Spotlight on Artificial Intelligence

2024 STATE OF DESIGN & MAKE

ARKANCE

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Introduction

Through the lens of the general public, artificial intelligence (AI) went mainstream when AI research company OpenAI released ChatGPT in late 2022. When generative pre-trained transformer (GPT) models were incorporated into ChatGPT, AI was instantly thrust into the global spotlight.

In 2023, the developments multiplied: Anthropic's generative AI, Claude, increased its text processing capabilities by 1,011% in the span of two months[1]; ChatGPT passed the bar exam[2]; Google introduced generative AI for internet searches[3]; Spotify debuted a personalized AI-driven DJ, and MidJourney brought generative AI images to the masses.

Away from the gloss of pop culture, however, AI development for applications that connect digital design and delivery of projects, or design and make, has been progressing for over a decade, a constant evolution of technology that began with training neural networks to recognize imagery.

"This was the start of the third wave," says Mike Haley, SVP of research at Autodesk.

"And it's what cemented AI as something that will be in our lives forever."

Business leaders and experts agree with Haley's assessment—66% of respondents to Autodesk's *2024 State of Design & Make* survey say AI will be essential for their businesses in the next two to three years.

The response to Autodesk's AI-powered tools also speaks to the speed of adoption of this new technology across the architecture, engineering, design and operations (AECO), design and manufacturing (D&M), and media and entertainment (M&E) industries. For Autodesk's cross-industry generative design- and AI-enabled products, user engagement increased by 24% from January 2023 to November 2023 (though this does not take overall subscriber growth into account). APAC led the way with a 55% increase in user engagement. And the beta version of a Maya automation tool that helps artists manage their scene data saw a 60% increase in the number of users, interested in the beta version compared to the average number of beta launch users, over the course of just a few months—a spike that is unprecedented in the history of the company's beta launches.

"I haven't seen a speed of access and adoption before like this," said May Winfield, global director of commercial legal languages at Buro Happold. "I remember the days moving from fax to email and everyone was kicking and screaming about it, whereas with AI, everyone just uses it."

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Spending solidifies AI as a strategic priority

With AI now firmly established as a strategic priority, businesses are racing to tap its potential— and they're investing heavily to avoid being left behind. In the past three years alone, 72% of *2024 State of Design & Make* **survey respondents say their organizations have increased spending on AI and emerging technology, with 27% qualifying their investments as having "strongly increased."**

Looking ahead, spending is only expected to rise—77% say they will continue to add to their AI and emerging tech investments over the next three years, with 32% strongly increasing their investments.

Such a large increase over such a short time could seem like a risk for organizations concerned about investing so heavily in emerging technology. But according to Stefan List, head of cabin market insights at Airbus, these AI dollars will pay dividends when it comes to competitive advantage.

"I think short-term significant but targeted investments are not really a risk. It's a need to be prepared," he says. "It's important to understand the full potential of AI for the business you're in. That's why, short term of course, we must experiment. What can we do better with the potential of AI and then develop the AI in a way that it really fits your purpose? Because at the end of the day, I think it doesn't matter what industry you're in, you have to ask yourself the question: How can AI help me stay competitive?"

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Organizations are betting big on AI

Investment in AI and emerging technology will continue to increase

● Strongly decrease   ● Somewhat decrease   ● Stay roughly the same   ● Somewhat increase   ● Strongly increase

Past 3 years   **Next 3 years**

27%   32%

45%   45%

23%   20%

4%   2%
                                    1%
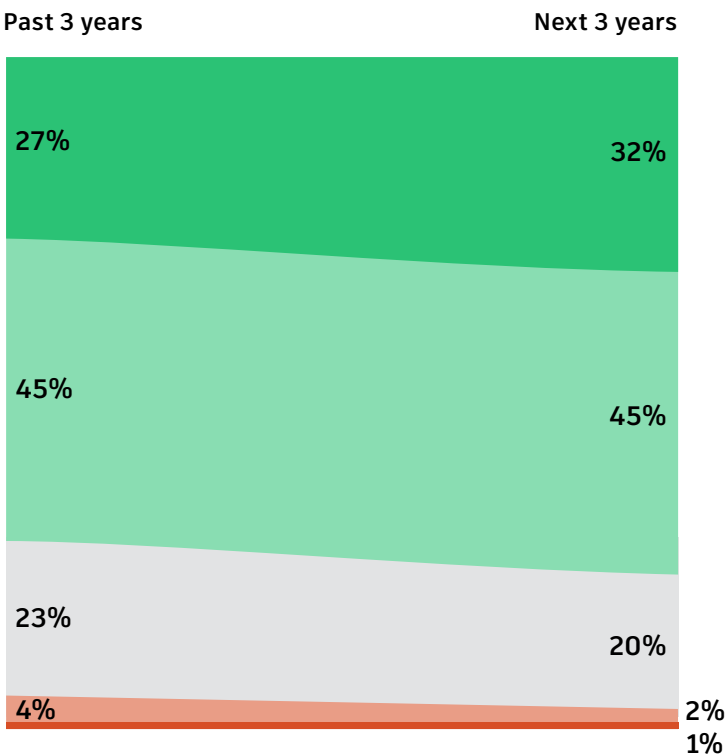
32% of AECO organizations will strongly increase investment in AI and emerging technologies over the next three years.

