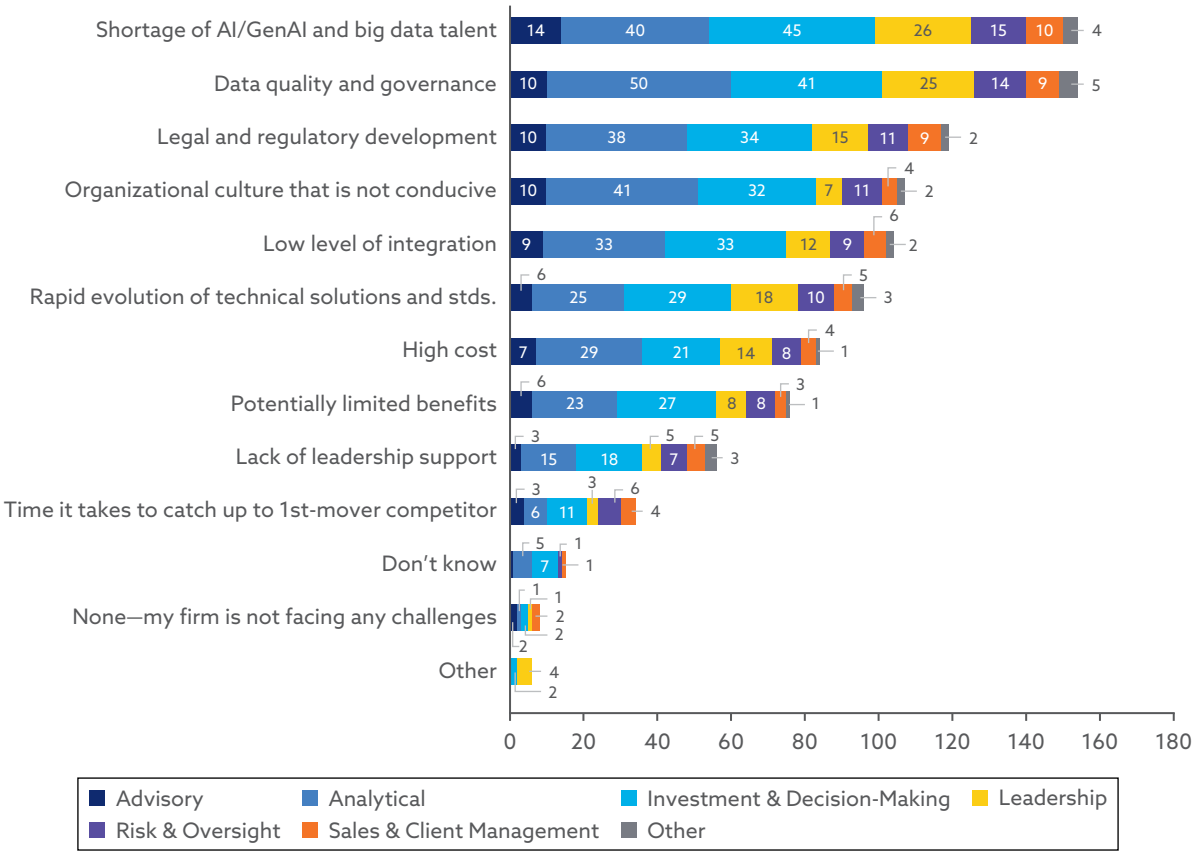
(3) The legal and regulatory environment (32% of respondents)

Respondents in all three regions also cited the first two challenges (shortage of relevant skills and data quality). In the Americas region, the third major organizational challenge was the legal and regulatory environment; in the Asia-Pacific and EMEA regions, it was the low level of integration between business and technology functions.

As **Exhibit 17** illustrates, the results by job group were consistent with the overall findings, with the skills gap and data quality issues also being the top two concerns. The results were mixed, however, regarding the third major organizational challenge. About one-third of investment professionals in the Analytical and Advisory groups cited an organizational culture not conducive to AI/GenAI and big data adoption, while a similar proportion in Leadership roles considered rapidly evolving technical solutions and standards to be a key organizational challenge. What at first appears to be a dichotomy, however, may instead reflect an interpretation of the same concern from two lived experiences—that of the practitioner and the executive.

Among roundtable participants, there was consensus that the dearth of "hybrid skills" was a major cause for concern for all industry stakeholders. Participants in the executive, practitioner, and regulatory roundtables all believed that the industry was significantly under-resourced in terms of professionals with enough knowledge of both technical issues and broader, systemic market issues. For instance, a roundtable participant noted that newly graduated job candidates were either more finance oriented or more computer science oriented, with minimal overlap.

Exhibit 17. Top Organizational Challenges, by Job Group (number of responses)



Participants were concerned that this under-resourcing of appropriately skilled human capital inhibited investment firms from fully and safely adopting AI. One roundtable participant espoused the need for a hybrid skill set to manage the workflows of an AI/ML tech-driven investment group—specifically, technologists who are experts in investments. The discourse evokes the recent CFA Institute publication *The Future of Work in Investment Management* (CFA Institute 2022), which envisioned future investment teams as T-shaped teams and discussed implications for talent development. T-shaped teams combine investment expertise, innovation, and technology application across investment strategies or processes.[8] Although the structure of the future investment team is still evolving, there is movement toward enhanced collaboration, as outlined in earlier CFA Institute works.

