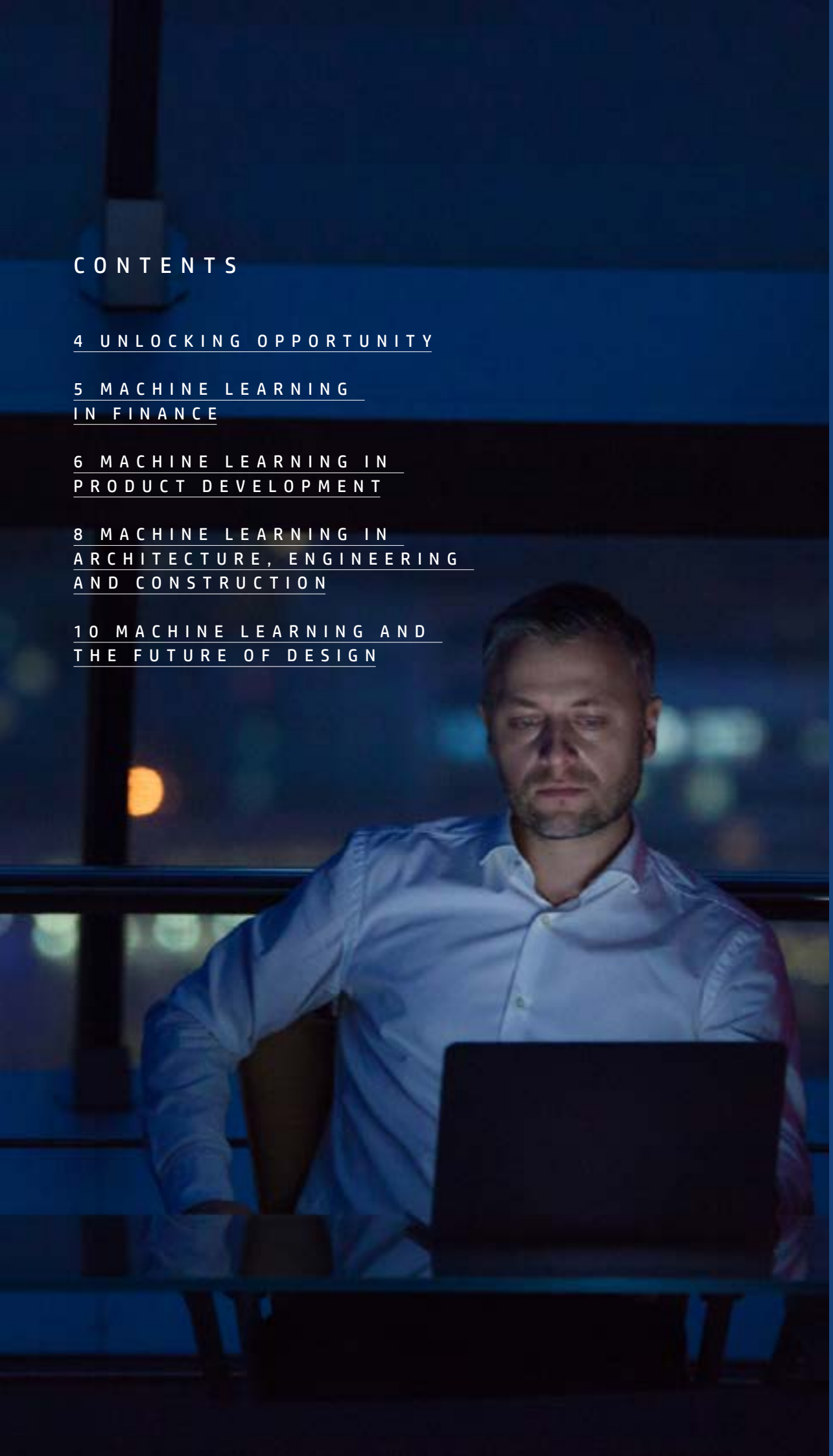
THE EVOLUTION OF WORK: HOW AI IS OPTIMIZING EMPLOYEE PERFORMANCE



CONTENTS

The Evolution of Work

How AI is optimizing employee performance

From banks to architectural firms and manufacturing plants, advances in AI are boosting productivity, igniting innovation and pushing the limits of what's possible.