D&M tops planned investment by industry over the next three years

76%
planned increase in **AECO**

79%
planned increase in **D&M**

75%
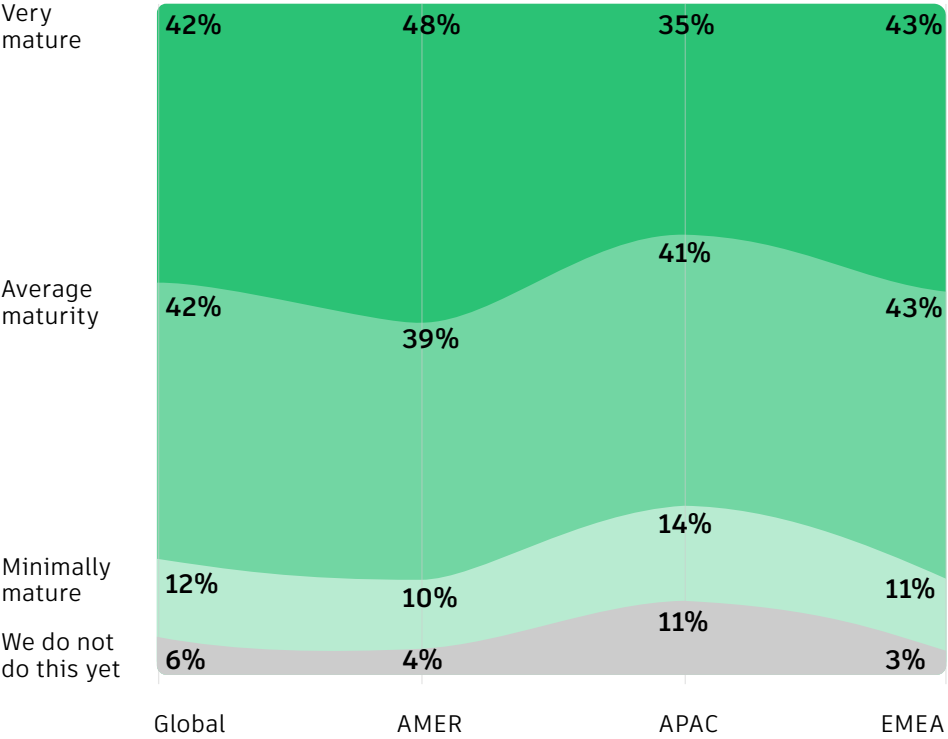planned increase in **M&E**

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The perception and knowledge gap

With a very short timeline between the start of the third wave of AI and today, we're still much closer to the starting point of the race than the finish line.

This is where market perception about AI's maturity appears skewed. Despite the newness of AI to many and its limited usage outside of the tech sector, survey findings suggest that companies believe they're more mature in their AI usage and progress to goals than seems realistic.

For instance, when asked about the maturity of their organization's use of design or operations automation, including the use of AI, nearly 42% of respondents from the AECO industry claim to be very mature, with an additional 41% saying they are at average maturity. On average, self-reported maturity levels are higher in the Americas (AMER) as well as Europe, the Middle East, and Africa (EMEA). They are lower in Asia Pacific (APAC).

Perception of digital maturity in AECO is high

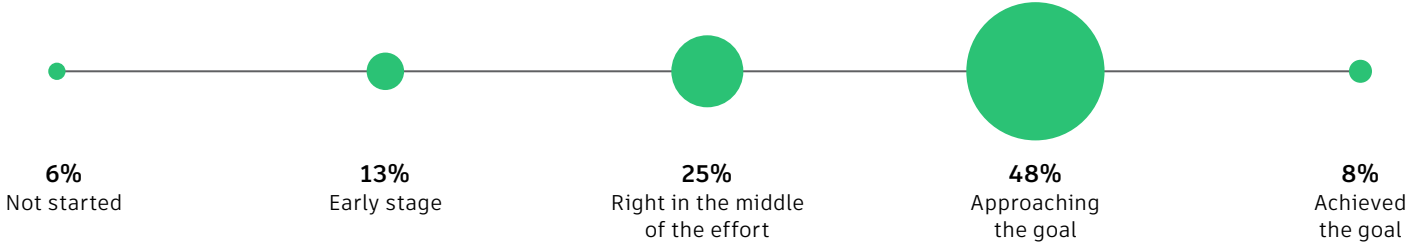|	Global	AMER	APAC	EMEA
Very mature	42%	48%	35%	43%
Average maturity	42%	39%	41%	43%
Minimally mature	12%	10%	14%	11%
We do not do this yet	6%	4%	11%	3%

AECO organizations were asked: "In your company or organization, how mature are the following? Design or operations automation, including use of artificial intelligence"

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Perhaps even more interesting is the belief among many that they're approaching their AI implementation goals. While 48% say they are approaching their AI implementation goals, an additional 8% say they have already achieved their goals. And while many organizational goals for AI may be modest at the moment, there is a gap between how close companies think they are to their goals and how quickly the tech is evolving.