Legacy skill sets combined with legacy thinking added another layer of complexity—for example, in cases where traditional investment managers

[8]For more detail, see CFA Institute, "T-Shaped Teams: Organizing to Adopt AI and Big Data at Investment Firms" (Charlottesville, VA: CFA Institute, 2021). https://rpc.cfainstitute.org/-/media/documents/article/industry-research/t-shaped-teams.pdf.

continued to rely on factor-based investing using econometric models. These investment managers possessed pure quantitative skills that were insufficient to manage ML operations teams where, according to an executive roundtable participant, "the change control processes, the stability, testing, and monitoring of models in production are completely different and on another level of complexity [than] traditional quantitative investing." Another participant advocated for a balance between investment industry experience (usually found in persons with longer periods of industry experience, who know where to be careful but may be unaware of how to use these newer technologies) and technological capability (generally found in younger persons who may lack the type of real-world experience that is needed).

Regulators considered the skills gap to be the biggest impediment to supervisory technology, also called SupTech. This term refers to the use of innovative technologies by financial supervisory authorities to enhance their regulatory and supervisory functions. SupTech involves digitizing reporting and regulatory processes to achieve a more efficient and proactive monitoring of risk and compliance at financial institutions.[9] A national regulator observed that budgetary constraints in smaller jurisdictions may further impede their efforts to recruit and retain appropriately skilled individuals.

Roundtable participants also cited limitations in the legal and regulatory environment as a key challenge to widespread adoption of AI and big data technologies. A significant impediment was the absence of international coherence or harmonization in the way different regulatory authorities approach AI. For example, many national regulators sought guidance from their umbrella regulatory authorities to establish a framework for the responsible use of AI and big data technologies in their respective jurisdictions. Regulators in some jurisdictions, however, took the view that AI-related policies generated by the umbrella organizations were too ambiguous to provide the necessary guidance. One example is the EU Artificial Intelligence Act, a broad cross-sectoral legislative initiative that does not prescribe specific measures for financial services.

Organizational Actions in the Face of Digital Transformation

We asked investment professionals what actions their organizations were undertaking in light of the rapid (and ongoing) digital transformation of the financial services industry. As **Exhibit 18** shows, the top four organizational actions cited by respondents were automating workflows, upskilling current employees, focusing on AI and data analytics, and integrating technology platforms.

Slightly more than one-third of investment professionals found that their organizations were making AI technologies and data analytics a strategic focus

[9]See Dirk Broeders and Jermy Prenio, "Innovative technology in financial supervision (suptech) – the experience of early users," Bank for International Settlements (2018). https://www.bis.org/fsi/publ/insights9.pdf.

Exhibit 18. Organizational Actions in the Face of Digital Transformation

for their firms, with 11% citing a specific focus on the Python digital platform. This sentiment aligned with other responses:

- 40% indicated that their organizations were automating existing work processes (e.g., by using chatbots or by programming the system to complete repetitive activities);
- 32% noted that firms were increasing their investment in integrating core technology platforms; and
- slightly more than one-third of investment professionals indicated that their organizations were upskilling existing employees. In this regard, 23% of respondents found that their firms were increasingly focused on recruiting new employees with technical skills, of which 12% specifically required new employees to have coding/programming skills.

Digital transformation activities did not appear to fuel any substantive replacement of human expertise with technology: Only 6% and 11% of respondents expected reductions in front- and back-office staff, respectively, in response to increasing automation. Just under one-fifth of respondents indicated that digital transformation was not yet a priority for their organizations.

As discussed in the "Organizational Challenges" subsection, the shortage of investment professionals with technological expertise is an issue of great concern to industry stakeholders. In the following section, we explore in greater detail (and from the perspective of the survey respondents) organizational actions pertaining to talent development.

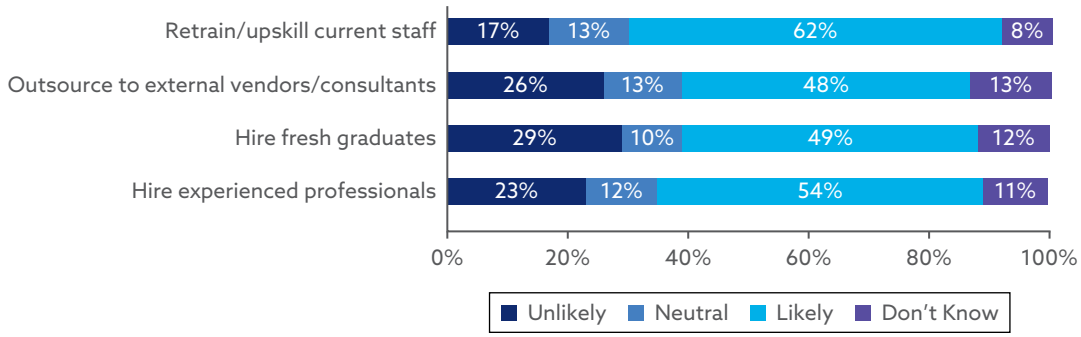
Organizational Actions in the Face of Digital Transformation: Talent Development

We asked investment professionals how likely their organizations were to use one of the four specified talent development pathways shown in **Exhibit 19** to support their firms' AI and big data initiatives. In Exhibit 19, the "likely" category incorporates "somewhat likely," "likely," or "very likely" responses. Conversely, the "unlikely" category incorporates "somewhat unlikely," "unlikely," or "very unlikely" responses. The consensus among survey respondents was that firms were more inclined to retrain their existing employees compared with other options (identified by 62% of survey respondents). By comparison, 54% thought their firms would likely hire experienced professionals, 49% felt that their firms would hire newly minted graduates, and 48% believed that their firms would probably outsource the staffing of AI/big data efforts. Overall, the results suggest that firms are likely to use a combination of the different approaches, with relative emphasis placed on upskilling current staff.

