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Proptech

Changing the Way
Real Estate Is Done

Recommended bibliographic listing:
Kramer, Anita. Proptech: *Changing the Way Real Estate Is Done*. Washington, DC: Urban Land Institute, 2021.

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The Urban Land Institute is a global, member-driven organization comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of shaping the future of the built environment for transformative impact in communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries.

The extraordinary impact that ULI makes on land use decision-making is based on its members sharing expertise on a variety of factors affecting the built environment, including urbanization, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

Peer-to-peer learning is achieved through the knowledge shared by members at thousands of convenings each year that reinforce ULI's position as a global authority on land use and real estate. In 2020 alone, more than 2,600 events were held in cities around the world.

Drawing on the work of its members, the Institute recognizes and shares best practices in urban design and development for the benefit of communities around the globe.

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Project Contributors

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Introduction

As the "internet of things" (IoT), the "cloud," mobile devices, and, more recently, 5G have expanded the potential for innovation, market attention has turned toward new applications for the untapped market of the real estate industry. Because real estate was once an industry known for "back of the envelope" calculations and standard approaches to development and investment processes, the question for both real estate and technology companies is not only which business activities could make use of new generations of technology, but also where industry-specific applications would have the greatest impact.

This report explores the level and profile of real estate companies' most recent activity—within roughly the last three years—in integrating the quickly growing and changing property technology (proptech) industry. It also provides a framework to understand the breadth of current applications and their impacts on business functions, as well as business strategies used for adoption and plans for the next three years (or the foreseeable future).

This report focuses solely on the experience of real estate companies—the end users of proptech. Data were collected via a survey of 200 ULI members who have direct involvement with their companies' recent adoption of proptech. These companies represent a wide range of roles within the real estate industry, with the largest groups of respondents in development, investment, or architecture. Eighteen in-depth interviews were also conducted with real estate executives whose companies have recently adopted new technologies and are planning for more.

Within these companies, 11 business areas are represented. While technology is increasingly interconnected within every organization, the experiences to date—and plans for the future—often differ by business area. The report provides the experiences of the survey respondent companies, as well as the insights and observations from one-on-one interviews, by business area.

In addition to providing a structure for thinking about technologies for real estate companies, a key goal of the research was to answer the question, "What aspects of technology that affect real estate have proved to be the most innovative, impactful, or brought about the most change to date, even as the number and nature of property technologies continue to evolve?"

The survey and interviews spotlight a real estate industry that has more than begun the process of moving far past traditional approaches. Technology is now viewed as the way to remain competitive in every business product, service, and operation—and even more so, as a means to challenge the status quo and lead market change. As one company said, "We are increasing our [adoption] capacity in order to be ahead of the curve and lead the transformation in the real estate sector."

Key Findings

Proptech changes the business of real estate.

- Proptech, which refers to the full range of technologies applicable to the business of real estate, has become essential to companies to maintain a competitive market position.

- Proactive real estate companies are adopting property technologies in all business areas— fundamental management and financial streams, design and construction, leasing/tenant relations, as well as newer areas of data analytics, health/wellness, and climate impact forecasting/mitigation.

- The vast majority of companies are already experiencing the powerful impacts of technologies adopted over the last few years: across 11 business areas, 80 percent of companies noted positive impacts on operations and services, and 70 percent have experienced positive impacts on each of decision-making and finances.[1]

- Beyond the power of individual technologies, companies are also experiencing the "snowball effect" of multiple technologies. For example, customer-facing technologies that enhance the customer experience from first touchpoint to tenant retention altogether lead to greater profitability. This effect is "what we strive for with the technologies we adopt."

- The expanding capabilities of technology platforms to communicate with other platforms are further unlocking the power of technology and supporting companies' own capacity to develop innovative business solutions.

- There is a growing understanding that appropriate asset-level technologies may differ widely throughout a portfolio given the numerous differences in assets themselves and their market, as well as the various stakeholders within a building.

- Interest is shifting dramatically to data analytics and overarching systems that unlock the power of data from all platforms and sources within a company, as well as from external data sources. Whereas data analytics, as a business area, was among the least-common business areas indicated by survey respondents, it is only second to project management as the focus for the next three years (or the foreseeable future). "We say data is the crude oil of our business" succinctly sums up current thinking.

> "
> The most proactive companies are pursuing multiple business strategies to stay ahead of change and innovation made possible by technology, and to identify and access optimal technological solutions as they become available or to encourage new solutions."

- Beyond the enormous capacity to expand a company's efficiency and effectiveness via data analytics technologies that tie all systems together, a hallmark of many companies is the accessibility of the data by everyone across all business units, so that the platform is the system "we push the business through."

- The most proactive companies are pursuing multiple business strategies to stay ahead of change and innovation made possible by technology, and to identify and access optimal technological solutions as they become available or to encourage new solutions. These strategies include direct investment in technology companies,

[1] Finances refer to cost savings, cost-reward analysis, and/or achievement of financial goals.

investment in venture capital firms, and/or venture capital funds, as well as technology development in-house.

- The COVID-19 pandemic accelerated demand for technologies that support tenant engagement, the touchless experience, and health and wellness factors, noted above. Many companies had previously adopted such technologies but have accelerated the exploration of new tools and new partnerships.

- The pace of recent proptech adoption will continue in all business areas in the next several years, with a strong mix of investment in new technology and expansion or improvement of recently adopted technologies.

Proptech addresses environmental and social impacts.

- Pressing environmental and health issues are the focus of relatively new business areas—climate impact risk assessment, climate mitigation, and health/wellness—closely tied to technology as indicated by being among the business areas with the highest recent technology adoption rates. Interest in these issues, as business areas, is growing as more companies are shifting their technology plans for the next few years to these areas.

- The challenges of climate mitigation and resilience also are becoming an integral consideration, to varying degrees, when companies are making technology investments in all other business areas. Investors are increasingly expecting owners to have an understanding of potential exposure to physical climate risks, such as sea-level rise, extreme heat, and wildfires. Technology investments in other business areas may enable progress in addressing this exposure, whether through investment in building-level resilience measures or property management strategies, or other solutions.

- Data analytic technologies combined with communication technologies are making possible daily information about companies' ongoing environmental, social, and governance (ESG) and wellness efforts that directly affect customers. This includes real-time data on a building's environmental and wellness metrics (such as air and water quality) and allows for internal monitoring as well.

- Construction technology (contech), particularly cloud-based technologies that connect key platforms and enable off-site construction, is increasingly viewed as having game-changing potential to deliver deeply affordable units without public subsidies.
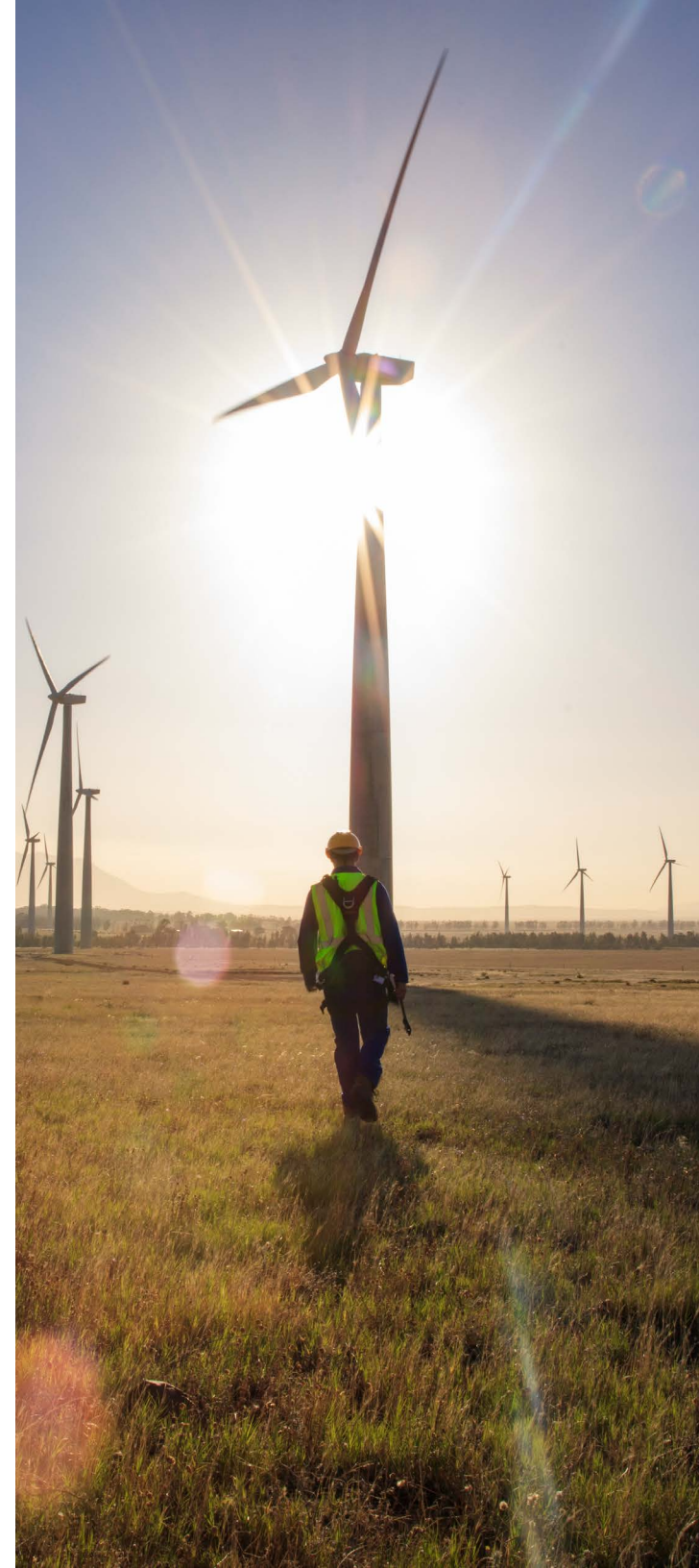
Research Results

Property technology's roots can be traced back to 1980, when the power of personal computers (PCs) made computerized spreadsheets basic tools for the real estate. Technological tools have continued evolving into complex management and transactions environments, as the IoT, cloud computing, advances in information technology, widespread wi-fi, mobile devices, and 5G have expanded capacity, speed, and innovation.

Thoughtful effort has been made to segment the "waves" of proptech with the current wave, much accelerated in the last several years as more startups focused on real estate, identified as the Second Wave.[2] Still, our interviewees, who are involved deeply in expanding their companies' use of technology, view their daily experience through a somewhat different lens. As one interviewee, whose company is proactively and expansively adopting proptech, said: "In terms of technology, we're in the first inning of a nine-inning game. Cars are over 100 years old and still being adapted and adopted. We're convinced that we've got lots of potential opportunities out there to use technology more and more, and we will."

For the purposes of this report, the range of traditional real estate business activities—management streams, design and construction, transactions, leasing/tenant relations, as well as three relatively new business areas—are grouped into 11 business areas, as listed at right.

Business Areas as Grouped in Report

Information collection
Data analytics

Asset level
Property management

Leasing/tenant transactions and relations

Project level
Project management

Construction and use
Construction

Space and use design

Financial
Portfolio management

Transaction management

Raising capital

New efforts
Health and/or wellness

Climate risk and mitigation

[2] *PropTech 3.0: the future of real estate*, Said Business School, University of Oxford, www.sbs.oxford.edu.

Profile of Recent Technology Adoption by Real Estate Companies

The ULI Proptech Survey results show that real estate companies have applied new (to their company) technology in all areas of business in the last three years.

- The vast majority of respondent companies active in each business area have adopted new technology for that business area in the last few years. *(See exhibits I and II.)*

  - A notable exception is in one of the three financial areas: companies for which raising capital is integral to their business efforts report substantially lower technology adoption rates for this purpose.

– The recent adoption rate of technologies for a second financial area—transaction management—is somewhat lower than for most other business areas.

– But companies involved in portfolio management—the third financial business area—report as high recent adoption rates for this purpose as for all other business areas.

- The *level* of recent adoption in the last three years was described as either extensive or moderate. *(See exhibit III.)*

– Adoption has been most extensive in the areas of data analytics, space and use design, health and/or wellness, and property management, with over one-half of companies in each of these four business areas reporting extensive adoption.

– In contrast, over one-half of companies in the seven other business areas describe their level of technology adoption as moderate.

– Notably, 70 percent of companies in two financial areas—portfolio management and raising capital—report a moderate level of adoption.

Exhibit 1: Recent New Technology Adoption, by Business Area

■ Adopted new technology   ■ Have not adopted new technology
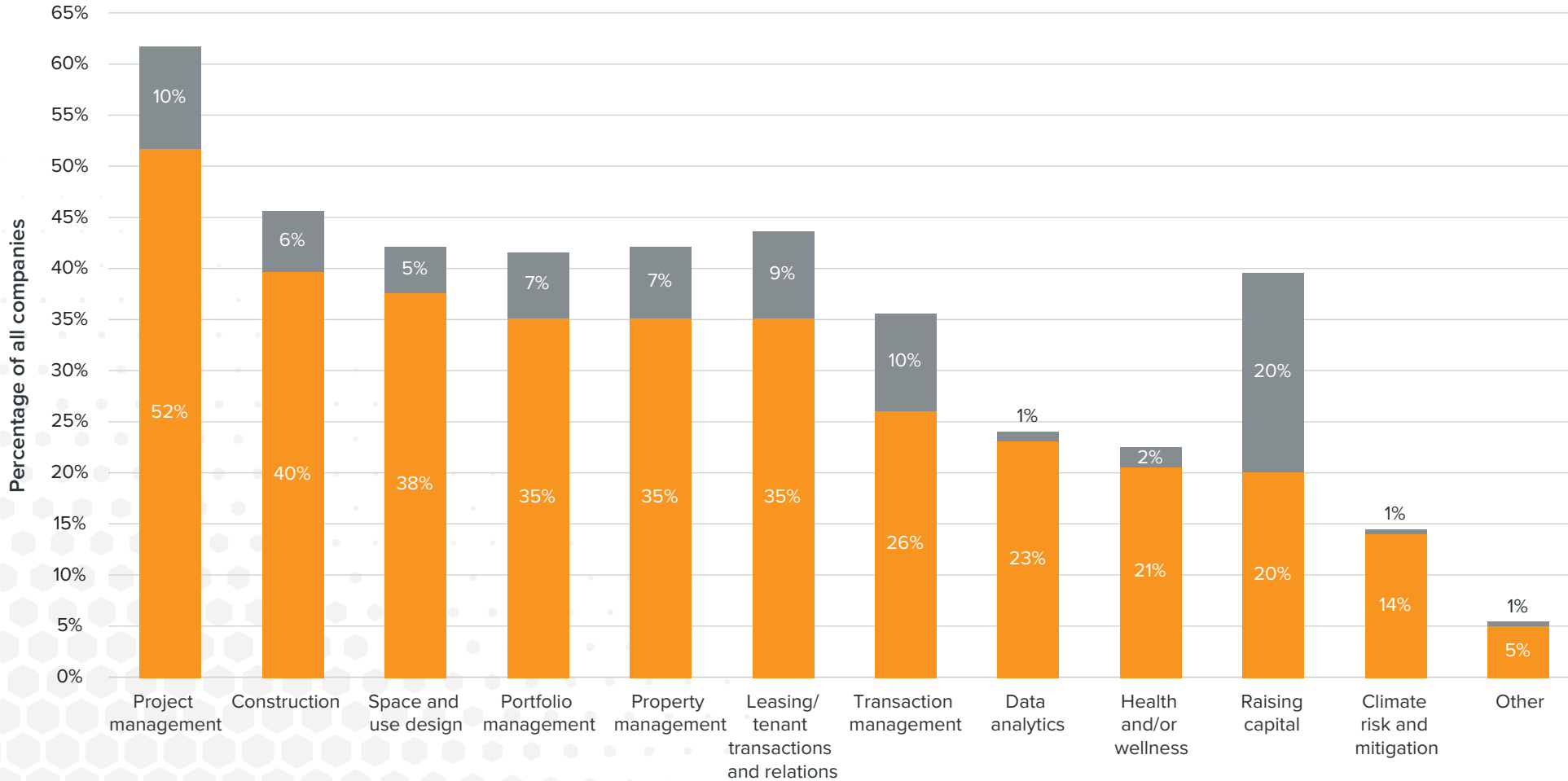
Note: *Recent refers* to about the past three years; *new technology* refers to technology that is new to the respondent company. Respondents provided answers for only their current business areas. Percentages total more than 100 percent because most companies reported involvement in more than one business area.
Source: ULI 2020 Proptech Survey.