The AI finish line is within sight for many

Most organizations are approaching or have achieved current AI goals

6%	13%	25%	48%	8%
Not started	Early stage	Right in the middle of the effort	Approaching the goal	Achieved the goal

Survey question: Many companies in your industry are in the process of digital transformation, which is the digital conversion of data and processes. Broadly speaking, where is your company or organization in the digital transformation journey?

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78%
believe AI will enhance **their industry**

79%
believe AI will enhance **their creativity**

Survey sentiment notwithstanding, business and tech industry leaders are very aligned in the belief that the real benefit of AI has yet to come.
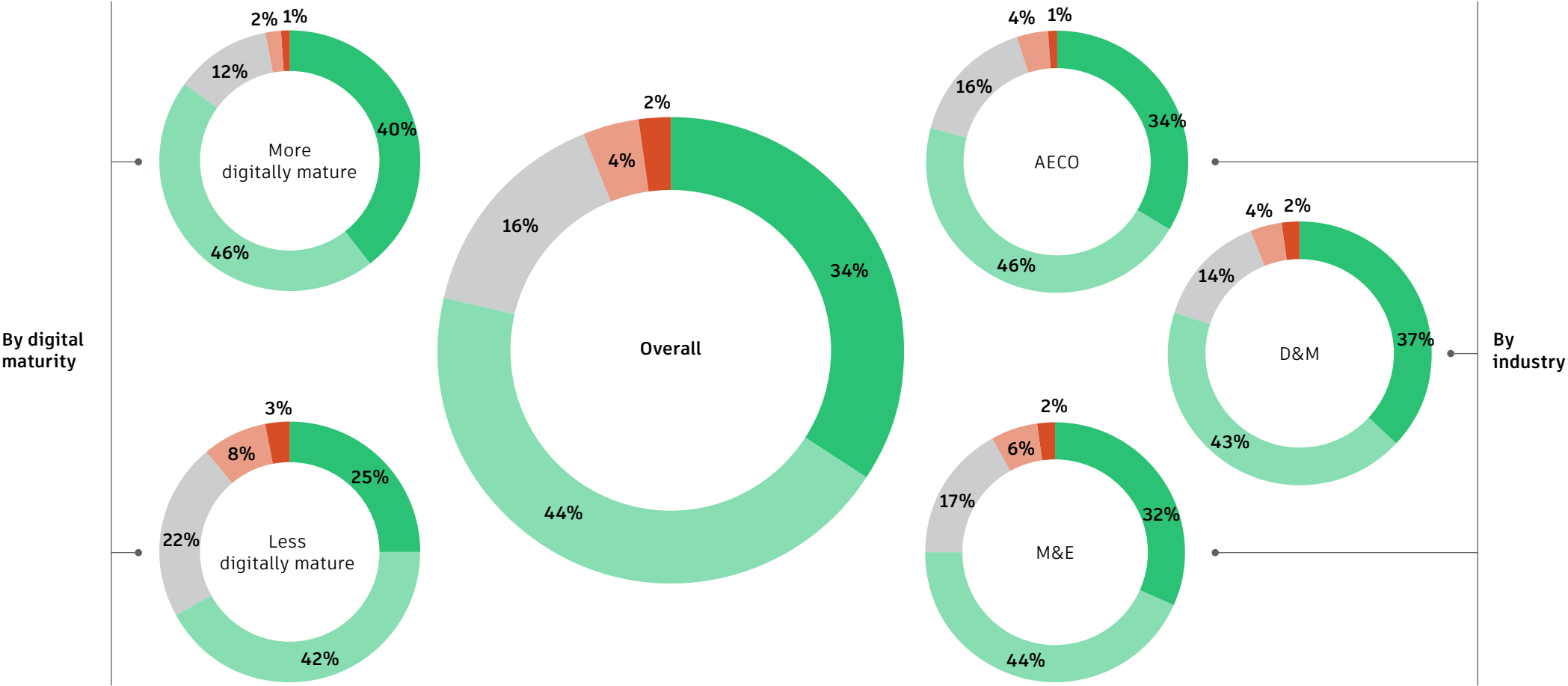
"I believe that we're on the precipice of an explosive expansion in human capabilities that these technologies are going to bring to individuals in a very democratized way—capabilities and powers that seem unimaginable," says Greg Corrado, cofounder of the Google Brain—a deep learning artificial intelligence research team—and current leader of Google's Health Research and Innovations Division.

Survey respondents agree, as an overwhelming 78% believe that AI will enhance their industry, while 79% believe it will enhance creativity.