Perhaps more than any other technology, the transformational promise of Artificial Intelligence (AI) has captured the imaginations of business leaders. Automating workflows and freeing up humans to do higher-value tasks has triggered both fantasies and fears for decades. But today, rapid advances in deep neural networks, huge computing power and vast, ever-growing supplies of data mean that these fantasies are being played out in reality by businesses to deliver exponential boosts in workforce productivity.

Unlocking a world of opportunity

The growing hype around the potential of AI technologies to optimize workflows and drive efficiencies is underpinned by recent advances in machine learning systems. Development in neural networks that can learn, predict and problem solve has unlocked a world of opportunity for business leaders.

Gartner, which predicts wide adoption of Machine Learning (ML) and Deep Learning (DL) over the next two to five years, considers AI to be "the most disruptive class of technologies over the next 10 years".[1] Businesses in most industries appear to agree. According to IDC global spending on cognitive and AI systems will have reached $35.8 Billion in 2019, and this figure will more than double to $79.2 Billion by 2022, with a compound annual growth rate (CAGR) of 38.0% over the 2018-2022 forecast period.[2]

For businesses in fields as diverse as Finance, Retail, Media and Entertainment (M&E), Product Development, and Architecture, Engineering and Construction (AEC), AI presents particular benefits. Developments in ML and DL offer engineers the opportunity to boost performance, productivity and quality. Meanwhile, technological advances in the related areas of Big Data, Cloud Computing and Desktop Processing Power mean tasks that would take humans hundreds of hours to perform can now be run in minutes, or even seconds.

> "By 2022, global spending on cognitive and AI systems will reach $79.2 Billion"
>
> IDC

From streamlining processes through to automating them completely, ML is going to drive efficiency, productivity and accuracy to the next level. Working with ML systems, an enterprise can make thousands of decisions in the time it would take a human manager to organize a team meeting. More than this, the curated results will push the limits of what is possible.

This transformation is likely to come in waves. According to David Schubmehl, Research Director for IDC's Cognitive/Artificial Intelligent Systems and Content Analytics research, the first wave of ML will act like a specialist virtual digital assistant, helping to improve data, fix errors and optimize solutions. A further wave of intelligent assistants will learn from users' behaviors and, through prediction, remove repetitive steps so that designers and engineers can spend more time on ideation.

The pace of change is rapid and the disruptive potential vast. What is clear in each industry is that ML is empowering end users to make better decisions quicker and achieve more.

Expert view

"AI will be increasingly leveraged in design. The 'Holy Grail' is an AI system that could ultimately improve its own design.

"But I would expect that, long before that occurs, AI-based applications will be powerful tools for design engineers. This may ultimately include even more creative aspects of design.

"I would expect there will be greatly increased emphasis on designing chips specifically for AI/ML/DL. This may eventually lead to entirely new architectures. Early examples of this are Google's Tensor Processing Chips, and I believe similar initiatives are underway at NVIDIA. I would expect there to be a great deal of competition in this arena and that it may prove to be one of the primary drivers of future progress — especially as Moore's Law seems to be challenged with regard to traditional processing architectures."

Martin Ford, Futurist and Author

Machine Learning in Finance

Finance is another sector in which ML is not only the future — it's been in use for years. Fraud detection has come a long way in recent years, with financial systems able to detect suspicious behavior on credit cards — whether used online or in store. That can be based on buying patterns or location — considering whether a credit card transaction has taken place in the same location as a user's phone, for instance.

What's more, the technology is already being used to remove huge administrative bottlenecks. JP Morgan, for instance, has implemented a program called COIN that drastically reduces the time it takes to review legal documents.[3]

COIN, which uses a ML system powered by a private cloud network, handles the laborious task of interpreting commercial loan agreements. This was a task that, before the project went online in June 2016 for its own credit contracts, accounted for 360,000 hours of JP Morgan's lawyers' time per year. With the help of ML, it's now completed in seconds.

In addition to freeing up resources, COIN has significantly reduced loan-servicing mistakes, many of which were the result of human error from those interpreting 12,000 new wholesale contracts per year.

The technology is being applied to much higher value tasks too, with algorithms increasingly being relied upon in portfolio management. Where traditionally a human investment advisor would be responsible for managing a financial portfolio, machines now have the power to make investments based on the goals and risk tolerance of individual investors, taking into account real-time market dynamics.