Exhibit 2: Recent New Technology Adoption, as Percentage of Business Area

■ Adopted new technology   **■ Have not adopted new technology**

Percentage of all companies

Business Area	Adopted new technology	Have not adopted new technology
Climate risk and mitigation	97%	3%
Data analytics	96%	4%
Health and/or wellness	91%	9%
Space and use design	89%	11%
Construction	87%	13%
Portfolio management	84%	16%
Project management	84%	16%
Property management	83%	17%
Leasing/tenant transactions and relations	80%	20%
Transaction management	73%	27%
Raising capital	51%	49%

Note: *Recent refers* to about the past three years; *new technology* refers to technology that is new to the respondent company. Respondents provided answers for only their current business areas.
Source: ULI 2020 Proptech Survey.

Exhibit 3: Level of Adoption by Companies Recently Adopting New Technology, by Business Area
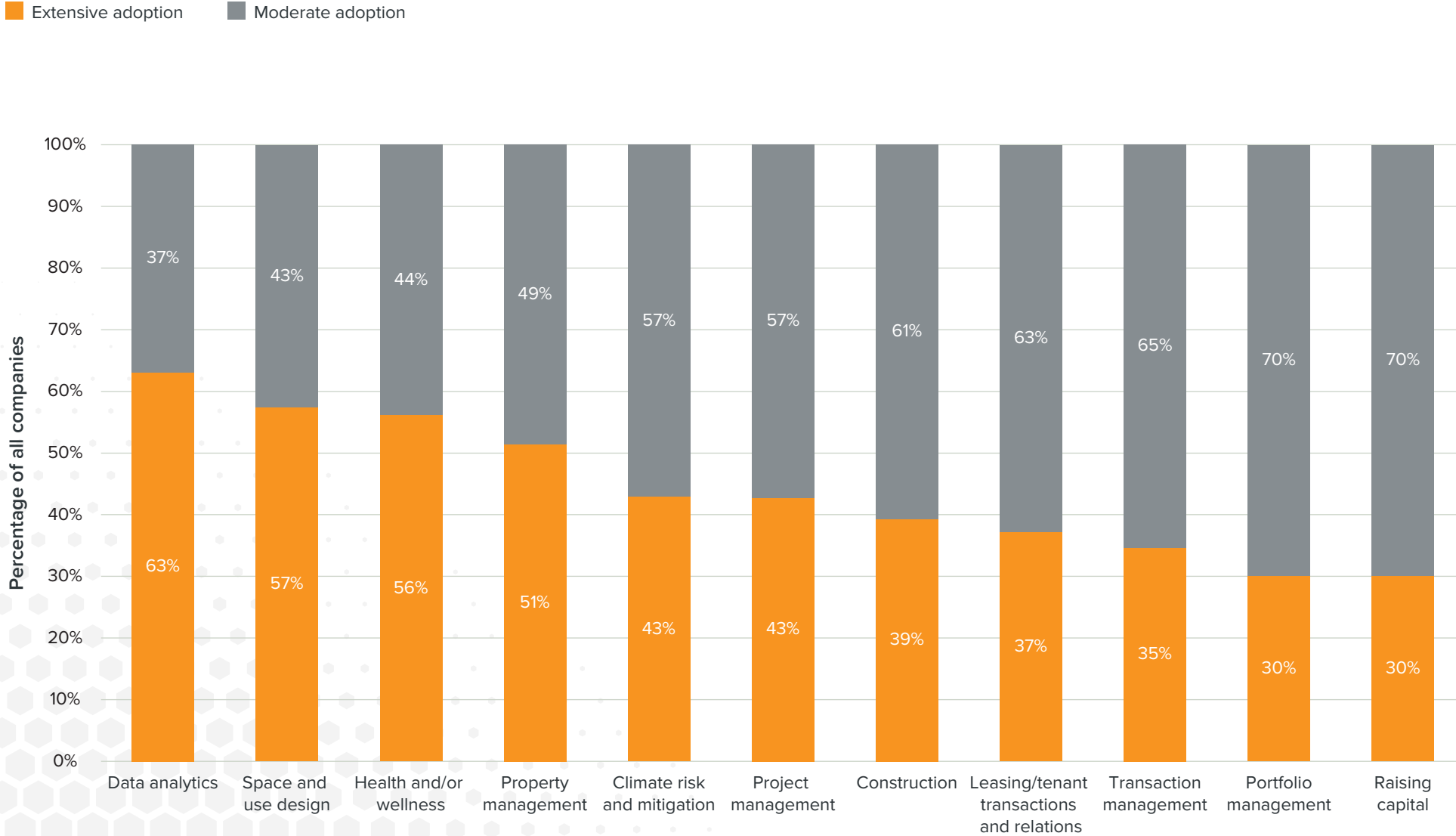
■ Extensive adoption ■ Moderate adoption

Percentage of all companies

Business Area	Extensive adoption	Moderate adoption
Data analytics	63%	37%
Space and use design	57%	43%
Health and/or wellness	56%	44%
Property management	51%	49%
Climate risk and mitigation	43%	57%
Project management	43%	57%
Construction	39%	61%
Leasing/tenant transactions and relations	37%	63%
Transaction management	35%	65%
Portfolio management	30%	70%
Raising capital	30%	70%

Note: *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Extensive adoption includes *to a great/very great extent*; *Moderate adoption* includes *to some/moderate extent*.
Source: ULI 2020 Proptech Survey.

Impact of Recent Technology Adoption on Business Functions

Technologies recently adopted by survey respondents' companies have primarily had overall positive impacts on three business functions—operations and services, finances, and decision-making.

Overall positive impacts, which include ratings of both high and moderate impacts, vary by business area. Noteworthy, though, is the significant segment of companies in each business area that indicate that recently adopted technologies have specifically had a high impact on these business functions: the average relative number of high ratings is 40 percent for the impact on operations and services, 32 percent for the impact on finances, and 30 percent for the impact on decision-making.

As may be expected, as companies investigate new technologies and technologies evolve, a segment of companies in all business areas have experienced little or no impact on business functions or indicated that it is too soon to tell the impact.

Exhibit 4: Impact of Recently Adopted New Technology: Operations and Services

- ■ Positive: High impact
- ■ Positive: Moderate impact
- ■ Little/no impact
- ■ Too soon to tell

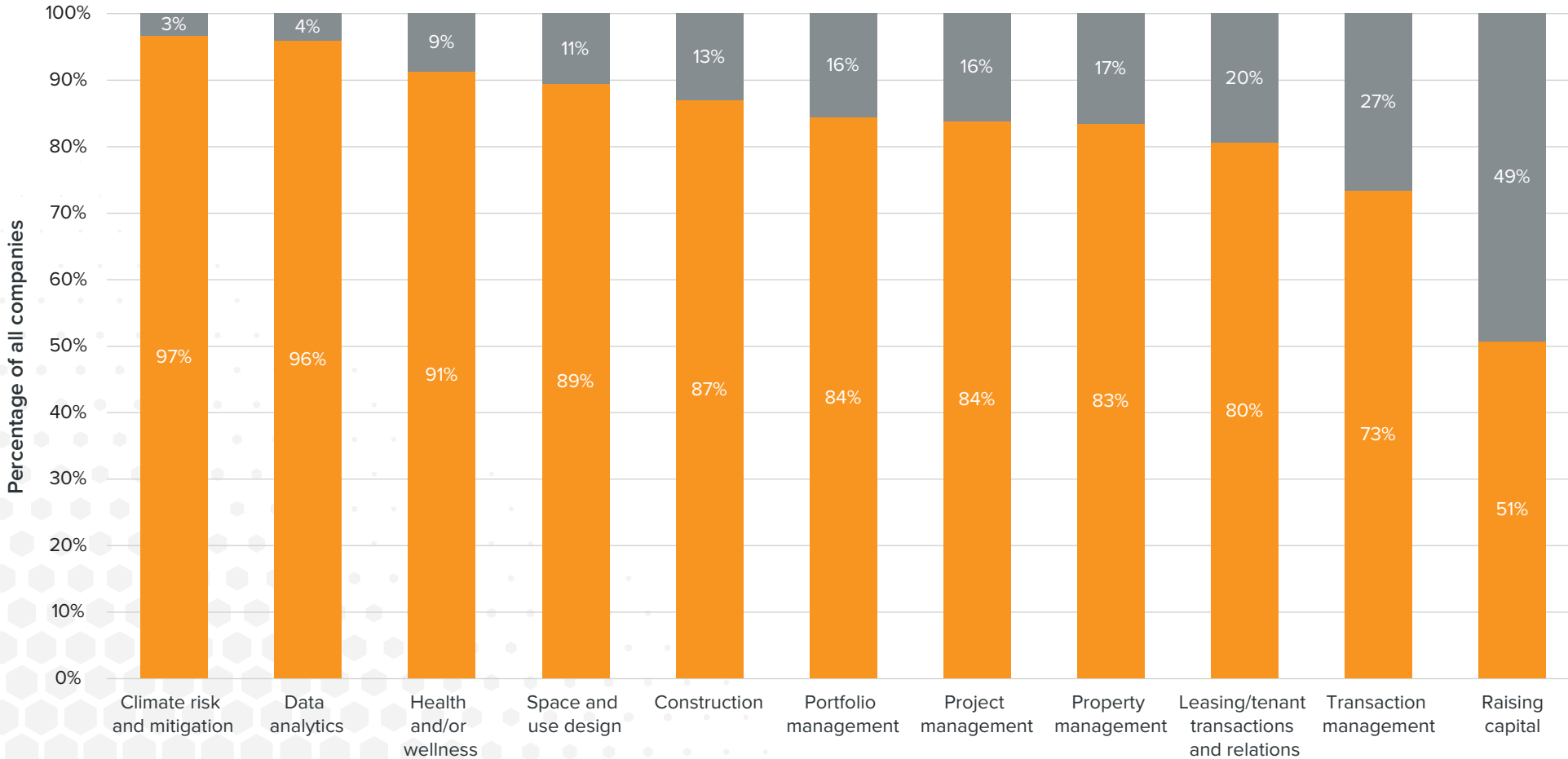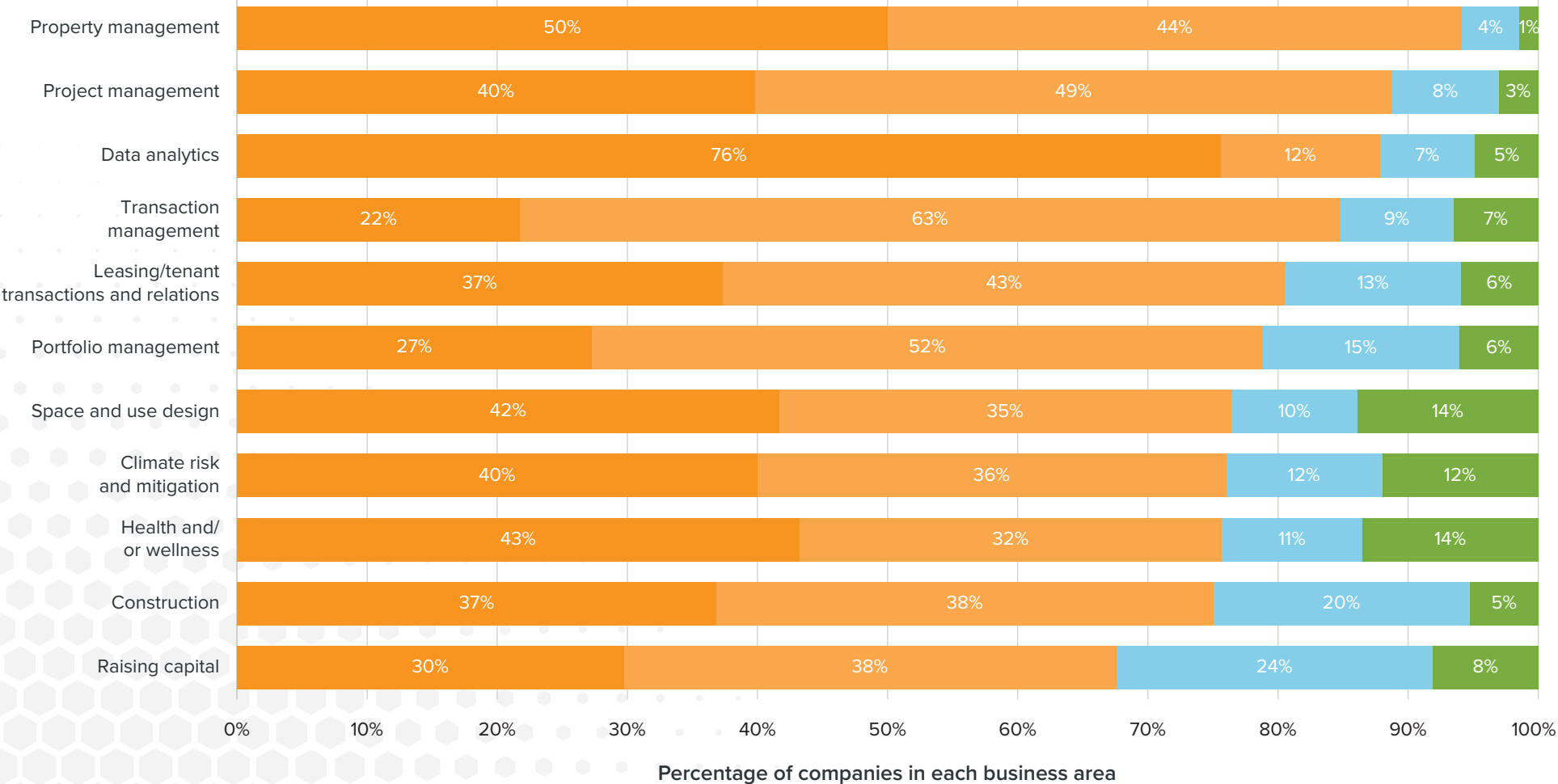| Business area	Positive: High impact	Positive: Moderate impact	Little/no impact	Too soon to tell
Property management	50%	44%	4%	1%
Project management	40%	49%	8%	3%
Data analytics	76%	12%	7%	5%
Transaction management	22%	63%	9%	7%
Leasing/tenant transactions and relations	37%	43%	13%	6%
Portfolio management	27%	52%	15%	6%
Space and use design	42%	35%	10%	14%
Climate risk and mitigation	40%	36%	12%	12%
Health and/or wellness	43%	32%	11%	14%
Construction	37%	38%	20%	5%
Raising capital	30%	38%	24%	8%

Percentage of companies in each business area

Note: *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Source: ULI 2020 Proptech Survey.