Somewhat surprisingly, given future investment forecasts, 16% of respondents are ambivalent and 6% disagree about AI's potential to enhance their industry. In media and entertainment (M&E), negative sentiment is highest, despite 76% of these same respondents saying that AI investment will increase going forward. Less surprisingly, uncertainty about the benefits of AI is higher at companies that consider themselves less digitally mature.

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AI is seen as game-changer across industries

● Strongly disagree ● Somewhat disagree ● Neither agree nor disagree ● Somewhat agree ● Strongly agree

By digital maturity

By industry

More digitally mature: 1% / 2% / 12% / 46% / 40%

Less digitally mature: 3% / 8% / 22% / 42% / 25%

Overall: 2% / 4% / 16% / 44% / 34%

AECO: 1% / 4% / 16% / 46% / 34%

D&M: 2% / 4% / 14% / 43% / 37%

M&E: 2% / 6% / 17% / 44% / 32%

24% of all respondents strongly agree with the statement "AI will enhance my industry."

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In terms of use cases, respondents believe AI's biggest benefit will be in improving productivity, while producing informed design decisions, helping with billing analysis, improving workplace safety and risk analysis, and automating mundane tasks are all being embraced by just under 40% of respondents.

"This generative AI technology will absolutely increase all of our productivity," says Michelle Lee, former head of Amazon Web Services Machine Learning Lab. "It will be an accelerant and an augmenter of all of our capabilities."

Business leaders looking to take advantage of the full potential of AI need to look past productivity and focus on the power of AI to produce meaningful insights and efficiencies across their organizations.

"I believe the first step is to increase productivity in our team," says Lorena Oliveira, director of quality and innovation at TPF Engenharia, an engineering consulting firm. "But I think that artificial intelligence could also help us in a few other areas. The first is expanding our ability to interact with big data. Another direction is using AI to develop digital products. The third is about using the large language model to pass on knowledge and experience to new employees."

Beyond productivity, AI use cases vary

Percentage of companies that use AI:

| 30%–34% | 35%–39% | 40%–44% | 45%–49% | 50%–55% |
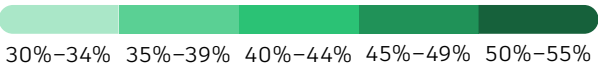
	AI is ubiquitous and will be adopted in all areas	Automating mundane, repeatable tasks	Billing analysis	Identifying product/asset performance gaps	Increasing productivity	Producing informed design options	Supplementing a skills gap	Workplace safety and risk analysis
Industry-wide/overall	32%	39%	34%	35%	47%	36%	35%	36%
Architecture, engineering, construction, and operations	30%	39%	34%	34%	44%	36%	34%	36%
Design and manufacturing	35%	40%	35%	37%	50%	35%	37%	37%
Media and entertainment	32%	37%	33%	33%	46%	36%	34%	34%

Survey question: What are the use cases for artificial intelligence (AI) in your company or organization? Select all that apply.

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CHAPTER 2

The survey data highlights a use case knowledge gap regarding the significant benefits of generative AI outside of productivity, especially when we consider the growing capabilities of deep neural networks—capabilities that greatly outpace those of humans.

"I think generative AI has a few implications on enterprises," says Arjun Prakash, CEO & co-founder of Distyl AI, an analytics firm that helps large companies use generative AI. "Number one is your ability to create insights. All of a sudden, we have increased the number of people at an enterprise who can communicate with an AI model. Many people can ask questions and get answers. Historically, you had to always go through the data scientists or the machine learning engineers. That is still a very important role, but now we have democratized this in many ways.

"Number two is faster time to value Historically, if I wanted to deploy an AI application, I had to build a model from scratch, which is pretty expensive. Now I can start with something out of the box that gives me the ability to get a working prototype in days, not months. That's an incredibly fast time to value."

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How we got here and the evolution of generative AI

While ChatGPT has elevated AI awareness well beyond technologists and computer vision researchers, the true application of AI and machine learning (ML) in how things are designed and made is very much rooted in some radical thinking by humans.

In traditional 3D parametric design software, designers use simulations to validate the final stage of projects to ensure feasibility. Getting to that stage is heavily reliant on the designer's experience, knowledge, and training in the field specific to the project. With all of that expertise baked into a design, simulations then provide the final check before a project is cleared to be built.

"If you go to a bridge designer, for example," says Autodesk's Haley, "they have a wealth of knowledge about bridges through training, experience, and learnings from others. But there's a good chance they haven't thought of every possible way to make a bridge. So, what if software could help explore that?"

This is the question that sparked the dawn of generative design, a process that inverts the relationship between design and simulation so that the process starts with the simulation.

"It sounds a little strange," says Haley, "but in thinking this way, you start by making the software think of any and all possible ways of designing. It starts with a bunch of truly off-the-wall and wild design simulations. Some will obviously not be feasible, but the ones that are feasible are the ones that you move along in the process."