Talent Development Pathways by Region

Upskilling current staff was the focus of talent development in all three regions, cited by 68% of respondents in the Americas, 59% in Asia Pacific, and 61% in EMEA. Outsourcing was the least likely option for firms in the Americas and EMEA regions, whereas hiring recent graduates was the least likely route for firms in the Asia-Pacific region.

Exhibit 19. Likelihood of a Firm Following Specified Talent Development Pathways



Talent Development Pathways by Firm Type

Survey respondents identified the talent development pathways that they believed their firms were most likely to select to support organizational AI and big data initiatives. Following is a summary of the results.

- *Upskill/retrain current staff*: This talent development pathway was cited as the option most likely to be pursued among firms engaged in consulting, information technology, asset management, and private wealth management. This result probably arises because these firm types require domain expertise in areas central to their core business, making it more efficient to select this option.
- *Hire new graduates*: This pathway was most likely to be selected by respondents at brokerage firms and investment banks. This result appears consistent with these firms' focus on an annual graduate intake and relatively high staff turnover.
- *Hire experienced professionals*: Regulatory institutions (central banks, government/regulatory) and firms that provide ancillary services to the financial services industry (credit rating agencies, securities exchanges) were equally likely to hire experienced professionals and retrain their current staff to support their AI and big data initiatives.
- *Outsource to external vendors/consultants*: Accounting and insurance firms were the most likely to focus on this talent development pathway.

AI Technologies in Investment Management: Individual Perspectives

We asked investment professionals, "What proportion of your workflow do you believe will be either replaced or enhanced by AI within the next five years?"

Survey respondents believed that AI would enhance 51% and replace 31% of their workflow. This finding likely reflects (a) an expectation of efficiency gains through automating repetitive and time-consuming tasks and (b) the technology's capacity to enable higher-level task fulfillment (such as investment professionals writing programs for sentiment analysis, model building, and other higher value-added tasks).

There were intra-regional variations. Although respondents region-wide believed that AI was more likely to be a boon to their jobs, the gap between the percentage of workflow enhanced versus replaced was narrower for members in Asia Pacific compared with other regions.

Exhibit 20 illustrates these findings.

Three job groups accounting for 73% of all survey respondents—Analytical, Investment & Decision-Making, and Leadership—were closely aligned with the baseline (and likely drive the overall result). **Exhibit 21** illustrates these results.

Exhibit 20. Replacement vs. Enhancement of Workflows within Five Years Because of AI, by Region

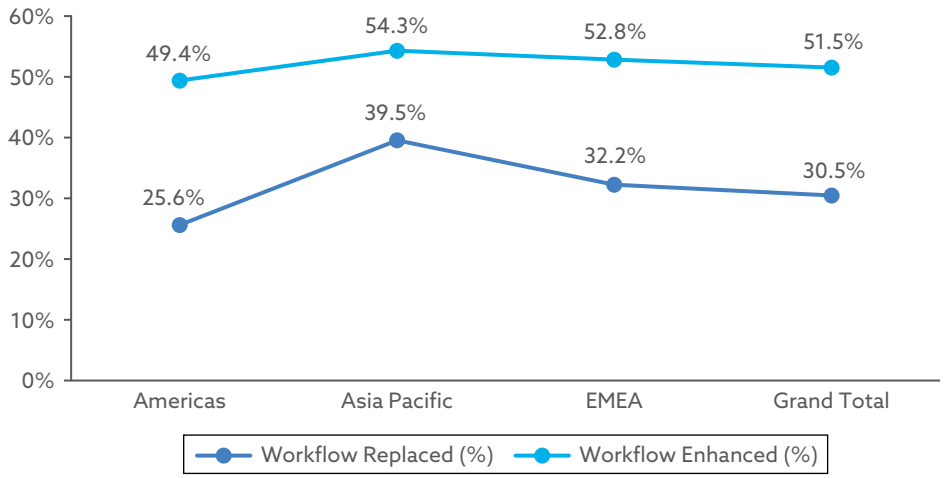
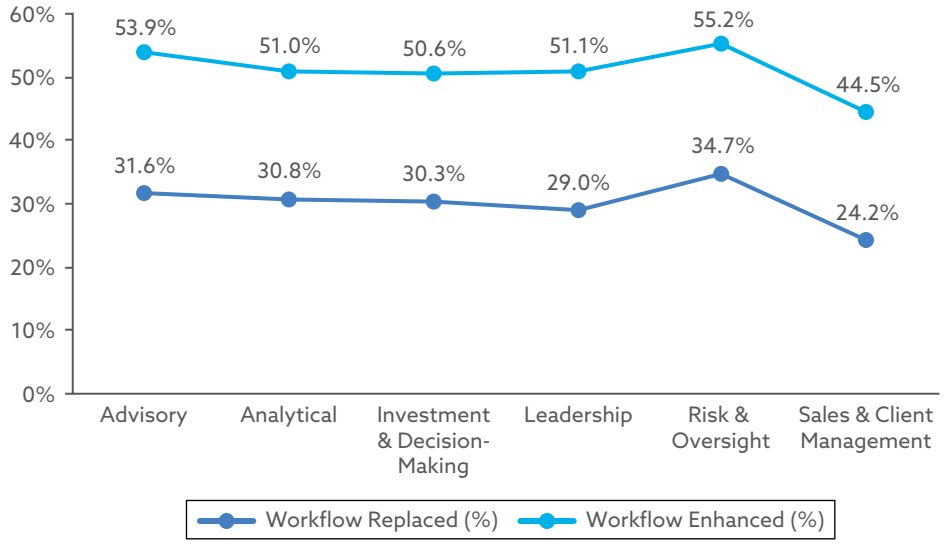