Exhibit 5: Impact of Recently Adopted New Technology: Finances

■ Positive: High impact   ■ Positive: Moderate impact   ■ Little/no impact   ■ Too soon to tell

Business area	Positive: High impact	Positive: Moderate impact	Little/no impact	Too soon to tell
Property management	33%	49%	12%	6%
Project management	31%	49%	13%	6%
Construction	30%	49%	12%	9%
Data analytics	57%	21%	12%	10%
Climate risk and mitigation	38%	35%	15%	12%
Space and use design	36%	36%	10%	18%
Leasing/tenant transactions and relations	31%	41%	16%	12%
Transaction management	18%	53%	12%	16%
Portfolio management	25%	41%	21%	13%
Raising capital	21%	45%	21%	13%
Health and/or wellness	37%	24%	13%	26%

Percentage of companies in each business area

Note: *Finances* includes impact on cost savings, cost/reward analysis, and/or achievement of financial goals. *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Source: ULI 2020 Proptech Survey.

Exhibit 6: Impact of Recently Adopted New Technology: Decision-Making

Legend:
- ■ Positive: High impact
- ■ Positive: Moderate impact
- ■ Little/no impact
- ■ Too soon to tell

Business area	Positive: High impact	Positive: Moderate impact	Little/no impact	Too soon to tell
Data analytics	62%	24%	5%	10%
Property management	29%	51%	18%	1%
Portfolio management	25%	54%	16%	4%
Project management	25%	48%	22%	5%
Leasing/tenant transactions and relations	25%	48%	22%	4%
Transaction management	29%	44%	19%	8%
Construction	28%	38%	26%	8%
Raising capital	23%	44%	26%	8%
Space and use design	27%	38%	16%	18%
Health and/or wellness	27%	32%	24%	16%
Climate risk and mitigation	31%	23%	27%	19%

Percentage of companies in each business area

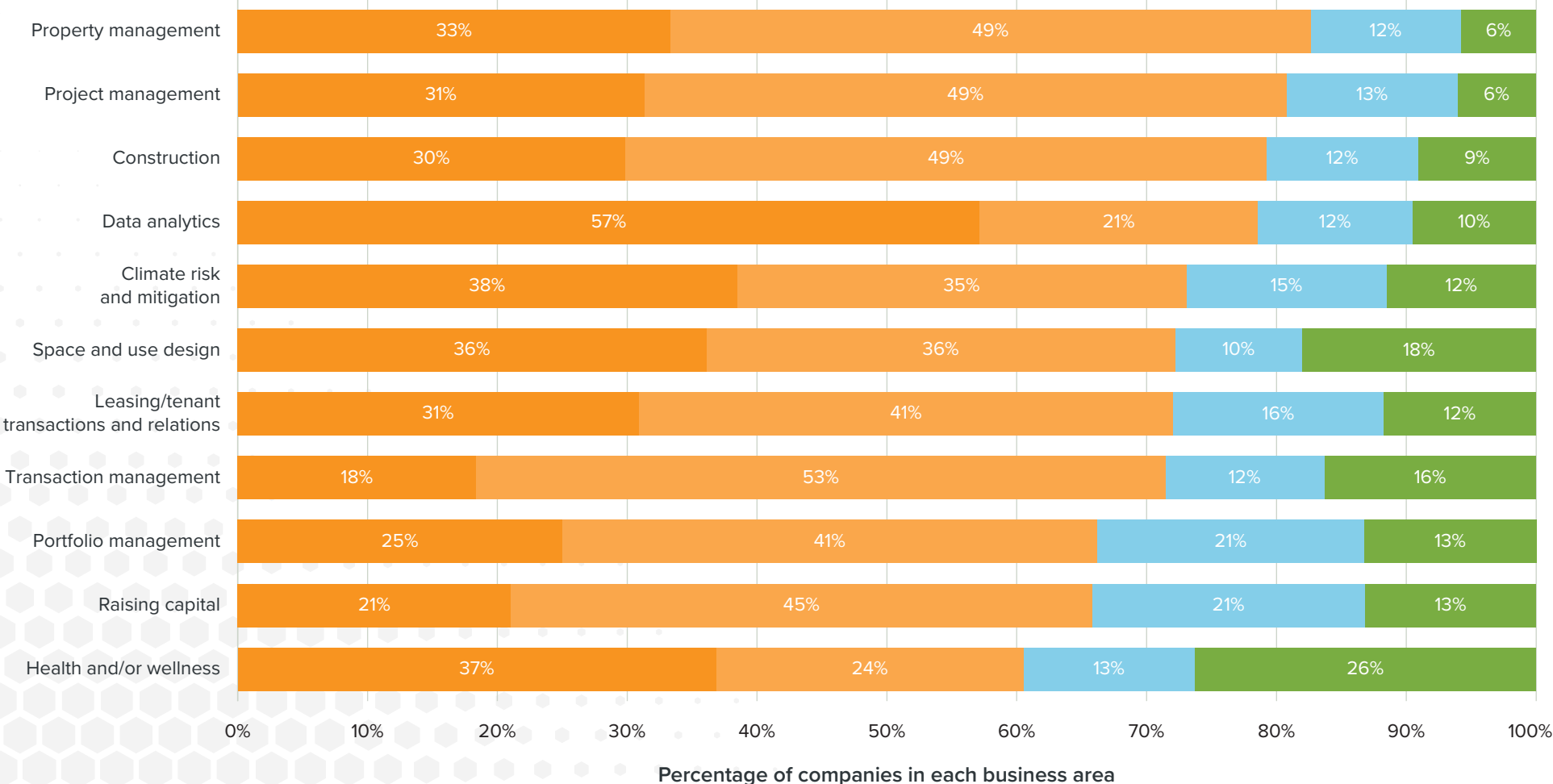Note: *Decision-making* includes underwriting. *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Source: ULI 2020 Proptech Survey.

Impact on Operations and Services

Property management technology stands out as the business area technology that overall most positively affects operations and services. Overall positive impact ratings include high and moderate impacts.

- Property management technologies include the automation of energy, HVAC, air ventilation, and air filtration systems to achieve efficiencies and effectiveness in reducing costs and supporting healthy indoor environments, as well as automation of such systems as access control and elevator queuing.

Project management, data analytics, and transaction management technologies are the technologies with the next highest rates of overall positive influence on operations and services.

- Project management technologies connect all disciplines throughout projects' life cycles. One company described the multiple benefits of its recent project management platform: "Not only does it help with the monumental task of communication among everyone involved in development—from contractors to investors—it also makes us more efficient. And, because it's new, it allows other platforms to tie in and use the same information."

- Data analytics technologies often involve an overarching system that pulls data in from all other business area systems.

- Transaction management technologies may involve cloud-based software to store, manage, and track all documents, as well as pipeline tracking, deal sourcing, and financial modeling.

By far, the overall impact of data analytics technology on operations and services stands out, with over 75 percent of companies specifically indicating a high impact. Most other overall positive impact ratings are a mix of high and moderate impacts.
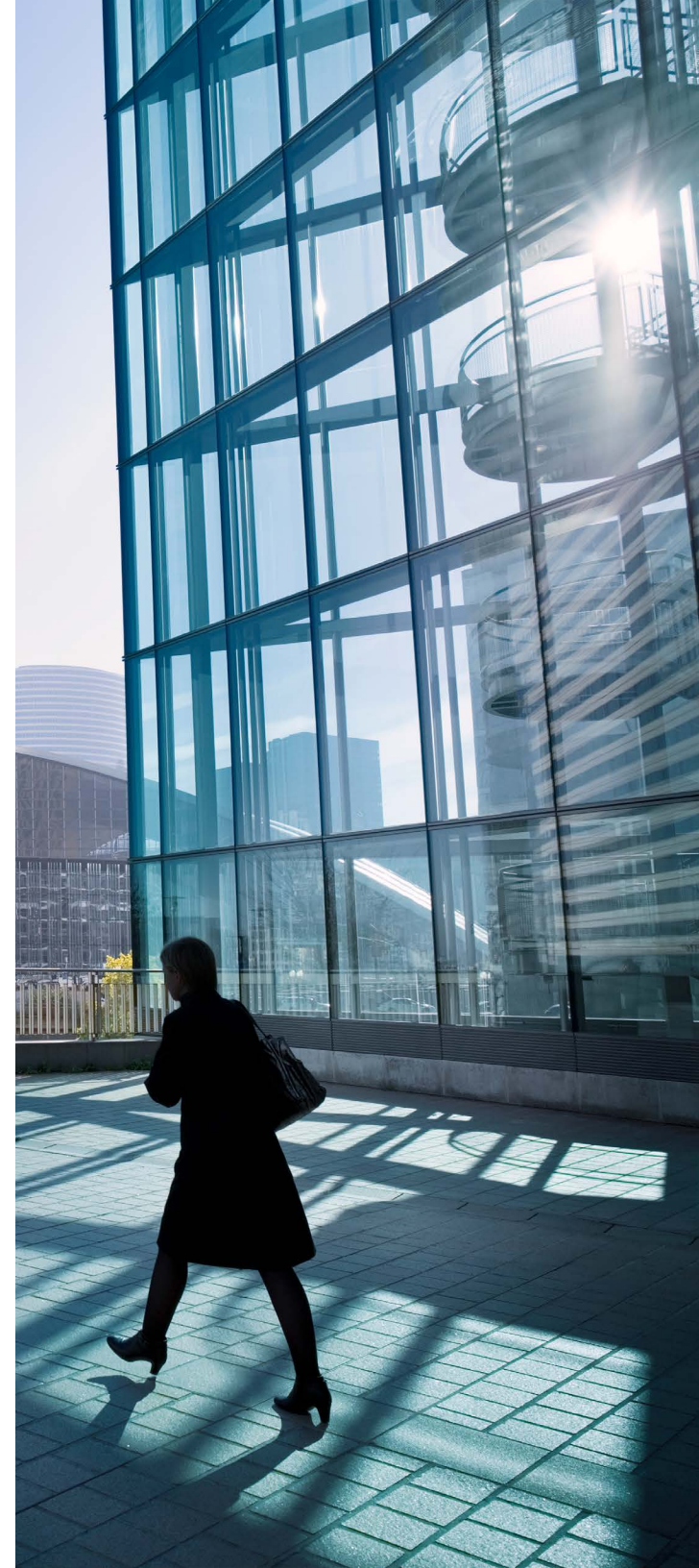
Impact on Finances

As with operations and services, property management technology stands out as the business area technology that overall most positively affects finances. A company noted that its software "has cut our electrical consumption by 44 percent, our carbon by 41 percent, and our steam consumption by 48 percent simply by identifying occupancy variables that never talked to each other before. It saves us roughly 55 cents a foot per year every year."

Project management, construction, and data analytics are the technologies with the next highest rates of overall positive influence on finances.

- Construction technologies include software and hardware to manage and document the construction process, as well as construction techniques. One company described a cloud-based platform that pulls in and stores documentation from on-site cameras of internal systems installation before walls are closed, as a permanent record of how the work was done. This allows for off-site review during the construction process and information at later stages if issues arise, as well as drilling down by geographic area.

Another company noted that "we are manufacturing 'pods' of rooms with dense electrical and plumbing systems. This off-site construction, where costs could fundamentally change, is made possible by digitization of both the design and construction process and the ability for those systems to talk to each other; it's very tied to technology, but not to a single one."

By far, the overall impact of data analytics technology on finances is also significant, since almost 60 percent of companies specifically indicate a high impact; this is almost double the high impacts noted for the other three business areas mentioned above.

Regarding the overall impact on profitability of other business area technologies, a company described the "snowball effect" of all leasing/tenant transactions and relations technologies that create a seamless process, starting with the first inquiry to the ongoing tenant experience.

Impact on Decision-Making

Data analytics technology is the business area technology that companies have found most positively affects decision-making. Notably, over 60 percent of the positive ratings (which include high and moderate impacts) indicate a high impact on decision-making.

- One company noted that its centralized data system is available to everyone at the company and is the "system we push our business through." Another expects that, in the next three years, its targeted investments in data analytics will improve decision-making in building design.

Technologies for property management and portfolio management are the technologies with the next highest rates of overall positive impact on decision-making.

- Portfolio management technologies include macro forecasting, analysis, and key performance indictor (KPI) tracking. One company described a portfolio management system that centralizes all internal and third-party data and drives its data-driven investment strategies.

Strategies for Identifying and Accessing New Technologies

Companies are diversifying their strategies for identifying and accessing new technologies. These strategies include one or both of the following:

- investing in and/or partnering with technology companies;

- developing technology in-house.

Typically, companies have multiple goals in pursuing these strategies, but goals focus on their interest in developing proprietary technological tools and as a means to screen for high-impact new technologies. Other goals include diversifying overall investment strategies as well as other company-specific goals.

Interviewees' comments on investing in and partnering with technology companies include the following:

- "We invest for strategic reasons, as well as to make sure we've got the best grip we possibly can on this quickly growing and changing proptech industry."

- "We partner with technology companies foremost to get knowledge in new technology fields so we can create high-value buildings, but also to use the partnership to change internal culture and become a more agile workplace."

- "We look at the best technology companies to figure out who we want to work with and this leads to multiple pilots and testing, where it is possible to experience the product. We then know whether it works for us or not."

Investment in technology companies takes multiple forms, including direct investment, investment in venture capital firms, and/or venture capital funds. Companies consider all of these as a means to broaden their view of disruptive changes in the industry.