From a practical application perspective, Stefan List of Airbus agrees, noting that while AI can play an important role in helping engineers build all available data into an algorithm, it will always need the validation competence of a skilled and trained engineer.

"We still need a data consistency and quality check," he says. "For manufacturing, [AI] can play an important role, but the most important thing when we manufacture our airplanes is repeatable results in order to constantly meet our safety standards. When we manufacture an airplane, we have to make sure we get 100% of the same quality results over time because we don't want to have the aircraft be a flying AI-trial."

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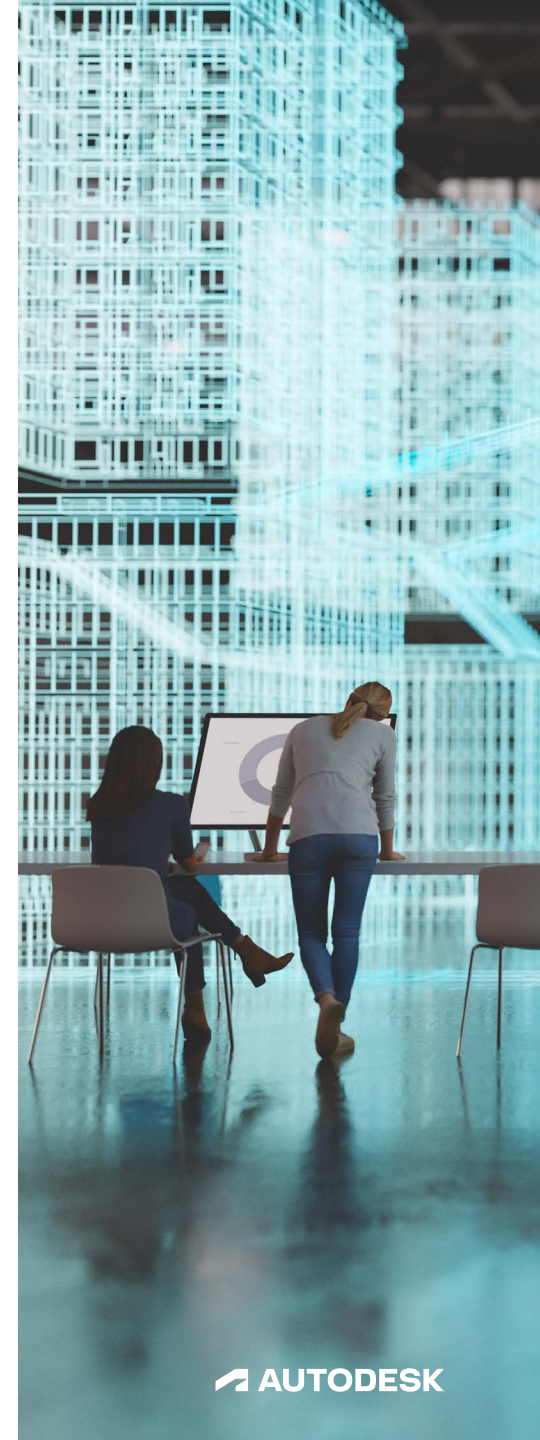
CHAPTER 3

While generative design is unmatched in delivering optimal designs, its dependence on exact specifications and tremendous computing power makes it somewhat cumbersome and impractical for widespread use. That's where AI comes in.

Generative AI, or AI that uses pre-trained deep neural networks to produce novel outputs, becomes an accelerant to the future of design and make. Generative AI could also eventually marry the incredible computing power of deep neural networks with the experience and precision that comes from designers and builders.

"Generative AI is the next big [technological] wave," says Tim O'Reilly, futurist and founder of O'Reilly Media.

"For the first time, we're really starting to have computers that have gotten smart enough that they're coming all the way toward us where we can actually speak with them in our language and they can understand it. So that's a profound shift."

"Controlling HVAC is a good example of where AI has been impactful. Beca's AI-based solution, B-Tune, has created savings from 20-30% of running costs."