Exhibit 21. Replacement vs. Enhancement of Workflows within Five Years Because of AI, by Job Group



Response of the Investment Professional to Job Role Changes

We asked investment professionals how they would respond to potential changes in their job roles caused by AI. **Exhibit 22** shows that more than 75% of respondents indicated that they would develop AI and other technical skills to remain relevant in the same job. The response levels were similar in the Americas and Asia-Pacific regions, with 72% of respondents indicating a

Exhibit 22. Responses by Investment Professionals to Potential Job Changes Caused by AI

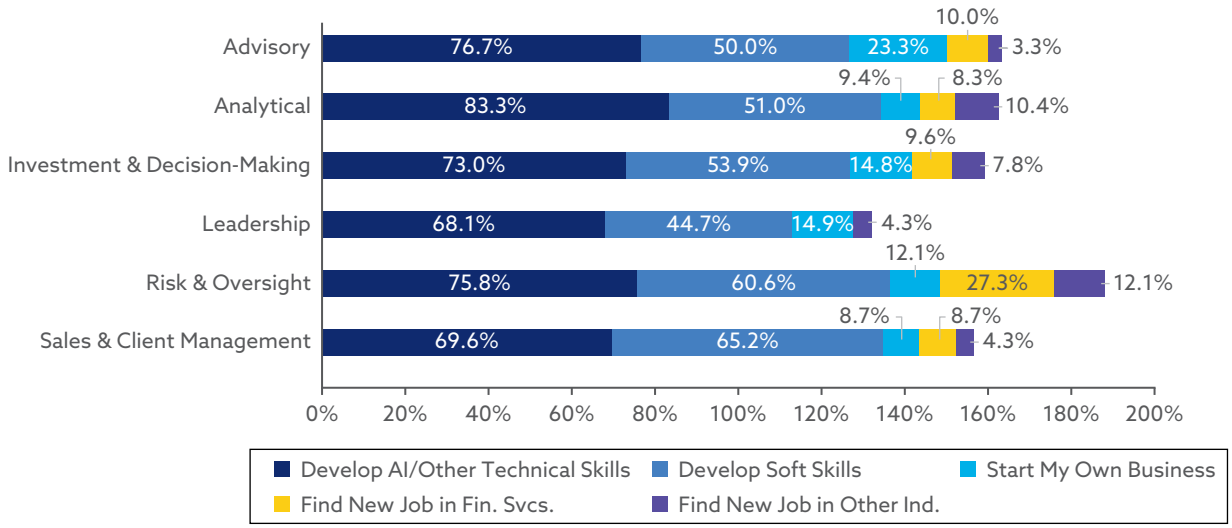
preference to stay relevant by developing their AI and other technical skills. A higher proportion of respondents within the EMEA region (83%) concurred.

A smaller proportion of investment professionals overall (53%) would potentially opt to develop their soft skills to remain relevant in the face of AI-inspired job role changes. The responses from the Asia-Pacific region were in line with the overall findings (also 53%), with a higher proportionate response from the Americas (58%) but lower from EMEA (47%).

More than two-thirds of respondents across all occupational categories indicated that they would develop their AI and other technical skills to remain relevant in the same job (see **Exhibit 23**). Although the option to develop their soft skills to stay relevant in the same job was the second most popular choice among all respondents, the results were somewhat more diverse across job groups. For example, only 45% of respondents in Leadership roles selected this option, compared with 61% of respondents in Risk & Oversight roles. This disparity probably reflects a higher proportion of individuals in Leadership roles who are already proficient in soft skills, compared with those in other roles.

With respect to investment professionals in Analytical roles, 51% would opt to develop their soft skills, compared with 65% of those in Sales & Client Management roles. Sales & Client Management roles may be less affected by AI-related job changes because machines are not proficient at those tasks (e.g., speaking with clients, building relationships)—at least for now. Thus, soft skills are where humans have a natural advantage. The desire to focus even more on these skills may be a way for Sales & Client Management professionals to capitalize on their strengths and further differentiate, or even insulate, themselves from potential future digital disruption. For analytical roles, the underlying rationale may be somewhat nuanced. As more repetitive or manual tasks become automated, some analysts may opt to develop their soft skills to differentiate themselves from other analysts who lack adequate soft skills.