One interviewee observed that when the question arises as to whether to develop a technology in-house, buy it from a provider, or partner with a technology company, the answer is "almost always in the partner bucket." Still, this company and others noted significant technologies that they have developed in-house. Several interviewees indicated that they developed an overarching data hub or data warehouse in-house with the capacity to pull in information from all their business lines, various subsystems, and external data sources to support their data analytics activities. Another created a portfolio management system that analyzed raw data on metropolitan statistical areas (MSAs) down to micro locations to

> " Investment in technology companies takes multiple forms, including direct investment, investment in venture capital firms, and/or venture capital funds."

provide data-driven investment decisions In all cases, the companies had not found any one existing tool that supported their particular company structure, systems, or needs. As one company noted, "Even with partners that have stacks of products, those products don't always talk to each other, so we needed a way to make that happen."

Finally, one company also described an in-house approach that used its office flex space as a "lab" to test out various property management, tenant engagement, and service tools to determine the value of scaling to that particular entire building.

Exhibit 7: Evolving Strategies for Pursuing New Technologies

■ Invested and/or partnered in technology **■ Developed technology in-house** **■ Pursued both strategies**

Business area	Invested and/or partnered in technology	Developed technology in-house	Pursued both strategies
Data analytics	17%	28%	24%
Space and use design	28%	20%	16%
Climate risk and mitigation	25%	21%	11%
Health and/or wellness	17%	22%	15%
Property management	19%	14%	10%
Transaction management	19%	15%	8%
Portfolio management	11%	20%	9%
Leasing/tenant transactions and relations	21%	9%	6%
Project management	17%	12%	4%
Construction	19%	5%	6%
Raising capital	15%	8%	

Percentage of total companies in each business area that have recently adopted technology and pursued an evolving strategy

Note: *Recently* refers to about the past three years.
Source: ULI 2020 Proptech Survey.

Exhibit 8: Goals in Partnering with and/or Investing in Technology Companies

Develop proprietary technology tools — 40%

Help screen for high-impact new technologies — 31%

Diversify overall investment strategy — 16%

Other — 13%
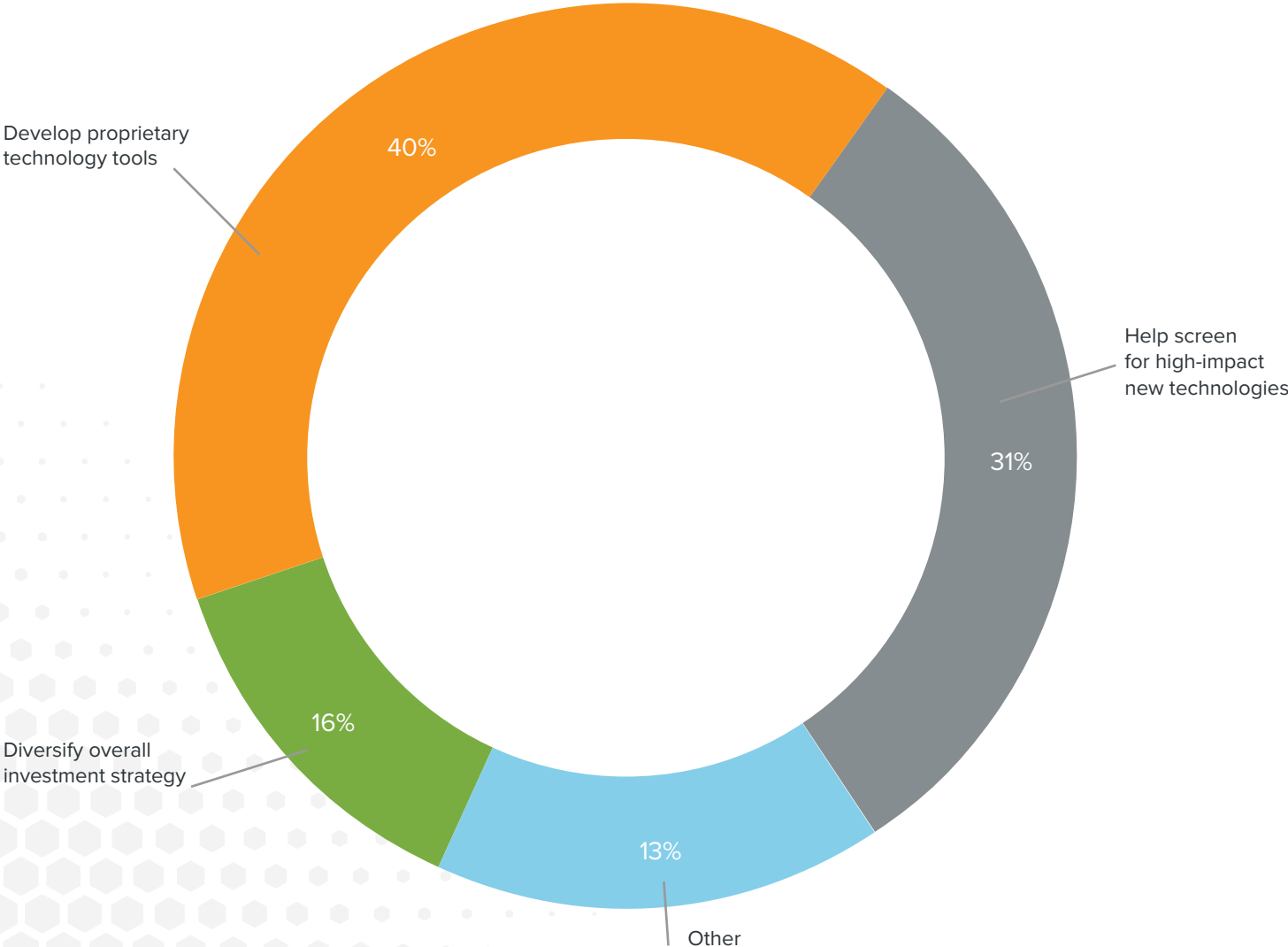
Note: Percentage of all company goals
Source: ULI 2020 Proptech Survey.

Exhibit 9: Goals in Partnering/Investing in Technology Companies, by Business Area

■ Develop proprietary technology tools   ■ Help screen for high-impact new technologies   ■ Diversify overall investment strategy   ■ Other

Business Area	Develop proprietary technology tools	Help screen for high-impact new technologies	Diversify overall investment strategy	Other
Leasing/tenant transactions and relations	52%	28%	4%	16%
Data analytics	49%	20%	20%	12%
Property management	47%	24%	15%	15%
Portfolio management	46%	19%	23%	12%
Project management	45%	26%	10%	19%
Transaction management	40%	20%	10%	30%
Construction	37%	40%	3%	20%
Health and/or wellness	33%	43%	14%	10%
Space and use design	30%	43%	10%	18%
Climate risk and mitigation	28%	50%	11%	11%
Raising capital	13%	47%	33%	7%

Percentage of all company goals for each business area

Source: ULI 2020 Proptech Survey.

Exhibit 10: Success in Partnering/Investing in Technology Companies, by Business Area

Legend:
- Highly successful
- Somewhat successful
- Neither successful nor unsuccessful
- Unsuccessful

Business Area	Highly successful	Somewhat successful	Neither successful nor unsuccessful	Unsuccessful
Climate risk and mitigation	35%	59%	6%	
Portfolio management	32%	36%	32%	
Health and/or wellness	32%	58%	11%	
Construction	27%	58%	15%	
Space and use design	26%	53%	21%	
Transaction management	25%	60%	15%	
Data analytics	24%	62%	14%	
Property management	24%	38%	35%	3%
Raising capital	20%	43%	36%	
Project management	21%	67%	10%	3%
Leasing/tenant transactions and relations	16%	68%	16%	
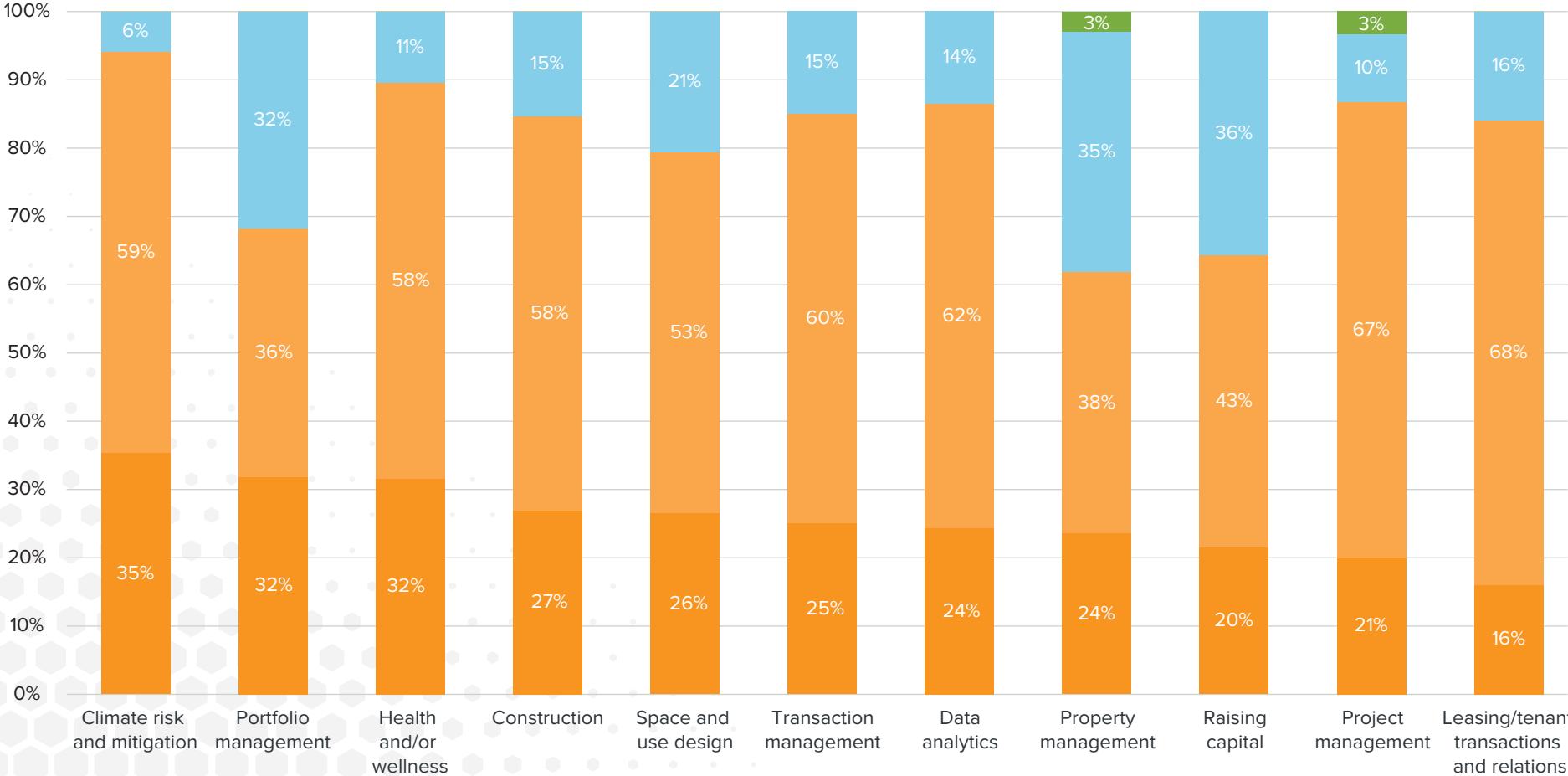
Source: ULI 2020 Proptech Survey.

Future Plans and Growth Areas

The strong pace of recent technology adoption will continue, as indicated by the vast majority of respondent companies that are taking on further technology over the next three years (or the foreseeable future) in all business areas. Although referencing a particular technology, this observation reflects sentiment conveyed in all interviews: "This is a self-reinforcing mechanism that will create even more advantages for the folks who use technology versus the folks who don't."

- Interest is growing in the three relatively new business areas—data analytics, health and/or wellness, and climate impact forecasting/mitigation. These are the only business areas for which more companies have plans up ahead than have recently adopted technology.

- Specifically, interest in data analytics as a business area is growing dramatically, with close to 70 percent growth in the number of companies with plans for adoption compared with the number of companies that recently adopted technology. Interest in health and/or wellness and climate impact forecasting/mitigation, as business areas, is growing, although just incrementally.

Overall, only 15 percent of companies do not have plans for the foreseeable future. According to interviewees, their decisions not to proceed with a technology at a point in time are based on assessments of market demand, satisfaction with their current technologies, relevance to their business goals, perceived state of technological and industry maturity, and a prioritization of resources. Interviewees provided these examples:

- Smart-home technology: If customers have not made it known that a particular smart-home technology is a factor in their decision to lease, then they are not likely to take that technology on.

- Business intelligence and market survey technology: A vendor may not integrate with the full spectrum of market sources.

- Revenue management technology: "We like what we have in place," and "are not yet sold on the next generation of these tools."

- Parametric design technology: One company places more emphasis on developing iconic buildings and finds that this technology does not further its objectives.

- Blockchain: Understanding the power of this technology, one company has concluded that it may not be mature enough at this point for them to divert resources from other efforts.

- Operational and security robots: Although one company is watching this technology closely for these particular tasks, it has chosen to wait.

> "
> Although referencing a particular technology, this observation reflects sentiment conveyed in all interviews: "This is a self-reinforcing mechanism that will create even more advantages for the folks who use technology versus the folks who don't."

Companies' plans for all business areas include a mix of technology new to the company and expansion/improvement of previously adopted technology.