—Tim Mumford, GM digital and innovation transport and infrastructure, Beca

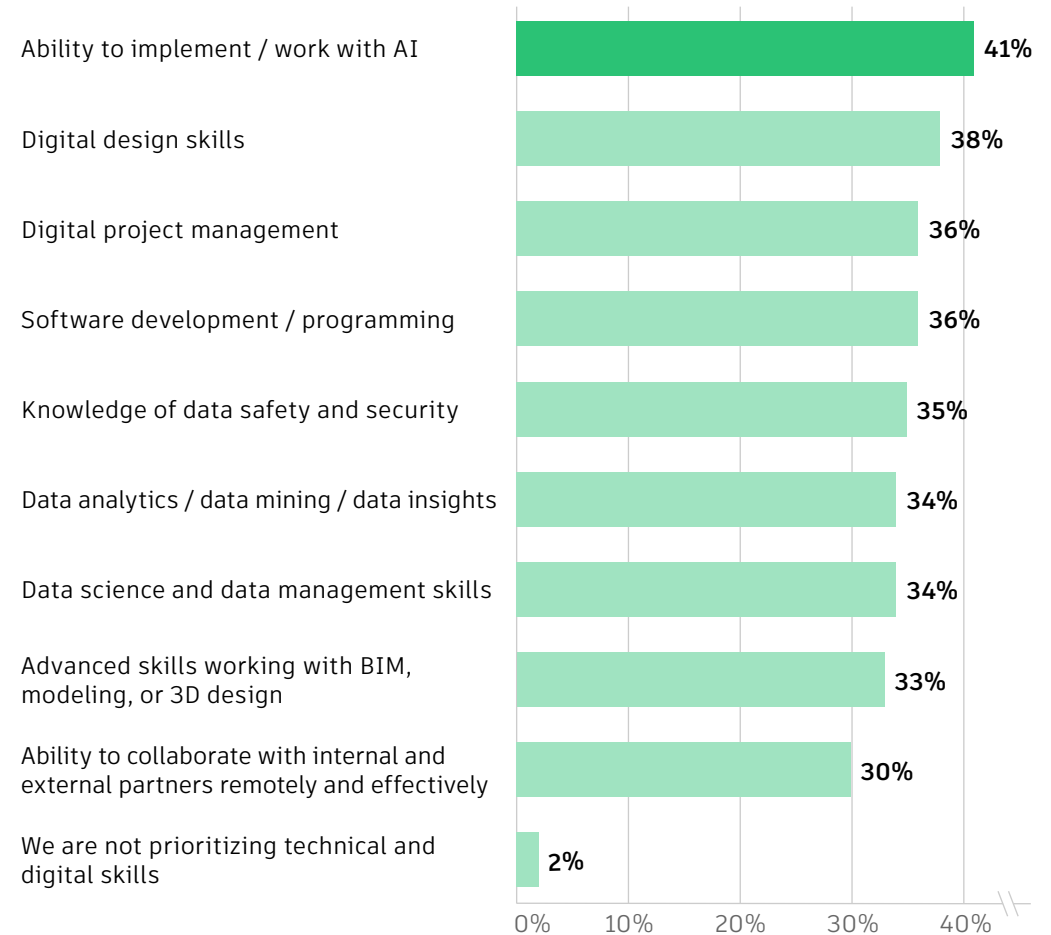AUTODESK

Getting and staying ahead of the AI curve

Looking at just the last year or two alone, it's easy to see how fast the field of AI is moving, and this rapid pace of change is something that organizations need to be mindful of and staff up for. In fact, leaders we spoke with say companies should be investing in people whose sole job is to stay ahead of the AI evolution.

Former head of Amazon Web Services Machine Learning Lab Michelle Lee notes that "when you combine a generalist with proprietary knowledge and information within a company, I think that's where you'll start unlocking of the power of AI."

Survey respondents agree on the importance of AI as a workplace skill going forward, with "the ability to implement/work with AI" ranking highest among the technical skills they say their companies will be prioritizing for hiring decisions over the next three years.

Companies are prioritizing technical skills for hiring

AI tops the list of desired skills

Skill	Percentage
Ability to implement / work with AI	41%
Digital design skills	38%
Digital project management	36%
Software development / programming	36%
Knowledge of data safety and security	35%
Data analytics / data mining / data insights	34%
Data science and data management skills	34%
Advanced skills working with BIM, modeling, or 3D design	33%
Ability to collaborate with internal and external partners remotely and effectively	30%
We are not prioritizing technical and digital skills	2%

0% 10% 20% 30% 40%

—
Survey question: What technical or digital skills do you believe your company or organization will be prioritizing when hiring over the next 3 years?

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Having ample people focused on AI and its evolution is also critical in identifying how AI can be most useful at an organizational level. Given the belief that we're barely at the beginning of the third AI wave, the world has quite a road ahead before it truly realizes the efficiencies that AI promises to deliver.

"If you look now at AI, for me it's a parallel to what we have seen in auto manufacturing with robots," says Stefan List from Airbus. "AI can complement areas where we will face a lag of resources, but it could also help in a more efficient and sustainable way to increase the output. Here I think is where we have a good match."

As well as increasing efficiency, AI can also help organizations attract new talent, a top challenge for 29% of our survey respondents facing double pressure from a still-tight labor market and a rapidly retiring knowledge base.

In addition to having the in-house skills to navigate the future of AI, leaders say the best way to prepare and leverage AI is to be digital and have your internal data well organized. Because with AI, the key to success lies in your data.

"As a starting point, I would say with all the systems, data is king," says Martha Tsigkari, head of Applied R+D at Foster + Partners. "And that means that first and foremost you need to have your own house in order in terms of understanding your data: Is it properly collected? Is it properly tagged? Is it properly organized? I can bet you that for most organizations out there, the answer to those questions would be no, it's not."

Autodesk's Mike Haley agrees. "If you want to be prepared and productive, spend some time collecting all of your company's data, input the data into a single cloud system and organize it. If you can do that, you'll be miles ahead of most of your competitors."