Expert view

"Over the past few decades we've seen how computing and robotics have automated many repetitive tasks.

"The AI revolution takes this to a whole new level and is all about smart automation. There's lots of talk about the impact this will have on jobs, but let's face it, nobody wants to work in a contact center having the same conversation 50 times a day: AI and human controlled chatbots are the perfect solution."

Chris Ezekiel, Founder & CEO, Creative Virtual

"ML has helped JP Morgan reduce the time it takes to interpret commercial loan agreements from 360,000 hours to seconds."

And while most financial institutions are cautious about discussing their approach to AI and ML, it's believed to be heavily used in trading. Terms such as Algorithmic Trading and Automated Trading Systems are becoming increasingly prevalent, allowing hedge funds, for example, to make millions of transactions per day based on near-instant trading decisions.

So prevalent has this form of investing become, it is now possible to take a course in Algorithmic Trading at one of the world's most prestigious universities. The University of Oxford's Saïd Business School launched the six- week course, which helps students understand algorithm-based trading strategies, in July 2018.[4]

Machine Learning in Media and Entertainment

In the M&E sector, ML is driving the recommendation of content on a growing number of digital platforms.

Now companies are starting to use AI to streamline their own design and creation processes. Netflix, for example, is using ML to inform better design decisions and save design time. An example of this is its use of ML to find and crop images of TV and film characters for promotional posters and apply a stylized title that is personalized to the consumer's location, interests and language. The optimal combination of images is then A/B tested. Using what it calls a 'similarity index', it can find out what combination of images and treatments perform best to drive engagement.[5]

The automation of repetitive or onerous design processes is an area that offers M&E businesses particular opportunities to drive productivity by saving designers time. For instance, researchers at the University of Edinburgh in the UK are working on a ML system that is trained on data from motion capture clips of various types of movement to then automate the blending and creation of animations that are more life-like.[6] The use of a phase function in the neural network ensures that a wide range of inputs are matched with the right movements. This means that characters will be able to demonstrate a greater variety of natural human movements that would normally require time-consuming work. It could save animators a lot of grunt work and allow them to focus on higher-value tasks.

ML is automating more complex design work too. Logo design generator MarkMaker uses a genetic algorithm to create a succession of logos based on a term search function, and then learns the user's preferences to design a logo.[7]

Similarly, Adobe has launched a product that uses its AI and ML program, Sensei, in integration with its Adobe Experience Manager CMS to offer what it is calling 'human augmented' design.[8] This system will analyze the elements required for a website design — from layouts, colors and photos through to photo sizes — and make recommendations around image selection that designers can then override if they wish.

Website design platform The Grid was the first to kick off a move towards entirely AI-led website design. The Grid starts by establishing what a user's design goals are, and then generates a personalized site design based on these preferences. Rival website design company Wix has launched Wix's Advance Design Intelligence which is using AI to design customized websites.

Another area that is also likely to benefit from the advances in ML and other forms of AI is meta-tagging — the process of tagging media with text so it can be found in system searches. For example, machine learning systems will be able to help companies fast-track the process of going through rolls of film and classifying them by using object and facial recognition alongside meta-tagging for nearly any element.

"ML could save animators a lot of grunt work and allow them to focus on higher value tasks"

Machine learning in Product Development

The business case for ML in product development is clear: faster design times, improved accuracy, better upfront testing and product material efficiencies all equate to greater potential for more cost-effective workflows and innovation.

The potential impact of AI for users of 3D Computer Aided Design (CAD) software is particularly significant. While CAD is the foundation for modern design, design engineers must often make trade-offs between different elements such as aesthetics and aerodynamics due to the traditionally time-consuming process of creating an outstanding design. Each time a designer modifies one of the properties, they also need to regenerate the design, waiting to see how the modifications show new results. AI is able to fast-track this process.

A big game changer is generative design. This is an old concept that has been revitalized by advances in ML that enable massive parallel exploration of computationally derived variations of a design. These are iterated based on specific constraints set out by the end user.

Generative approaches are being deployed by designers such as 3D printing specialist Francis Bitonti along with Intel and prosthetics developer UNYQ to create personalized lighterweight breathable back braces for sufferers of spinal condition scoliosis,[9] and by fashion design studios like MHOX to create 3D printed fashion accessories.