- Raising capital stands out, with almost 70 percent of the plans targeting new technology. This most likely reflects the fact that only one-half of respondent companies engaged in raising capital have adopted new technology in the last three years, the lowest recent adoption rate among all business areas by far. In fact, over 50 percent of those with plans to adopt in the next three years have not adopted recently.
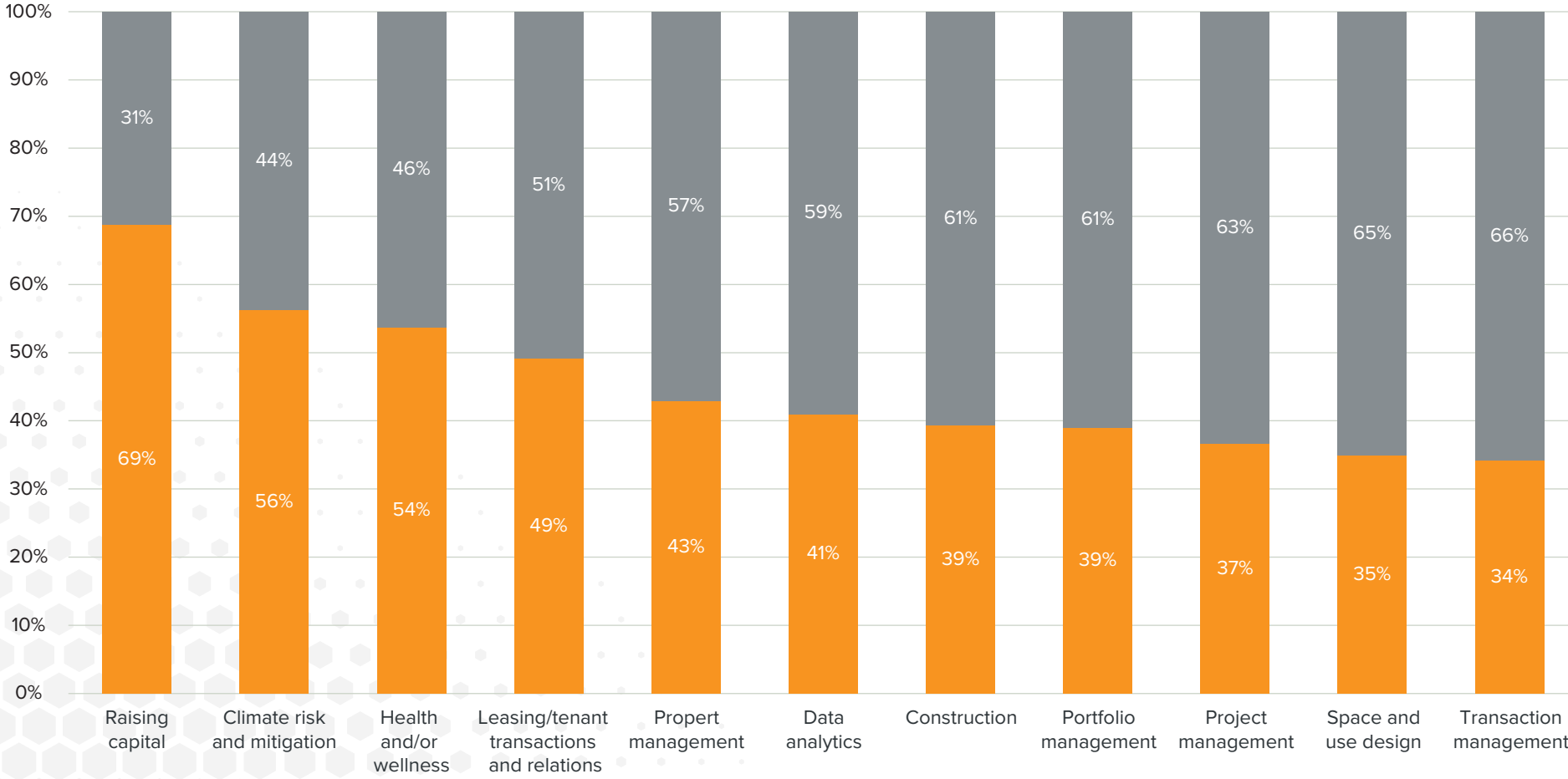
Exhibit 11: Recent Technology Adoption vs. Future Plans, by Business Area
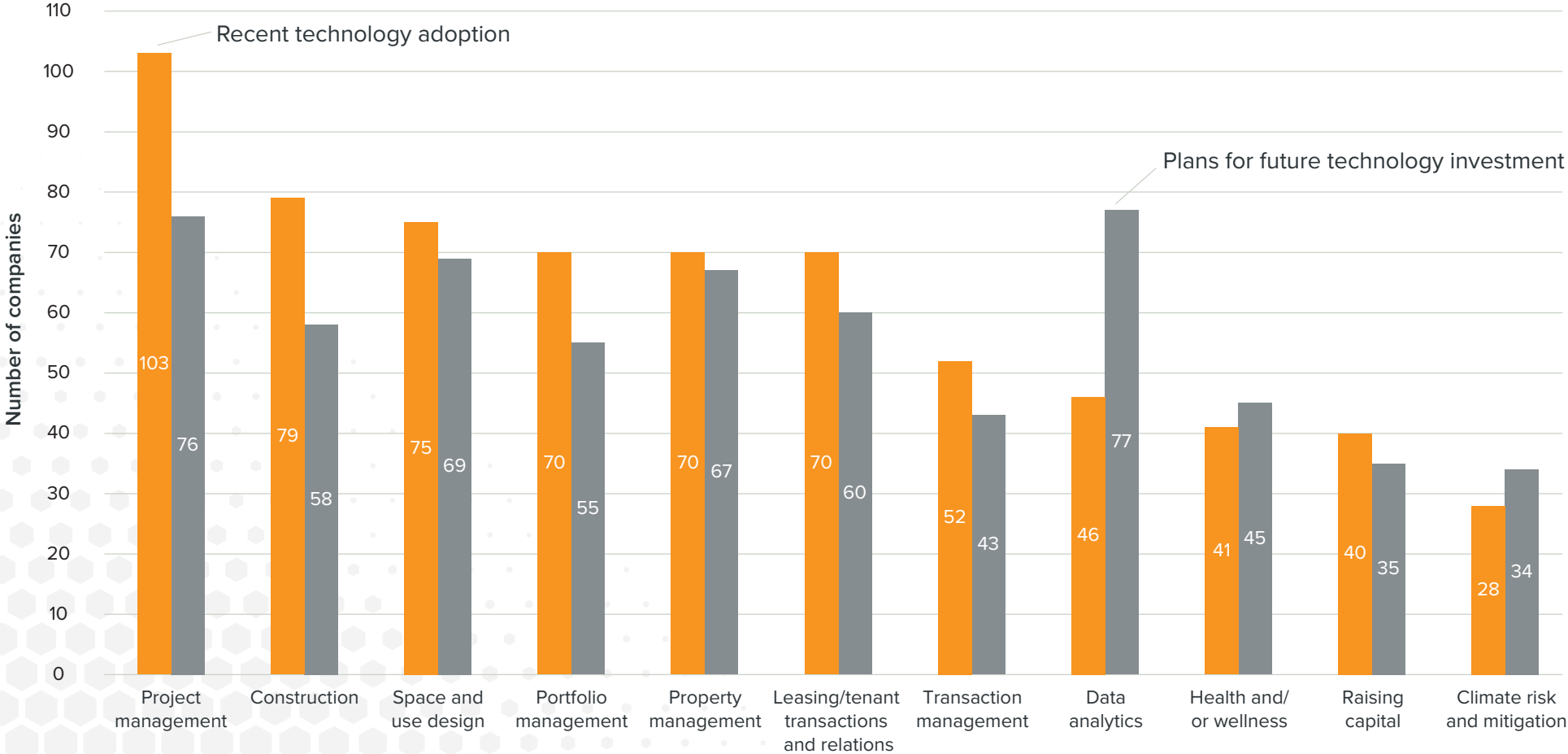
Note: *Recently* refers to about the past three years; *future* refers to the next three years or the foreseeable future.
Source: ULI 2020 Proptech Survey.

Exhibit 12: Type of Plans for Technology Investments over the Next 3 Years, by Business Area

■ Technology new to the company   ■ Expansion/improvement of previously adopted technology

Business Area	Technology new to the company	Expansion/improvement of previously adopted technology
Raising capital	69%	31%
Climate risk and mitigation	56%	44%
Health and/or wellness	54%	46%
Leasing/tenant transactions and relations	49%	51%
Propert management	43%	57%
Data analytics	41%	59%
Construction	39%	61%
Portfolio management	39%	61%
Project management	37%	63%
Space and use design	35%	65%
Transaction management	34%	66%

Note: *Next 3 years* refers to three years or the foreseeable future.
Source: ULI 2020 Proptech Survey.

Lessons Learned

Several recurring themes were noted regarding guidelines learned and observed.

Beyond the power of individual technologies, companies are also experiencing the "snowball effect" of multiple technologies contributing to, for example, customer-facing technologies that enhance the customer experience from first touchpoint to tenant retention altogether leading to greater profitability. This effect is "what we strive for with the technologies, we adopt."

The expanding capabilities of technology platforms to communicate with other platforms are unlocking the power of technology and supporting companies' own capacity to develop innovative business solutions. Furthermore, when new technologies can interface with existing platforms, the overall potential and usability of all company technology expands. One company described powerful new project management software that interfaced perfectly with its existing accounting platform, streamlining essential tasks. It is essentially the old adage about the whole being greater than the sum of its parts.
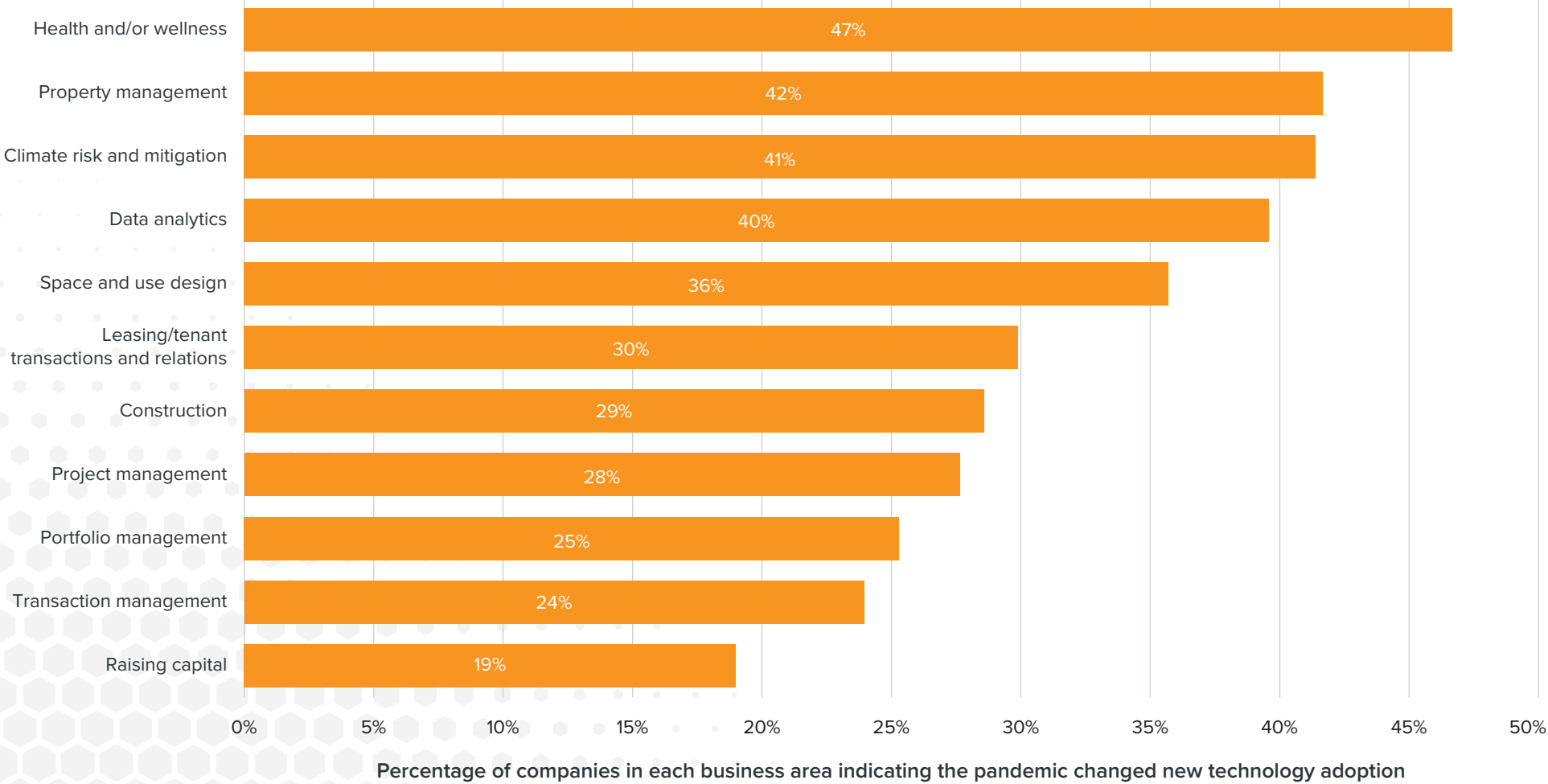
Companies also spoke of customizing which technologies apply to a building and how, rather than a portfolio-wide adoption. One

interviewee noted, "We don't have a blueprint or template where we say every building needs to have, for example, a smart lock." But companies do build in the data-enabling protocol and interfaces so that there can be enough bandwidth to support any future technologies. A developer indicated that its new buildings have been certified technology-enabled and scored to create more value and marketability for future tenants.

Reflecting the need to, at times, develop technology in-house, one company observed that the most challenging part in the process of adopting technology is that the real estate sector is currently still so heterogeneous and the different parties and stakeholders within the building have different agendas and incentives. This creates a complex situation that makes it hard to get the technology working together in one functioning ecosystem.
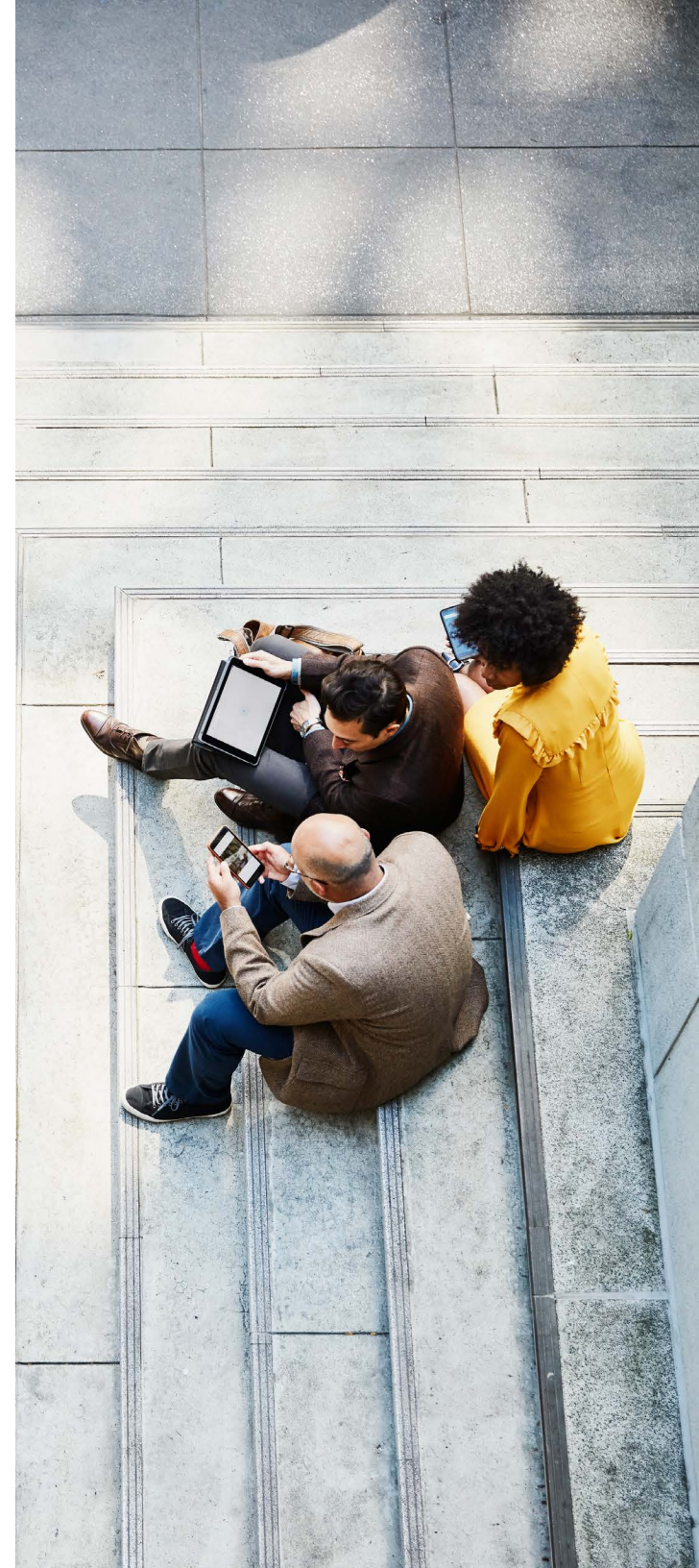
Exhibit 13: Pandemic Has Changed the Timing, Type, or Extent of New Technology Adoption, by Business Area

Business Area	Percentage
Health and/or wellness	47%
Property management	42%
Climate risk and mitigation	41%
Data analytics	40%
Space and use design	36%
Leasing/tenant transactions and relations	30%
Construction	29%
Project management	28%
Portfolio management	25%
Transaction management	24%
Raising capital	19%

Percentage of companies in each business area indicating the pandemic changed new technology adoption

Source: ULI 2020 Proptech Survey.