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Opportunity overcomes skepticism

As is common whenever a new technology begins to reshape the status quo, the growing buzz around the future applications of AI has sparked both enthusiasm and skepticism.
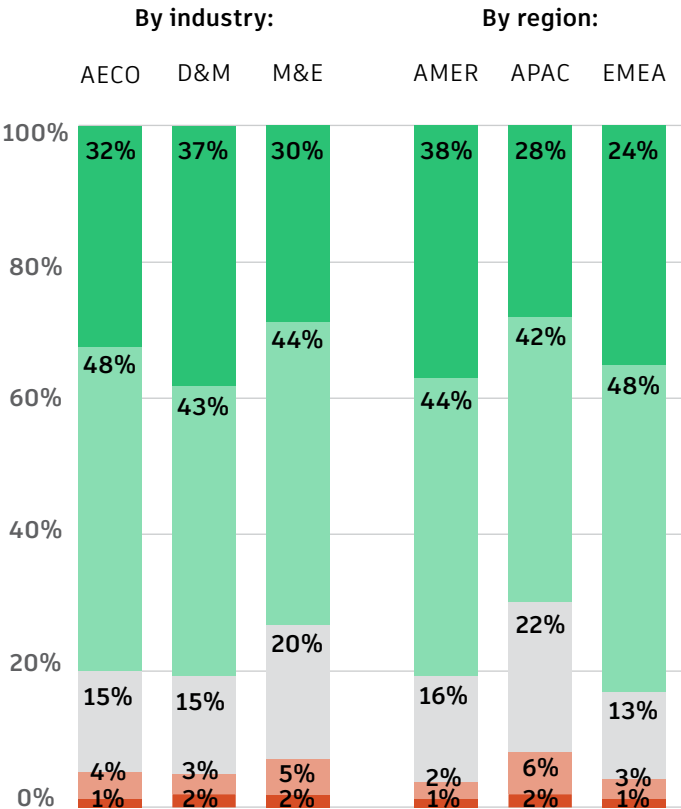
Seventy-six percent of the respondents from Autodesk's *2024 State of Design & Make* survey say they trust the use of AI in their industries. While this number may seem high given the relative newness of the technology, experts suggest that trust isn't necessarily misplaced.

"AI sits at a juncture that we've never come to before," says Autodesk's Haley. "Asking if I trust it is like asking me if I trust my lawnmower. Think of AI as a functional device. It's more a matter of trust in the partner or vendor providing the AI to act responsibly in terms of using data and in training and testing AI systems appropriately."

Through that lens, survey respondents are even more optimistic, with 78% saying they trust that their organizations will make the "right decisions" about AI. In fact, only 5% say they somewhat or strongly disagree that their organizations will make the right decisions about AI. Across regions, uncertainty about company use of AI is highest in Asia Pacific (APAC).

Confidence in companies to make the "right" AI decisions is high

● Strongly disagree   ● Somewhat disagree   ● Neither agree nor disagree   ● Somewhat agree   ● Strongly agree

By industry: | **By region:**

	AECO	D&M	M&E		AMER	APAC	EMEA
Strongly agree	32%	37%	30%		38%	28%	24%
Somewhat agree	48%	43%	44%		44%	42%	48%
Neither agree nor disagree	15%	15%	20%		16%	22%	13%
Somewhat disagree	4%	3%	5%		2%	6%	3%
Strongly disagree	1%	2%	2%		1%	2%	1%

32% of AECO respondents agree with the statement "I am confident my company will make the right decisions regarding AI." Values do not add up to 100% due to rounding.

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This enthusiasm doesn't come without concerns, however—some leaders suggest this trust will be tested as AI becomes a tool for innovators of a different type.

"We've not yet had cases where AI has done something really bad," notes Severin Tenim of ALEC, a construction and contracting firm. "Once more people start using AI for cybercrime or other malicious acts, I think that trust level will come down."
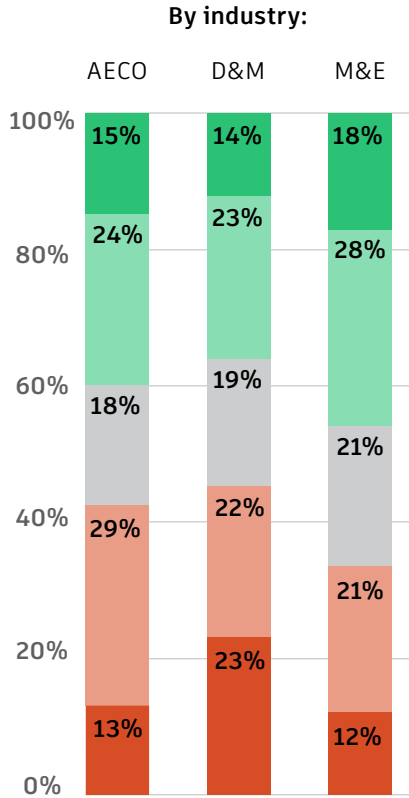
Tim Mumford, GM digital and innovation transport and infrastructure at Beca, an engineering consulting firm, believes everyone bears responsibility in ensuring AI remains a trusted technology. "Individuals who are creating AI technology must develop it in line with society's best interests. Users must use it in line with intended use cases. Organizations using it must procure it as an intelligent owner. Governments, who are both buyers and ideal regulators of the technology, must adopt an intelligent

leadership role in its adoption. I think we owe it to the communities in which we live and work to make sure that AI-based solutions meet society's needs and are mindful of their best interests. While it can be challenging, it's critical to think more holistically about the implications of what we do with this technology every day."