Autodesk's Project Dreamcatcher is leading innovation on this front. The software is designed to optimize parametric design and also integrate with other Autodesk software such as Fusion 360 and Inventor. This generative design system allows users to input design goals and parameters (such as cost, materials and strength), and then select the best of thousands of options (complete with performance data) created using algorithms and computational reasoning. Not only can this be done in the time it might take a human to create just one design, it also tests and learns from each iteration what works and what doesn't.

This means reduced product development time and lower manufacturing costs, tabling better solutions with more efficient materials. A company called Hack Rod has used this system to iterate the chassis of the first AI-engineered car.[10] The company tested a human- designed chassis with proven geometrics on a track, and used data from connected sensors to feed back into the Dreamcatcher system to optimize the design. Sports brands such as Under Armour and New Balance have used a similar approach to produce ultra-light trainers,[11] and Airbus used Dreamcatcher to create an ultra-light and strong partition for its A320 aircraft,[12] which could lead to savings of 3,180kg of fuel per year — and an A320 with multiple partitions could also save 166 metric tons of CO_2 per year.

A step further still is considering the transformational impact ML could have on computational geometry and metamaterials. By taking into consideration environmental variables, design goals and physical constraints, it will be possible for computers to calculate geometry and heterogenous materials based on the effect one has on the other.

This methodology means it should be possible to use additive manufacturing techniques to produce functional objects with soft robotics. This could have myriad applications in industries such as aerospace, automotive and discrete manufacturing.

"Generative design has been revitalized by advances in ML that enable massive parallel exploration of computationally derived variations of a design"

Machine learning in Architecture, Engineering and Construction

ML has the potential to drive huge productivity in the built environment, from upfront site research and the design process through to the construction and maintenance of buildings.

For architects and civil engineers there is considerable data-heavy upfront work required during site surveys. AI could fast-track much of this process by tapping into existing Big Data and new connected data from Internet of Things (IoT) devices to combine existing Building Information Modeling (BIM) information with real-time site evaluation data. In the construction industry, there is also the opportunity to use drones to carry out photogrammetry (photographic site mapping) autonomously using ML. It could enable 3D scanning, autonomous navigation and inter-drone communications, known as 'swarming'.

There are many other powerful applications for connected IoT data in the engineering and manufacturing sectors. For instance, civil engineers can use AI to analyze performance data to find the optimal layout of a manufacturing plant.

ML can also automatically define architectural elements and structural components according to design guidelines and the physical constraints. This also has applications in engineering for setting out requirements around Mechanical, Electrical and Plumbing (MEP) components. Doing this significantly improves design productivity.

ML is already enabling the computational design of buildings based on specified design goals such as size and cost. Leading architectural firms like Zaha Hadid and MAD Architects have been using parametric design techniques for some time to get a commercial and creative edge. By tweaking the spatial parameters until the desired form is reached, these firms have designed iconic modern buildings featuring futuristic lattice-like forms that imitate structures in nature.[13]

By feeding 3D CAD models and other data, such as environmental information, architects can go beyond form and use ML to address other design decisions.

For example, ML is being used to rearrange or generate spaces, and organize buildings. Space Syntax's 'depthmapX' is used to analyze the spatial network of a city in designs, and gaming engine Unity 3D is allowing designers to analyze and optimize their plans by rearranging or generating spaces in plan.[14]

Autodesk's generative design system, Dreamcatcher, is also being applied to architecture to solve problems around comfort and conditions, such as light, temperature, and the flow of people in a building layout. The system is integrated with Autodesk's BIM tools like Revit and Dynamo.