Exhibit 14: Climate Mitigation/Resilience as a Factor in Recent or Planned Technology Investment, by Business Area

■ A significant factor　■ A moderate factor　■ Not a factor

Business Area	A significant factor	A moderate factor	Not a factor
Climate risk and mitigation	74%	24%	3%
Health and/or wellness	40%	40%	20%
Space design and use	32%	46%	22%
Data analytics	23%	35%	42%
Property management	20%	37%	43%
Construction	25%	30%	45%
Portfolio management	18%	34%	48%
Leasing/tenant transactions and relations	12%	40%	48%
Project management	10%	40%	50%
Raising capital	13%	24%	63%
Transaction management	10%	21%	69%
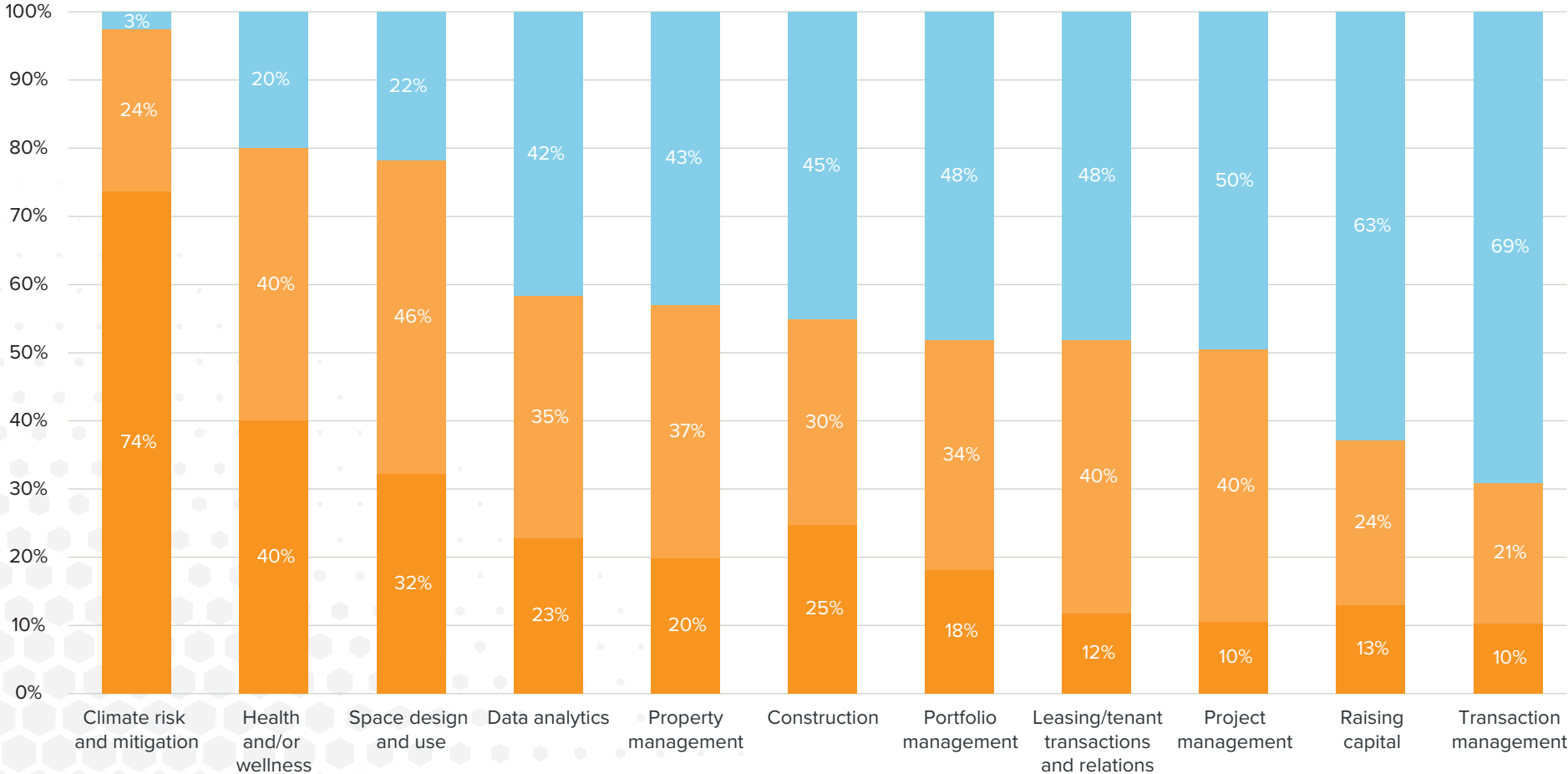
Source: ULI 2020 Proptech Survey.

Drilling Down by Business Area

Information Collection: Data Analytics

Data analytics, as a business area, was noted by only a small number of survey respondents as one that they currently are engaged in. But this number jumps by almost 70 percent when respondents were asked about their technology investment plans over the next three years (or the foreseeable future). This dramatic growth sets it apart from every other business area.

The impact of recently adopted data analytics technology on business functions also distinguishes this business area from others. Three-quarters of respondent companies describe the impact on operations and services as specifically highly impactful—again, substantially more than the impact of any other business area technology on operations and services. This relative comparison holds true regarding the impact on finances and decision-making.

One company described its experience: "Our investment in data analytics is all about improved data-driven decision-making. We capture, consolidate, and mine data that we have, which allows us to continually learn,

evolve. The way in which we make decisions through data is going to give us a leg up in just about all of our operations." Furthermore, the interviewee notes, "We are able to be nimble and do ad hoc reporting, dashboards, data visualization, etc., to get questions answered with greater speed and flexibility."

Another interviewee described data analytics as one of their recent technology initiatives: "We all say data is the crude oil. Given the volumes that we process, we have access to phenomenal amounts of data. And we've been on a journey to derive meaningful insights from the right data, the right place, at the right time for our clients and our professionals."

Respondent companies with recently adopted data analytics technology also lead in the use of strategies beyond purchasing or contracting with a vendor. Almost 70 percent have either invested in and/or partnered with technology companies or have developed the technology in-house, with some companies pursuing both strategies. As an interviewee said, "We developed a data warehouse [in-house]; we use so many different types of software and systems and each one has [its] own reporting tool, so we needed to get all of this data in one area interfacing with each other."

> " Our investment in data analytics is all about improved data-driven decision-making. We capture, consolidate, and mine data that we have, which allows us to continually learn, evolve. The way in which we make decisions through data is going to give us a leg up in just about all of our operations."

A designated data analytics team is another recent business model for adoption and use of data analytics technology. In one company, it was this team that created a robust data platform for the entire organization that gathers data from all systems and sources. "Not only do we have all this data in one place, but it is central to how we do business and how we share information with each other; everyone in the firm has access."

Going forward, almost 60 percent of the respondent companies that have plans for investments in data analytics over the next three years (or in the foreseeable future) plan to expand/improve on previously adopted technology, reflecting the already high impact of the technology. And just over 40 percent plan to further adopt new (to their company) technology.

Asset-Level Technologies: Property Management, Leasing/ Tenant Transactions and Relations

Survey respondent companies report, in roughly equal numbers, recent technology adoption for property management and for leasing/tenant transactions and relations. But the impact of these technologies on business functions differs somewhat.

Property management technologies. Property management technology has left little doubt among the companies of its impact on operations and services, finances, and decision-making.

Over 90 percent of companies indicate an overall positive impact (including high and moderate impacts) on operations and services, and about one-half of these ratings specifically indicate a high impact. The impact of these technologies is stronger than the impact of any other business area technologies on operations and services. Very few indicated anything other than a positive impact, such as "too soon to tell," as well as little/no impact.

Just over 80 percent of companies indicate an overall positive impact of property management technology on finances, also relatively stronger than the impact of other business area technologies on finances.

The overall positive impact on decision-making, also indicated by over 80 percent of the companies, is second only to that of data analytics technology. The impacts on these two functions skew slightly to a moderate impact, although 33 percent and 29 percent, respectively, specifically report high impacts.

Interviewees' discussions of property management technologies centered on automation of energy and HVAC systems to achieve efficiencies in resource consumption to lower utility costs for tenants, as well as on air ventilation and filtration technologies to provide a healthy environment. One company detailed the cost savings that its portfolio realizes through the use of property management software that determines the required level of cooling or heating based on building occupancy. "Now when you walk into a room or building, your occupancy is actually influencing the amount of chilled air for heated air that we're distributing and we lower it as the population of the building leaves and we raise it when occupancy levels come back." Taking this variable into account, the company cut electrical consumption by 44 percent, carbon by 41 percent, and steam consumption by 48 percent "simply by identifying variables that never talked to each other before. It's a great tool that saves us roughly 55 cents a foot per year."

Most likely reflective of the overall strong impact on business functions, about the same number of companies that have recently adopted property management technologies have plans for further adoption within the next three years. About 60 percent of the planned activity will be for expansion or improvement of their existing technologies, and 40 percent will be focused on new technology.

Leasing/tenant transactions and relations technologies. As companies explore these technologies to address their evolving needs, assessment of impacts can vary. About 80 percent of companies note an overall positive impact of leasing/tenant relations technologies on operations and services, with almost one-half of these companies specifically noting a high impact. Just over 70 percent of companies noted an overall positive impact on finances, as well as on decision-making. On the other hand, 20 percent indicate that there has been little or no impact to date or that it is too soon to tell the impact on operations and services, and almost 30 percent indicate the same about the impact on finances and decision-making.

Interviewees mentioned the touchless experience (both in person and virtual) for tenants, for which demand was already evident prior to the COVID-19 pandemic, but for which the need has accelerated. Technologies noted to support this physical experience include smart locks, elevator queuing, and amenity space access. In the area of a virtual touchless experience, a company described its focus on virtual-reality tools for a digital renting process in its residential properties, including an online virtual-reality navigator that allows prospective residents to walk through the building and, with drones, they can provide a view out of any apartment even prior to construction. A robot can connect to agents through WebEx so that a potential tenant can walk through the property with a robot and ask any question to the agent.

In addition, other examples include platforms where prospective residents can access the entire leasing process online, creating a frictionless experience from locating the perfect space to signing the lease. Or as noted, this includes "anything that makes it easier to do with business with us," and, from this company's perspective, ranges from improved digital marketing, to the ability to personalize its online experience—book appointments online, provide virtual self-tours, complete first and renewal leases online, and communicate with customers in whatever channel they prefer." Such engagement tools that enhance marketing and communications, an ability to tour, and increase their online presence are expected to reduce the time and cost of leasing, resulting in greater profitability.

" Interviewees mentioned the touchless experience (both in person and virtual) for tenants, for which demand was already evident prior to the COVID-19 pandemic, but for which the need has accelerated."

Another technology that differentiates tenant experience is to offer internet access to residents through 5G providers. The provider installs an antenna on the roof of the building that receives the 5G signal; usually, the 5G internet can tap into the existing infrastructure in the building to get the signal to each individual unit. The results of offering 5G internet can be increased speeds, greater reliability, and economical pricing options.

On the commercial side, numerous operators are using real estate customer relationship management software to manage the entire leasing cycle. They are able to create a leasing strategy for the building, analyze the best tenant mix, track all touch points with prospective tenants, and manage the ongoing relationship after they sign a lease.

Tenant engagement tools for both commercial and residential properties, such as a tenant engagement experience platform, were also noted. Such a platform allows building

tenants to interact with each other, make room bookings or desk bookings, and request personal services. One operator noted, "We want to be a landlord that is not only providing space, but microservices to enhance the user experience of our tenants and users of our buildings." Some of these types of microservices were described by another interviewee as "things that make people more comfortable and [that] will facilitate a healthier workplace."

Specifically on the commercial side, one company developed its own experience platform that streamlines everything from finding colleagues, finding space to work, and knowing what's in and around the campus or within the office environment. The company believes that "you can't expect employees to have 20 different apps just around the workplace, so we've built a platform that is extensible."

Just slightly fewer companies have plans for further adoption within the next three years than have recently adopted leasing/tenant relations technologies. About one-half of the planned activity will be for expansion or improvement of their existing technologies, and the other half will be focused on new technology.

Project Management Technologies

Project management is the most common business area among respondent companies and the most common area for which technology was adopted in the last three years.

The overall impact on operations and services was rated positively (including both high and moderate impacts) by 89 percent of the companies in this area, and the overall impact on finances was rated positively by 80 percent of companies. Both overall impact ratings are second only to property management.

The overall impact on decision-making was somewhat lower, rated positively by just over 73 percent.

Project management platforms mainly operate in the cloud and play a role in bringing the entire team into a single environment to allow for more efficient flow. Referring to a recent evolution in project management technologies, one company described its software as able to incorporate artificial intelligence for tasks such as receiving drawings and converting them into a usable format.