Surprisingly, given the high trust and confidence numbers, 40% of our survey respondents believe AI will destabilize their industry. The destabilization sentiment is lowest in D&M (36%) and highest in M&E (46%). Across industries, ambiguity about possible destabilization is also highest in M&E. In fact, the entertainment industry is already seeing the effects of AI disruption—along with the challenge of managing IP rights and assets, the SAG-AFTRA strikes that recently brought the movie and television industry in the United States to a halt were partially in response to AI being used for script and screenplay writing.

AI seen by some as an industry destabilizer

● Strongly disagree ● Somewhat disagree ● Neither agree nor disagree ● Somewhat agree ● Strongly agree

By industry:

	AECO	D&M	M&E
Strongly agree	15%	14%	18%
Somewhat agree	24%	23%	28%
Neither agree nor disagree	18%	19%	21%
Somewhat disagree	29%	22%	21%
Strongly disagree	13%	23%	12%

15% of AECO respondents strongly agree with the statement "AI will destabilize my industry." Values do not add up to 100% due to rounding.

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Conclusion

Despite certain misgivings, advances in generative design and AI over the past decade have helped win over people who have long been uncertain about whether AI would ever evolve to foster creativity and enhance how projects are built.

"I've been a skeptic about artificial intelligence for 50 years," says Ken Goldberg, chair of AI and Robotics at UC Berkeley. "I always said AI would never be creative, that it's never going to really create anything new or interesting. I no longer believe that is the case. I believe it can do that. We now have something that is a form of artificial creativity for the first time, and I'm very excited about that because it means that it opens up all these possibilities."

Stefan List from Airbus agrees that AI can be a valuable tool, but emphasizes that the human element will always be essential for creativity. "Creativity is a very specific human being thing. I think here, AI can be a feeder tool to inspire the way we discuss, the way we think, what we take into account in a much faster way than we do, or we can do today."

The experts we spoke with share Goldberg's and List's optimism, as they imagine a world beyond the next wave of AI, and the possibilities that could hold for the future of design and make.

"What most excites me about the future of artificial intelligence is its inextricable link with the human story," says Dr. Erezi

Utiome, digital engineering practice lead at SMEC. "As with other technological advancement, significant breakthroughs in the evolution of AI will be built on the "shoulders" of other foundational and enabling technologies. From this standpoint, my enthusiasm stems not from AI as an end in itself, but from the possibilities it holds for the future; a future that remains relatively obscure. In this regard, I am confident that how we interact with AI today provides the building blocks for a future that hopefully will be enjoyed and improved upon by the next generation."

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Sources

1. Anthropic; <u>Introducing 100K Context Windows</u> (by November 2023, Claude was processing <u>200K per minute</u>).
2. Open AI; <u>GPT-4 Technical Report</u>
3. CNET; <u>Google Launches New AI Search Engine</u>

About the *State of Design & Make: Spotlight on Artificial Intelligence* report

Data for the *State of Design & Make: Spotlight on Artificial Intelligence* report was compiled from the Autodesk *2024 State of Design & Make* survey data. For the 2024 report, Autodesk surveyed 5,368 industry leaders, futurists, and experts in the architecture, engineering, construction, and operations; design and manufacturing; and media and entertainment industries from countries around the globe. This report contains key findings from this research, including details at the sector and regional level.

The quantitative data (n= 5,368) was collected between July and September 2023, through a 20-minute online survey. Autodesk partnered with Qualtrics for the collection of this data. In addition, seven qualitative interviews with business leaders and futurists were conducted in October and November 2023. In some instances, aggregated and anonymized Autodesk customer data has been analyzed to identify trends.

In addition to survey data and qualitative interviews, the Spotlight on AI report contains quotes from an AI-focused event: The Great Progression Series, hosted by Reinvent Futures, of which Autodesk was a sponsor. Individuals quoted from the event include Greg Corrado, Michelle Lee, Arjun Prakash, Tim O'Reilly, and Ken Goldberg.

Autodesk is changing how the world is designed and made. Its technology spans architecture, engineering, construction, product design, manufacturing, and media and entertainment, empowering innovators everywhere to solve challenges big and small. From greener buildings to smarter products to more mesmerizing blockbusters, Autodesk software helps customers design and make a better world for all.

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