Exhibit 23. Responses by Investment Professionals to Potential Job Changes Caused by AI, by Job Role



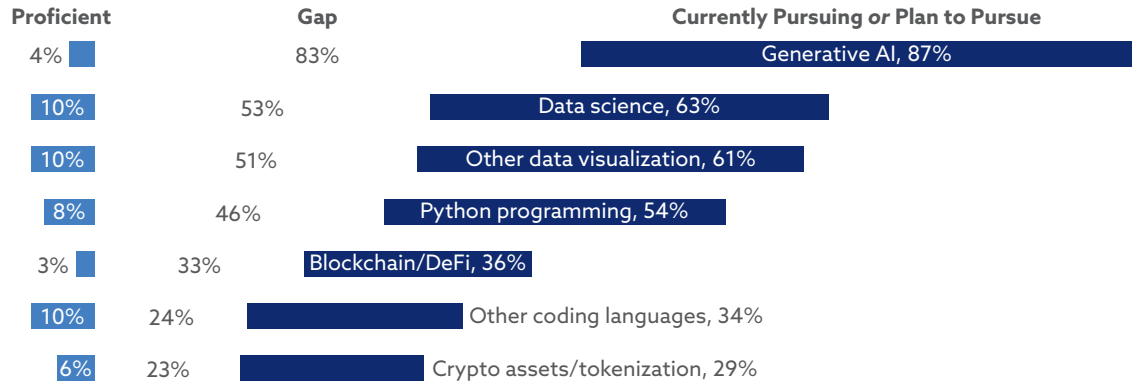
Skill Development Plans

Given that an overwhelming majority of investment professionals would choose to develop their AI and other technical skills to remain relevant in their jobs, it is important to ascertain the technologies and/or skills in which they are most interested. Thus, we asked survey participants to describe their plans to pursue training in the following areas:

- Generative AI technologies
- Python programming
- Blockchain/decentralized finance
- Crypto assets/tokenization
- Data science
- Other data visualization technologies
- Other coding languages

Respondents selected from a menu of mutually exclusive options: (a) currently pursuing training, (b) planning to pursue training, (c) already proficient, or (d) no plans to develop skills in the specific technology. In general, baseline proficiency levels (a proxy for the supply of talent in a given skill) were low among respondents, with no more than 10% of respondents citing proficiency in AI and big data technologies or skills. **Exhibit 24** illustrates our findings.

Exhibit 24. Supply and Demand Skills Gap

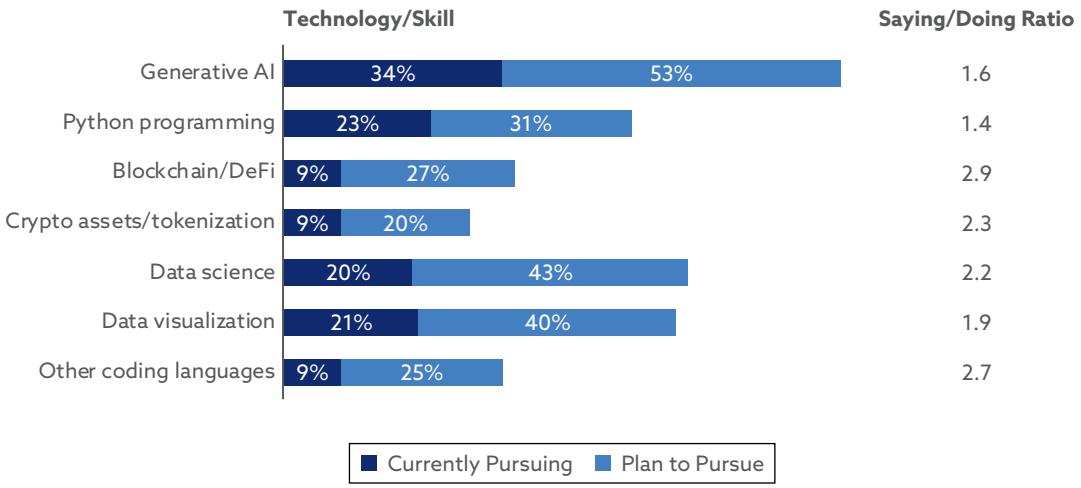


Most investment professionals are interested in upskilling in GenAI technologies (87%), data science (63%), and other data visualization technologies (61%). The largest gaps between the demand for learning and supply of talent are also in these areas. The results are not surprising; in a 2021 CFA Institute survey, artificial intelligence and machine learning was second only to sustainability as the most popular skill development area among investment professionals (CFA Institute 2022).

Specific comparisons between the 2021 and 2024 findings are available for the following technologies: blockchain/decentralized finance, crypto assets, and data visualization. Although proficiency levels in blockchain/decentralized finance remained low (2021: 2%), in 2024 the supply and demand skills gap (33%) declined substantially relative to the prior period (2021: 56%). Similar results were reported for crypto assets: a small increase in proficiency levels (to 6%) compared with the 2021 level of 2%, accompanied by a significant decline in the skills gap (to 23%, down from 51% in 2021). Conversely, the proficiency level in other data visualization technologies declined by 1% between 2021 (11%) and 2024 (10%), accompanied by a 9% *increase* in the skills gap from the 2021 level (42%), possibly resulting from a greater focus by professionals on learning to use Tableau for data visualization.