Project management is "a monumental job to keep everyone informed on what's happening and pushing everyone in the same direction. We've been searching for a platform that we thought would do the communication portion, but also make us more efficient as we're developing buildings." This company needs to communicate and share information with a wide circle—the general contractor, subcontractors, the architect, the architect's consultants, engineers, other professionals, the bank, and investors. Once everyone is on the platform, it is used for communication, drawing uploads, requests for information (RFIs), and change orders "so everyone has all the same information in an accurate way." The company finds it to be much more efficient and effective

for them, but it did describe some upfront initial challenges training people and getting other companies to adopt it. The company noted, however, that these challenges are minor compared with the advantages of being on the platform.

A unique aspect of the new technology that the company adopted is that it "allows other platforms, such as their accounting system, to tie into the project management platform and use the same information."

Another interviewee focused on the ability of their project management platform to keep everyone consistently informed, saying that "it is accessible to everyone in the C-suite, the entire business development team, the leasing team, they all have licenses. If I have a conversation I think is of note to the larger organization, I enter it in and every day at 10 o'clock everybody who's on this system gets a list of entries from the prior day pushed to their email, which allows me to not have to worry about telling everyone." It was also noted that they experienced some initial challenges, one of which was "making sure people don't put everything in, so there's some judgment involved in terms of what's really notable that the rest of the group needs to see; I think we're doing well there."

> "
> Technology and capability [have] advanced so much now with the digital revolution, cloud-based technologies, and AI. It just feels like we should be on the cusp of this incredible sea change of how we build."

While fewer companies engaged in project management have plans for additional technology investments within the next three years compared with the number that have recently adopted technology for project management, about two-thirds of the planned activity will be for expansion or improvement of recently adopted technologies. The other one-third will be focused on new technology.

Construction and Use Technologies: Construction, Space and Use Design

About one-half of the respondent companies involved in construction are developers, with another almost one-quarter in architecture. Conversely, one-half of the respondent companies involved in space and use design are architects or engineers, with another almost one-quarter in development. The survey respondents report, in roughly equal numbers,

recent technology adoption, but the impact of these technologies on business functions differs in a few ways.

Construction technologies (contech). About three-quarters of companies noted the overall positive impact (including high and moderate impacts) of contech on operations and service, as well as on finances; one-half of the companies specifically indicated a high impact on operations and services. Two-thirds noted an overall positive impact on decision-making. As may be expected as companies investigate new technologies—one interviewee described a group within their company specifically responsible for surveying the field of new contech—a segment of companies indicated that there has been no impact to date or it is too soon to tell, ranging from 34 percent regarding the impact on decision-making to 21 percent for the impact on finances.

Interviewees' discussions of construction technology focused on various cloud-based comprehensive management tools. BIM, which has been in use for decades but more recently has cloud capability, was noted for construction planning to provide a means of quality assurance and time and risk management. Also noted was a tool that incorporates

artificial intelligence in receiving drawings and converting them into a format usable from any mobile device. A living documentation software creates a permanent record of each step during the construction process via a helmet-mounted camera and a walk-through of the site a few times a week. Every step and system that will be hidden when a wall goes up—duct work, fireproofing, risers, studs, etc.—can be reviewed off site, mitigating risk and reducing labor costs, and can be revisited at any point in time if issues arise. Both construction companies and real estate developers discussed adopting this type of documenting technology.

There also are important variables that cannot be verified visually on a construction site, such as the concrete poured over rebar. To monitor this aspect, contractors are placing sensors into the rebar before pouring the concrete. These sensors monitor strength, temperature, and humidity, maintaining these variables at the proper level necessary for the concrete to dry properly and have the expected strength and integrity.

Other contech noted includes the following: drone technology to monitor and document on-site progress, sensors to detect leaks via for smart water valves, and off-site production of whole rooms, such as bathrooms, where the plumbing and electrical systems are dense

and "the bathrooms are shipped as a whole unit that just needs to be broken out and installed." This latter effort, as described by one company, is made more possible by the enhanced capacity for communication between building information modeling (BIM) and design technology systems. This company expressed its belief that off-site construction is where costs can fundamentally change.

Reflecting on the potential of contech up ahead, another interviewee noted the application to the challenge of reducing costs to make housing more affordable: "Technology and capability [have] advanced so much now with the digital revolution, cloud-based technologies, and AI. It just feels like we should be on the cusp of this incredible sea change of how we build."

These latter two assessments reflect the overall direction of industry thinking on where best to address the challenge of housing affordability. Hard costs (labor and materials) and construction process inefficiencies have proved difficult to address, yet these drivers are responsible for up to 70 percent of residential development costs, making it difficult—if not impossible—to produce units that can be rented or sold at prices affordable to substantial numbers of moderate- and lower-income U.S. households. Frequently limited in their ability to influence land prices and soft costs,

developers increasingly view technology as having game-changing potential to deliver more deeply affordable units without public subsidy. Although transportation costs have limited the geographic impact of many technologies that have shown promise to date, replication and product standardization are likely to mitigate these challenges over time. With expected investments in infrastructure likely to drive labor costs even higher and critical material costs, including lumber, already at historically high levels, technology and manufacturing strategies are ripe to break through and to begin to reduce the overall cost of housing production.

While fewer companies in construction have plans for additional technology investments within the next three years compared with the number that have recently adopted technology, about 60 percent of the planned activity will be for expansion or improvement of their existing technologies. The other 40 percent will be focused on new technology.

Space and use design technologies. The overall impact of space and use design technologies on operations and service, as well as on finances, was rated positively (including both high and moderate impacts) by about three-quarters of companies in this business area. A slightly lower number of companies reported an overall positive impact on

decision-making. Indicating fairly recent adoption activity, the relative number reporting that it is too soon to tell whether the impact stands out, particularly for the impact on finances and decision-making (18 percent of companies, each).

When users described this technology, architects focused on the use of software and hardware to design and showcase a space, whereas real estate developers focused on how they can better use built space. Some tools include BIM to illustrate ideas, which was described as being "very important recently on large-scale projects," light detection and ranging (LiDAR), augmented reality and virtual reality (AR and VR), and collaboration software to bring all of this alive.

Regarding the impact of technologies on its business, one company noted the impact on clients' decision-making. The company was able to use BIM to create a model of a hotel room and put the client in a VR headset to showcase the space. The client was immediately onboard with the direction and asked to proceed with next steps. "It was great for us to get to use those tools to get a major signoff and approval, and also have them embrace the technology, and understand and appreciate the value of what we did and why

we did it." Using technology in this capacity accelerated the decision-making process, avoiding multiple iterations of drawings.

In another example of creating virtual environments to visualize spaces, the MIT Real Estate Innovation Lab also described that technology can be used "for the transfer of multiple BIM and CADx models into a three-dimensional, real-time environment. The real-time visualization enabled in these engines helps to gain a better understanding of the physical environment—such as scale and proportion, switch locations, lighting—and can accelerate future development proposals."

One company described a platform for determining where employees should be placed when moving into a new space. The intelligent software mines calendar and email traffic through artificial intelligence. This was originally intended to be offered to new tenants to help them lay out their office space, but it offered another use during the pandemic. "During the pandemic, it was a way to maintain social distancing in the office. We use it to figure out an A, B structure when people come in the office and when they aren't allowed to come into the office."
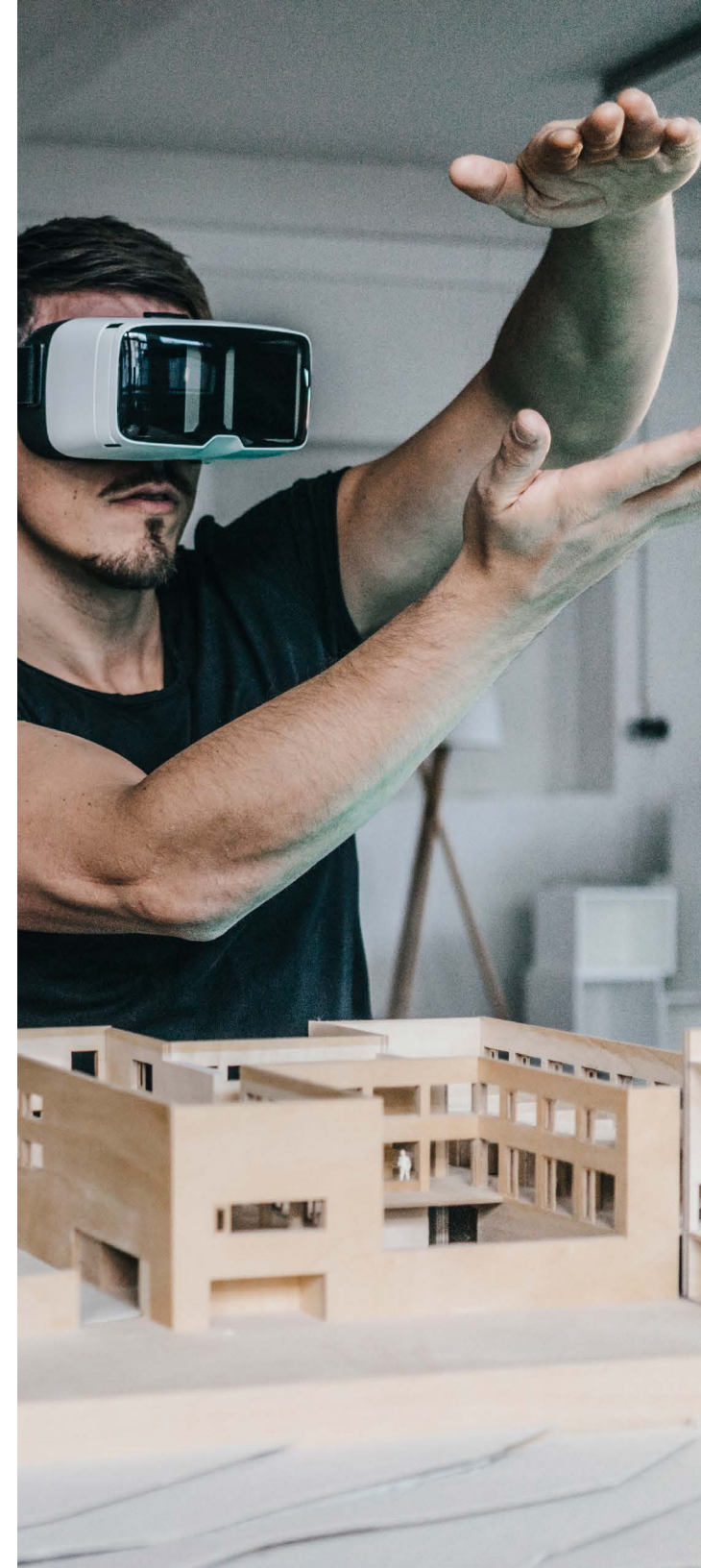
Just slightly fewer companies have plans for further adoption within the next three years than have recently adopted leasing/tenant relations technologies. About 60 percent of the planned activity will be for expansion or improvement of their existing technologies, and 40 percent will be focused on new technology.

Financial Technologies: Portfolio Management, Transaction Management, Raising Capital

The different tasks involved in these three financial business areas may be reflected in the rates of recent technology adoption. Almost 85 percent of companies that manage portfolios have recently adopted technologies for this purpose, similar to most other business areas, while 70 percent of companies have recently adopted technologies for transaction management, but only about 50 percent of those that raise capital have adopted technologies to support these efforts. The latter two adoption rates are the lowest among all business areas to date.

Portfolio management technologies. Portfolio management technologies have been equally impactful on two business functions—operations and services, and decision-making—with almost 80 percent of companies in these areas indicating an overall positive impact (including both high and moderate impacts). The impact

on finances is somewhat lower, with 66 percent noting an overall positive impact. As may be expected as companies investigate new technologies applicable to their specific needs, a segment of respondents find that technologies adopted to date have had little or no impact or that it is too soon to tell the impact, 21 percent, 21 percent, and 34 percent, respectively.

One company developed proprietary portfolio management technology in-house to direct data-driven investment strategies in listed real estate investment trusts (REITs), nonlisted real estate funds, and listed infrastructure funds around the world. They made the decision to have a smaller centralized team of about 12, instead of many professionals based in satellite offices, and the team structure changed to include data engineers. In emphasizing the importance of this tool, the interviewee said, "Our data-driven investment process would not be possible without technology, so without our data infrastructure we would be lost."

The software was described as having a back end that analyzes the raw data—"the bones"—and then a front-end visualization that overlays the data infrastructure. One of the most powerful interfaces that can be pulled up is called Property Map, which contains a multitude of different dashboards to access information about both residential and commercial markets and submarkets. When any submarket is

> " Our data-driven investment process would not be possible without technology, so without our data infrastructure we would be lost."

selected, 12 unique variables are displayed. For those 12 variables, there is an individual value, a score assigned to that value, and a weight assigned to the score, which is then compiled together to create a submarket score. The submarket score leads to a long-term net operating income (NOI) growth assumption, so the higher the score, the higher the long-term NOI growth potential of a certain building inside that submarket. Ultimately, this feeds into an internal rate of return (IRR) calculation that determines the investment decision.

On the retail side, one company described its portfolio management software as the "lifeblood of the company, 90 percent of the company uses it every single day," with it touching everything from collections to sales tracking to merchant health to budgeting to expense reconciliation. The company described the beauty of the software as it is able to overlay the data inside of preexisting accounting and property management systems, extract it out, and normalizes it into a purpose-built report for an asset manager or a property manager.

While fewer respondent companies plan further technology adoption in the next three years than have recently adopted portfolio management technology, 60 percent that do have plans expect to expand and/or improve their current technologies, and 40 percent plan to adopt new (to their company) technologies.

Transaction management technologies.
Transaction management technologies have had the most impact to date on operations and services, with 85 percent of companies in this business area noting an overall positive impact. The impacts on decision-making and finances are somewhat lower, with just over 70 percent of companies indicating an overall positive impact on each of these functions. As companies investigate new technologies applicable to their specific needs, a segment of respondents find that technologies adopted to date have had little or no impact or that it is too soon to tell the impact—15 percent, 27 percent, and 29 percent, respectively.

One company is investing in, and currently piloting, technology that gives it greater transparency into transacted building prices and locations, providing input during investment due diligence. Another interviewee is using technology to manage the entire real estate transaction from receiving the offering memorandum to closing. The cloud-based

software securely manages and distributes documents to parties, creates interactive checklists for closing, and allows all parties to collaborate and communicate on one platform. As work from home becomes more prevalent, the company believes that its "need to invest in these platforms will accelerate."

Fewer respondent companies plan further technology adoption in the next three years than have recently adopted transaction management technology. But notably, about half of the companies that do have plans have not recently adopted these technologies. With two-thirds of the companies noting that their plans are for expansion/improvement of new technologies, it appears that at least some companies adopted technologies more than three years ago. One-third of the companies are planning to adopt new technologies.