These results align with our earlier findings in the "Technological Intensity" subsection, which indicate that most professionals use data visualization technologies such as Tableau and Power BI in their workflow activities. The comparison between the 2021 and 2024 findings may also reflect a change in focus away from blockchain and crypto assets (at least at the time this survey was conducted), the demand for which may be dampened by continued regulatory uncertainty across jurisdictions and a lack of widespread institutional adoption.

Exhibit 25. Saying/Doing Ratio: Comparison of Those Who Plan to Pursue a Skill vs. Those Currently Pursuing It



The "saying/doing ratio" detailed in **Exhibit 25** indicates what proportion of individuals who expressed interest in acquiring a skill have already begun to pursue it (CFA Institute 2022). Generally speaking, a larger ratio signifies a higher potential to increase industry knowledge and the future talent pool in the respective skill, provided those "planning to pursue" convert to pursuing that skill. The examples of blockchain and crypto assets show that the relative change in proportions is integral to the analysis. The saying/doing ratios remained high (and in the case of crypto assets, increased) between 2021 (blockchain: 3.3; crypto assets: 1.9) and 2024. However, the percentages of investment professionals who indicated an interest in learning crypto assets (in 2021, currently pursuing: 19% vs. plan to pursue: 35%) and blockchain (in 2021, currently pursuing: 14% vs. plan to pursue: 44%) declined markedly in 2024. Conversely, interest in data visualization technologies increased markedly in 2024 vis-à-vis 2021, as noted earlier.

Harnessing the Power of Artificial Intelligence for Enhanced Decision Making and Efficiency

The financial sector is undergoing a profound transformation propelled by the integration of modern technology and AI. This dynamic shift is not merely a trend but a fundamental change in how firms operate, make decisions, and serve their clients. AI offers unprecedented opportunities for firms and investment professionals, enabling them to enhance their decision-making processes, democratize access to financial services, and improve regulatory oversight. In this section, we elaborate on these opportunities based on input from our roundtable discussions.

The Opportunities AI Presents to Firms and Investment Professionals

Among the opportunities AI offers the investment industry are democratization of financial services, collaborative innovation, trading and investment strategy improvements, and enhanced fraud detection and prevention. The potential to transform the industry with human–AI collaboration is only beginning. We explore some of the possibilities in this section.

Democratization of Financial Services

AI holds the promise of democratizing access to financial advice. For instance, robo-advisers, powered by AI, can provide retail investors with professional-level advice and decision-making support. This technology is particularly beneficial for unsophisticated investors, who may lack the resources to hire traditional financial advisers. PwC's 2023 Global Asset and Wealth Management Survey projects that assets managed by robo-advisers could double to US$6 trillion by 2027.[10]

One example is Wealthfront,[11] a pioneer in the robo-advisory industry. It uses AI to create personalized investment strategies for its users. Using algorithms to create and manage diversified portfolios based on user risk tolerance, financial goals, and market conditions, Wealthfront provides a highly personalized service that adapts to the dynamics of the financial landscape. This technology is thus geared to making professional-grade investment advice available to a broader audience, fostering greater participation in the financial markets.

By making professional advice accessible through smartphones, AI can contribute to lower transaction costs, increasing market access and financial inclusion through services that extend beyond robo-advice, such as direct indexing, trading apps, and tools utilizing gamification practices. The democratization of financial advice is not without its challenges, however. As one regulator noted, "Success will require regulatory oversight to ensure that the market works as it is supposed to and protect investors from potential abuses."

Collaborative Innovation through AI

In the past, many financial institutions relied heavily on Excel-based systems. These traditional methods were often siloed, with each team or individual maintaining their own parameters, file locations, and settings. This siloed approach to technology deployment led to confusion and inconsistency across

[10]PwC, "AI Is Transforming Asset and Wealth Management," *The Leadership Agenda* (2023). www.pwc.com/gx/en/issues/c-suite-insights/the-leadership-agenda/ai-and-wealth-management-a-new-era.html.

[11]Thomas H. Davenport and Randy Bean, "The Pursuit of AI-Driven Wealth Management," *MIT Sloan Management Review* (7 July 2021). https://sloanreview.mit.edu/article/the-pursuit-of-ai-driven-wealth-management/.

teams and individuals. As one participant noted, "No one really knows which is the Excel book that the organization should trust. Or where is the House view?"

The introduction of modern cloud-based systems, such as Python, has addressed these issues, offering a more reliable solution. By recording everyone's input and providing continuous feedback, these systems ensure that analysts and portfolio managers can refine their forecasts and decisions iteratively. AI leverages the collective expertise of the organization to track the accuracy of forecasts and the effectiveness of decisions, thereby creating a feedback loop that enhances learning and decision quality.