Technologies for raising capital. Reflecting the fact, noted above, that companies have adopted technologies for raising capital at a substantially lower rate than those in other business areas, one interviewee noted: "A large part of raising capital for real estate deals has historically involved relationships, which often are not technology driven. Technology may not magically fund a new deal, but new software can now help with the process." To this latter point, about two-thirds of companies

> **"**
> A large part of raising capital for real estate deals has historically involved relationships, which often are not technology driven. Technology may not magically fund a new deal, but new software can now help with the process."

that have recently applied technologies to raising capital indicate that these technologies have had an overall positive impact on all three business functions—operations and services, finances, and decision-making. One-third have experienced little or no impact to date or indicate that it is too early to tell the impact.

Capital-raising activities such as relationship management, investor reporting, contact management, fundraising, distributions, and portals for both the sponsor and investor side can now be managed on cloud platforms. For relationship management, the sponsor is able to track contacts and their activity in relation to their investments, as well as customize the type and level of communication they receive. The person who is communicating with the investor has access to all relevant information that the investor would want to know. Investor reports can also be generated directly by the software so that the sponsor is easily able

to fulfill regular or ad hoc requests. In terms of fundraising, key features are described as giving the investor relations or fundraising teams the information that they need about a current deal or fund, including investor history. A key benefit of having all of the information on one platform is the ability to easily track the capital stack profile of each deal.

Even fewer respondent companies plan further technology adoption in the next three years than have recently adopted. But notably, more than half of the companies with plans have not recently adopted technologies for raising capital. It is not surprising then that 70 percent of the plans are for adoption of new technologies, with the balance addressing expansion/improvement of existing technologies.

Technologies for New Business Areas: Health/Wellness, Climate Risk and Mitigation

Reflecting the relatively recent emergence of health and/or wellness, as well as climate risk and mitigation (which, in this report, includes both climate risk assessment/mitigation and climate mitigation) as areas of business activity, these are the two least common business areas among the respondent companies. Activity

to date, however, appears closely tied to technology, as indicated by the highest recent technology adoption rates (along with data analytics) among all business areas.

Health and/or wellness technologies. Three-quarters of companies indicate an overall positive impact (including high and moderate impacts) of these technologies on operations and services, with over one-half of these ratings specifically indicating a high impact. Overall positive impacts on finances and decision-making were lower, each at about 60 percent; still, just under 40 percent specifically reported a high impact on finances. As would be expected as companies explore evolving technologies, a particularly strong segment of companies indicate that there has been little to no impact on these business functions or it is too soon to tell—25 percent, 39 percent, and 41 percent, respectively.

Health and wellness was a focus of real estate professionals prior to COVID-19, and many interviewees referenced technology initiatives that they already were working on. The pandemic has only strengthened ongoing initiatives and expanded new ones.

One initiative noted by multiple companies is the need for transparency and communication on health and ESG-related metrics. Data about air and water quality are now shared with their

tenants through an app or on lobby displays. This is accomplished through sensors that can, for example, measure average carbon dioxide in the air. An interviewee said that the urgency for these types of solutions in their buildings has increased, noting, "Not only are we using indoor tracking solutions to provide high air quality in the buildings, we are being transparent about that by showing it on a display. You need to have all those sensors for tracking and reporting. Therefore, the urgency and need for the proptech solutions in our building have increased."

Directly addressing the requirements to safely return to work, one company encourages employees to take a Centers for Disease Control and Prevention (CDC) questionnaire on a mobile app that they developed. Furthermore, a company described features that they are being asked more frequently to install in current projects, such as ionizing ultraviolet filters to process air in spaces where air recirculation is more common—common areas and elevator cabs. One noted that individual multifamily units are not of the same concern because more typically 100 percent outside air is being pumped into them.

Looking forward, slightly more companies are planning to adopt health and/or wellness technologies in the next three years than have adopted recently.

Just over one-half of companies with plans will focus on technologies new to their business, while the balance will expand/improve their recently adopted technologies.

Climate risk and mitigation technologies. About three-quarters of companies indicate an overall positive impact of these technologies on operations and services, as well as on finances, with over one-half of these ratings specifically indicating a high impact. About 54 percent of companies indicated that these technologies had an overall positive impact on decision-making; still, about 30 percent specifically reported a high impact on decision-making. As would be expected as companies explore evolving technologies, a particularly strong segment of companies indicate that there has been little to no impact on these business functions or it is too soon to tell—25 percent, 27 percent, and 46 percent, respectively.

One company is using climate risk data to guide investments and mitigate risk by analyzing data at the micro location level for flooding, wildfires, hurricanes, and other climate events "to get a better grasp of how the climate is changing and what risk does that impose on certain buildings." Their goal is to identify the risk during the investment due diligence that an asset may become "stranded" and therefore worthless at some later point. The data can also be used to determine what sorts of protective

measures may be needed for an asset to be viable, such as elevation, dry floodproofing, or deployable flood barriers. This company spoke to the importance of incorporating climate risk into its investment process, saying, "This is a self-reinforcing mechanism that will create even more advantages for the folks that use technology versus the folks that don't use technology." These sorts of physical risk assessments are increasingly standard among real estate investors and owners and are anticipated to be incorporated into future disclosure requirements.

Another interviewee is currently in the middle of a carbon accounting and renewable resources initiative, whereby their portfolio management software identifies electrical demand and matches it with real-time renewable resource supply, while creating a blockchain between the two bookends. The interviewee said, "There is going to be a point in time where a regulator is going to knock on your door and say prove that you bought this renewable energy and used it at a certain date and time at a certain building. The blockchain provides that immutable ledger to prove this, and then tee it up for carbon trading."

Other companies have committed to overarching goals of reducing greenhouse gas emissions by a target date across their entire property management portfolio. To

> " There is going to be a point in time where a regulator is going to knock on your door and say prove that you bought this renewable energy and used it at a certain date and time at a certain building. The blockchain provides that immutable ledger to prove this, and then tee it up for carbon trading."

accomplish this, they have adopted proptech solutions surrounding energy usage monitoring and run recommendations to reduce energy use. Specifically, they say that their building operating app has "the ability to control temperature and lighting in the workplace and understand the best set point averages, to ensure that it's [an] optimal comfort level but also it's energy efficient."

Looking ahead, slightly more companies are planning to adopt climate impact forecasting/mitigation technologies in the next three years than have recently adopted these technologies. Over one-half of companies with plans will focus on technologies new to their business, while the balance will expand/improve their recently adopted technologies.

Conclusion

The broad range of available proptech applications across business areas is significantly changing expectations about the way the real estate industry does business, and is resulting in strong, positive business outcomes. Meaningfully, proptech is also providing tools to address housing and climate challenges.

The most proactive companies are seeking out and adopting the most recent proptech innovations and leading the industry in change, a continual process for all companies as the number and nature of property technologies continue to evolve. Since the pace of recent proptech adoption is expected to continue over the next several years, one interviewee's observation succinctly sums up these rapidly accelerating industry trends: "All the technologies around automation, understanding workplace analytics and occupancy, making smart portfolio decisions, designing the new space differently, ensuring that the space maintains occupancy standards—all of that requires technology and data, and these trends are accelerating. It's a phenomenal time just from an application of a technology standpoint to enable these critical business outcomes."

Appendix

Exhibit A1: Respondent Company Profile—Real Estate Industry Roles

Legend:
- Developer
- Architect or engineer
- Private owner
- Investment manager/adviser
- Private equity investor
- Other (real estate services)
- Institutional equity investor
- Property management
- REIT or other public owner
- Construction/construction services
- Lender

Business area	Developer	Architect or engineer	Private owner	Investment manager/adviser	Private equity investor	Other (real estate services)	Institutional equity investor	Property management	REIT or other public owner	Construction/construction services	Lender
Leasing/tenant transactions and relations	52%		12%	12%	4%	4%	6%	9%	1%		
Construction	52%	19%	6%	5%	5%	3%	3%	3%	3%	3%	
Project management	51%	15%	4%	9%	7%	5%	2%	5%	2%	1%	
Property management	51%		13%	9%	9%	3%	4%	10%	1%		
Raising capital	38%	3%	10%	13%	18%	10%	10%				
Portfolio management	35%		17%	19%	13%	3%	6%	4%	1%		1%
Transaction management	35%		17%	25%	8%	10%	6%				
Data analytics	30%	4%	7%	24%	9%	15%	2%	4%	4%		
Climate risk and mitigation	25%	36%		18%	7%	7%	7%				
Space and use design	21%	52%	1%	8%	1%	7%	1%	4%	3%	1%	
Health and/or wellness	20%	35%	8%	13%	5%	8%	5%	5%	3%		

Percentage of companies in each business area that have recently adopted new technology

Note: *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Source: ULI 2020 Proptech Survey.

Exhibit A2: Respondent Company Profile—Property Type Specialization

Legend:
- Office
- Multifamily/rental (including student, senior, and single-family rental)
- Mixed use
- Retail
- Industrial, logistics
- Life sciences
- All property types
- Medical office
- Single-family/owner-occupied
- Hotels
- Other

Business area	Office	Multifamily/rental	Mixed use	Retail	Industrial, logistics	Life sciences	All property types	Medical office	Single-family/owner-occupied	Hotels	Other
Leasing/tenant transactions and relations	21%	18%	18%	14%	7%	5%	4%	4%	4%	3%	2%
Property management	20%	17%	17%	15%	8%	4%	4%	3%	3%	4%	2%
Portfolio management	19%	18%	15%	12%	8%	5%	5%	4%	5%	6%	3%
Transaction management	19%	16%	17%	11%	10%	5%	7%	3%	4%	6%	3%
Raising capital	19%	17%	18%	12%	6%	5%	4%	3%	3%	9%	3%
Data analytics	17%	19%	15%	10%	8%	5%	9%	3%	7%	6%	2%
Project management	17%	18%	19%	12%	6%	4%	3%	3%	6%	8%	2%
Health and/or wellness	17%	15%	15%	11%	5%	9%	6%	8%	2%	9%	4%
Climate risk and mitigation	16%	16%	15%	11%	6%	8%	8%	6%	1%	8%	5%
Construction	16%	16%	17%	14%	6%	4%	4%	4%	6%	10%	2%
Space and use design	16%	16%	18%	11%	3%	6%	5%	5%	5%	11%	4%
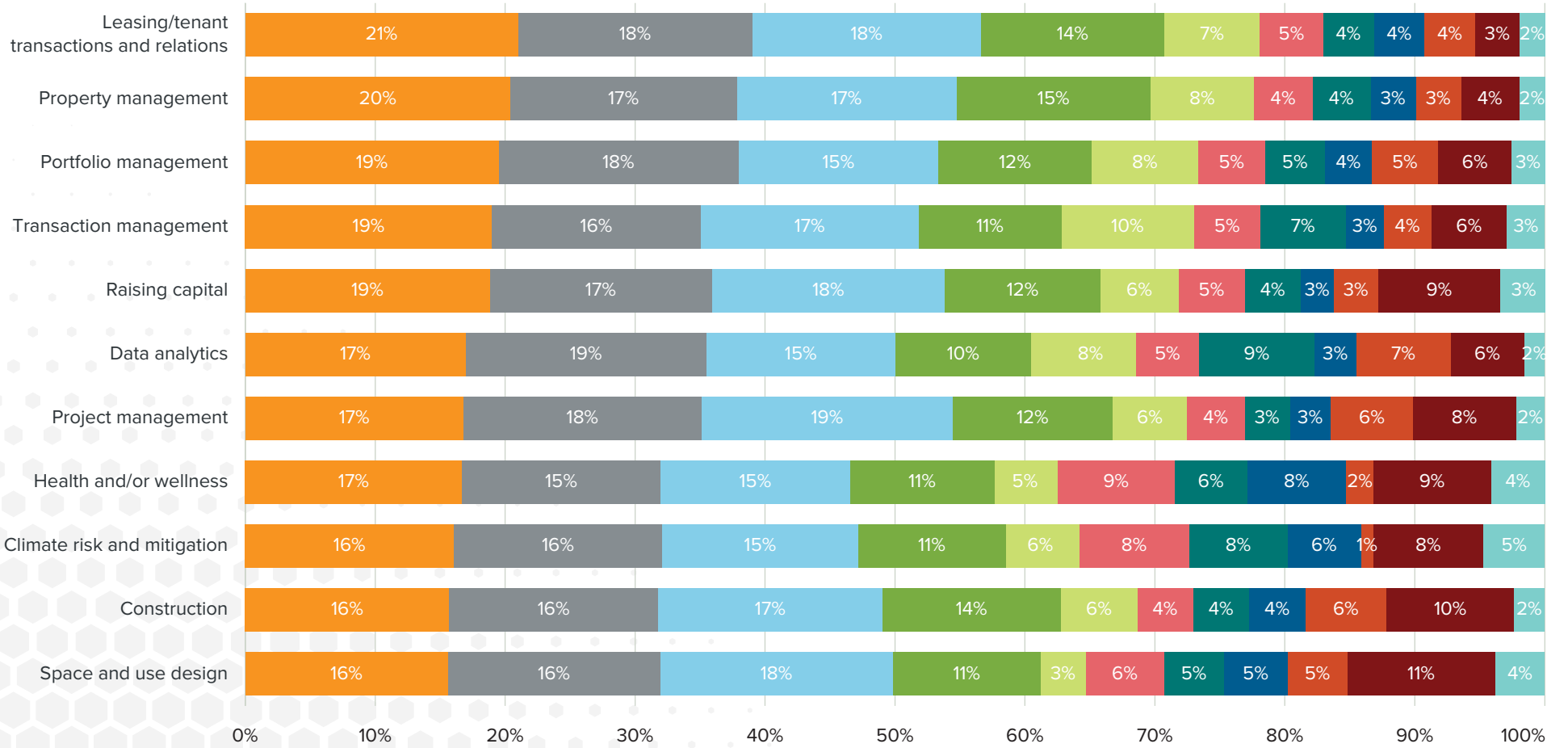
Percentage of companies in each business area that have recently adopted new technology

Note: *Recently* refers to about the past three years; *new technology* refers to technology that is new to the respondent company.
Source: ULI 2020 Proptech Survey.

Interviewees

Aviation Facilities Company Inc. (AFCO)
Steve Forrer

BrightStreet Ventures; Datex Property Solutions
Mark Sigal

Brookfield Asset Management
Annie Laurie McCulloh

CBRE
Sandeep Davé

Hines
Paige Pitcher

Hines
Charles Kuntz

Host Hotels & Resorts
Michael Chang

James G. Davis Construction
Daniel Ressler

Kempen Capital Management
Egbert Nijmeijer

Leo A Daly
Ryan Martin

Lincoln Property Company
Khushbu Sikaria

Linden Associates Inc.
Christopher Kurz

Navitas Capital
Michael Spies

Nuveen
Jacinda Lofland

Rudin Management Company
John Gilbert

SIGNA
David Nadge

Silverstein Properties
Brian Collins

TCA Architects Inc.
Teresa Ruiz