Transforming Trading and Investment Strategies

AI's ability to process vast amounts of data at unprecedented speeds has revolutionized trading and investment strategies. Several firms have already embraced AI to improve their investment strategies. For instance, Bridgewater Associates uses AI-driven predictive analytics to forecast market trends and economic conditions.[12] By applying machine learning models to large datasets, including macroeconomic indicators and historical market data, a firm can make more informed investment decisions. This approach not only enhances precision but also mitigates risks by identifying patterns that traditional methods might overlook. Similarly, BlackRock, the world's largest asset manager, is using AI copilots to enhance the capabilities of its digital platform Aladdin.[13] The Aladdin platform helps in risk management, portfolio management, and trading by analyzing large datasets to provide actionable insights.

Two CFA Institute publications provide an in-depth treatment on the possibilities of enhancing trading and investment decision-making using AI and ML. First, "AI Pioneers in Investment Management" details a case study highlighting Man AHL's use of machine learning to augment its trading strategy and execution capabilities (CFA Institute 2019a, p. 18). Second, the CFA Institute Research Foundation *Handbook of Artificial Intelligence and Big Data Applications in Investments* (Cao 2023, Section III, "Trading with Machine Learning and Big Data," pp. 92–106) presents five real-life examples of machine learning applications in analytics and trading.

The growth in the industry's use of AI and big data technologies has spawned new investment innovations. Digitization has created the potential to monetize proprietary data. For example, Gulp Data is a company that considers data itself to be an asset class, based on its business model of providing data valuation services, loans backed by data, and other data monetization services.[14]

[12]Sonali Basak, "Bridgewater Launches $2 Billion Fund Run by Machine Learning," *Bloomberg* (1 July 2024). www.bloomberg.com/news/articles/2024-07-01/bridgewater-launches-2-billion-fund-powered-by-machine-learning.

[13]Allison Nachtigal, "Elevating Investment Management Tech: AI-Powered Leadership from BlackRock and Microsoft," *Microsoft Industry Blogs* (30 September 2024). www.microsoft.com/en-us/industry/blog/financial-services/2024/09/30/elevating-investment-management-tech-ai-powered-leadership-from-blackrock-and-microsoft/.

[14]"Gulp Data Offers New Revenue Streams through Proprietary Data," *Business Wire* (22 May 2024).

Enhancing Fraud Detection and Prevention

AI can be an invaluable tool in the realm of fraud detection. For example, Chainalysis, a firm specializing in blockchain analysis, combines AI with advanced algorithms to detect and prevent cryptocurrency fraud.[15] Their platform uses machine learning to analyze blockchain transactions, identify suspicious activities, and assist law enforcement in investigating financial crimes. By automating the detection process, AI reduces the likelihood of human error and increases the speed at which fraudulent activities are identified and addressed.

AI and GenAI: Revolutionizing the Investment Profession

The integration of AI and GenAI presents significant opportunities, such as in the realm of legal documentation for transactions involving real assets. Mastering prompt engineering and the ability to evaluate legal documents efficiently can dramatically enhance the productivity of professionals, such as real estate analysts. For instance, JPMorgan Chase[16] has implemented an AI-powered virtual assistant called COiN (short for Contract Intelligence) to analyze legal documents and extract relevant data. This innovation has significantly reduced the time required for document review from thousands of hours to just a few seconds, thereby reducing costs and enhancing operational efficiency.

In the future, the financial sector is expected to become leaner and more efficient, driven by the adoption of AI tools. This evolution could lead to a workforce made up of fewer but better-trained individuals who are adept at using these technologies. Early training in AI tools is crucial for career development because it allows professionals to shift their focus from mundane tasks to more critical thinking and strategic roles.

The Human–AI Collaboration

AI and GenAI can transform human-intensive processes into more automated and intelligent workflows. For example, using these technologies to streamline client onboarding processes allows professionals to focus on activities that require human interaction, such as problem-solving and relationship development. This move creates a significant opportunity for early-career professionals to enhance their soft skills, as AI takes over the more monotonous aspects of their roles.

[15]"BNY Mellon To Integrate Chainalysis Product Suite for Cryptocurrency Compliance," Chainalysis (2022). Retrieved from https://www.chainalysis.com/blog/chainalysis-bny-mellon-announcement/.

[16]The AI Zone, "How JPMorgan Chase's COIN is Revolutionizing Financial Operations with AI," *Medium* (26 June 2024). https://medium.com/@the_AI_ZONE/how-jpmorgan-chases-coin-is-revolutionizing-financial-operations-with-ai-120a2938dab7.

By the same token, AI has the potential to free analysts from repetitive work, enabling them to engage more critically with their tasks. This shift necessitates the development of soft skills, such as public speaking and relationship building, which cannot be replicated by AI (at least not yet). As one industry participant noted, "AI can't foster trust, so the ability to connect with people and communicate effectively will become increasingly important." As the human–AI collaborative dynamic evolves, it is likely that the tasks that humans perform will change in fundamental ways, with the potential to boost overall productivity.

The Regulatory Opportunities Unlocked by Artificial Intelligence

AI is revolutionizing various sectors, which presents numerous opportunities for regulators to enhance oversight, improve efficiency, and mitigate risks in complex financial systems. As AI becomes more integrated into the financial industry, regulatory bodies can leverage these advancements to ensure a more resilient and transparent financial market.

Enhanced Predictive Capabilities

One of the most promising opportunities AI offers to regulators is the enhancement of predictive capabilities. Advanced AI models can sift through vast amounts of data to identify patterns and predict potential issues before they escalate, providing a proactive approach to risk management and supervision. For instance, AI can detect irregular trading activities, allowing regulators to step in promptly to prevent market manipulation or fraud.

Efficiency in Data Management

The vast amount of data generated by financial institutions can overwhelm regulators. AI-driven data management systems streamline the collection, storage, and analysis of this data, making it easier to monitor and regulate the financial sector. Technologies such as federated learning allow AI models to be trained across multiple decentralized data sources without compromising data privacy (OECD 2023). This approach enhances data security while providing comprehensive insights into market behavior.

Federated learning is a machine learning technique that allows multiple parties to collaboratively train a model without sharing their data. Instead of sending raw data to a central server, each party trains the model locally on its own data and shares only the model updates. These updates are then aggregated to improve the global model. This approach helps address data privacy and security concerns, because the raw data never leaves the local environment.

Other advanced privacy-preserving technologies allow for collaborative data analysis across institutions while maintaining strict confidentiality, thus enhancing the integrity of regulatory processes. These include secure multi-party computation (SMPC), homomorphic encryption, and differential privacy, which enable regulators to analyze sensitive data without compromising individual privacy (OECD 2023).

Enhanced Market Surveillance and Regulatory Efficacy

Because AI enables real-time monitoring of vast amounts of financial data and exchange transactions, it allows regulators to quickly identify suspicious activities. This capability is crucial for maintaining market integrity and protecting investors. According to a report by Deloitte, AI-powered analytics can significantly improve regulatory supervision by detecting market abuses, suspicious price patterns, trends, and anomalies in large datasets more effectively than traditional systems (Gracie, Eggers, Walsh, Streiner, and Kishmani 2023).

One notable example is the use of AI at the US Securities and Exchange Commission (SEC). The SEC uses machine learning algorithms to analyze trading data and detect irregularities that may indicate insider trading or market manipulation.[17] For example, in 2022 the work of the SEC's Enforcement Division's Market Abuse Unit's Analysis and Detection Center, which uses data analysis tools to detect suspicious trading patterns, enabled the SEC to file multiple insider-trading scheme actions in a day.[18]

Conclusion

The integration of AI and big data technologies into the investment management process represents a transformative shift that offers significant opportunities for enhancing decision-making, improving efficiency, revolutionizing the way we work, and creating new investment innovations. Our comprehensive study, conducted from February to April 2024, highlights the gradual yet promising adoption of these technologies across various job functions within the industry. Despite the current predominance of legacy tools such as Excel, a clear trend has emerged toward a multihoming strategy, which uses diverse platforms and technologies to optimize workflow processes.

The key challenges to AI adoption—including the complexity and opacity of AI models, data privacy concerns, and a demand–supply skills gap—must be addressed through targeted organizational actions. These actions include automating workflows, upskilling employees, and integrating technology

[17]Dave Michaels, "SEC Says It's Using AI to Surveil Markets and Assist Investigations," *The Wall Street Journal* (12 September 2023). www.wsj.com/livecoverage/stock-market-today-dow-jones-09-12-2023/card/sec-says-it-s-using-ai-to-surveil-markets-and-assist-investigations-21IlvQMffrjIgkkS4IyY.

[18]US Securities and Exchange Commission, "SEC Files Multiple Insider Trading Actions Originating from the Market Abuse Unit's Analysis and Detection Center," press release (25 July 2022). www.sec.gov/newsroom/press-releases/2022-129.

platforms to adapt to digital transformation. Additionally, the regulatory landscape must evolve to ensure international coherence in AI policy, enhancing risk management, market surveillance, and democratization of capital market activities.

As we move forward, it is crucial for investment professionals to develop their AI and technical skills to remain relevant in an increasingly digital world. More than 75% of professionals plan to do so, with a focus on GenAI, Python programming, data visualization, and data science. Firms are more likely to retrain existing employees than hire new talent, which highlights the importance of continuing professional development.

This report offers a framework for CFA Institute members, industry stakeholders, regulators, and the public at large, providing valuable insights and guidance on using AI and big data to create value in the investment management process. By embracing these technologies and addressing the associated challenges, the investment management industry can unlock new opportunities and drive future growth.

Glossary of Survey Terms

GenAI: GenAI refers to technologies that use advanced algorithms and machine learning techniques to generate new content, ideas, or data-driven insights. These include tools and platforms that can create text, images, audio, and other forms of media or information, often using natural language processing, predictive modeling, and bulk data processing and analysis. Examples include BloombergGPT, ChatGPT, GitHub Copilot, or Microsoft Copilot.

Platform: Software-based platforms (also known as digital platforms) such as Python or Excel on which various applications ("libraries" in Python) operate:

Excel platform: It includes Microsoft Excel spreadsheet software and related Microsoft applications, such as Visual Basic Applications (VBA) and PowerPoint.

Python platform: It includes the Python programming language and various libraries for data manipulation/analysis (e.g., Pandas, NumPy); time series analysis (e.g., SciPy); data visualization (e.g., Matplotlib, Seaborn); machine/deep learning (e.g., Scikit-Learn, PyTorch); and web scraping (e.g., Beautiful Soup).

Programming language: how coders translate their instructions into computer-understandable form.

Other programming languages include C, C#, C++, Java, MATLAB, and R.

Other data visualization technologies include Tableau and Power BI.

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