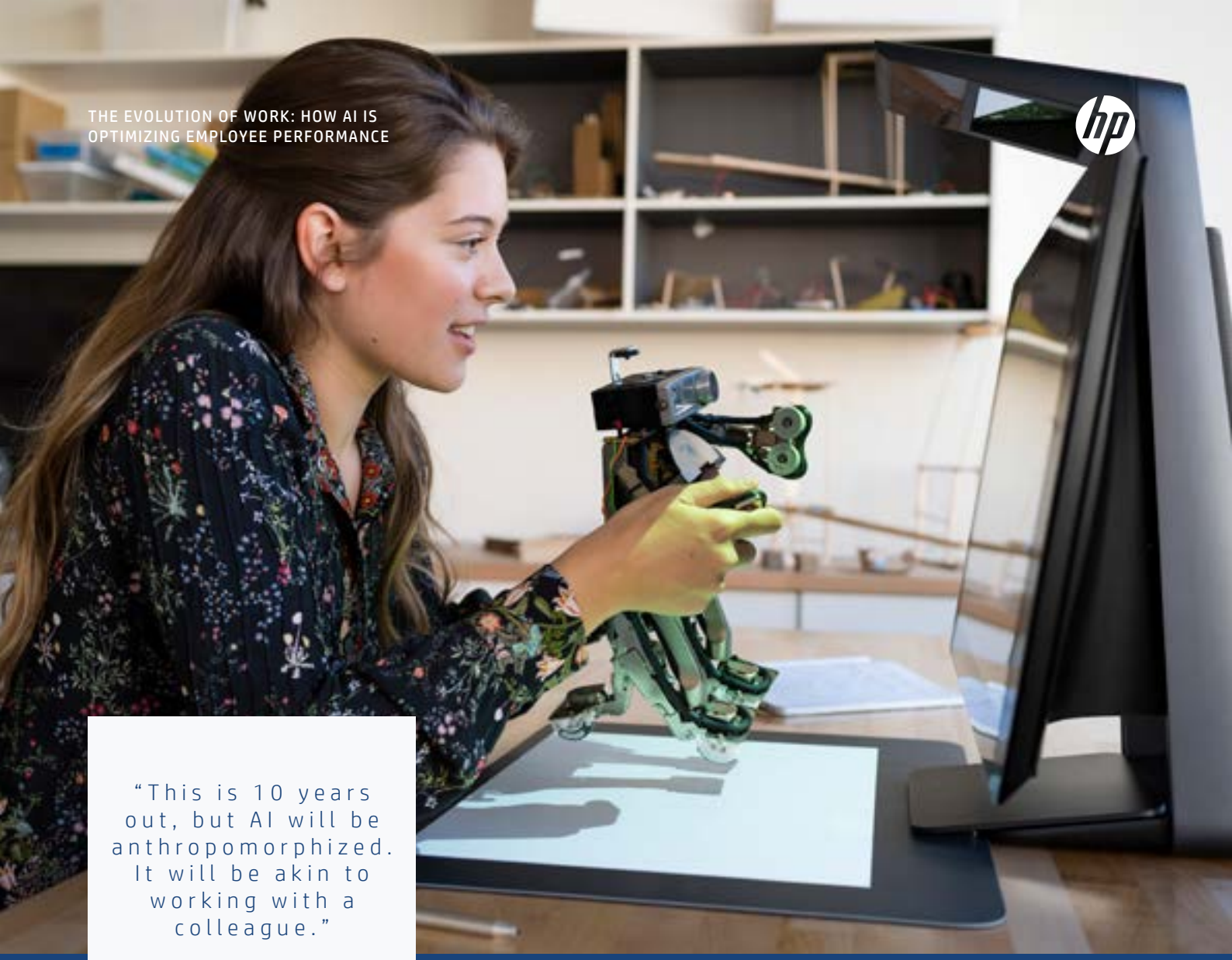
The space planning at Autodesk's new offices in Toronto, Canada was carried out using generative design methods.[16] By combining generative design with additive manufacturing technology like 3D printing, AI can also transform the way that building structures are designed. So, for example, instead of designing building envelopes with different layers for different functions such as heating and ventilation, these could be 3D printed as a single 'skin' with qualities that mimic biological organisms. Informed by real-time solar data from IoT devices, buildings could have transformable windows that allow the optimal amount of light into a space at the right time of day.

Expert view

"AI, Big Data, and Machine Learning will have an increasing and eventually a huge impact on all engineering work.

"Initially [this will be] with tools that help and assist, and potentially with intelligent systems that replace people."

Gregory Piatetsky-ShapiroData Scientist and editor of Kdnuggets.com



> "This is 10 years out, but AI will be anthropomorphized. It will be akin to working with a colleague."
>
> Mike Haley, Senior Director of AI & Robotics, Autodesk

Machine learning and the future of design

Combined with the confluence of other emerging technologies, ML offers unprecedented design opportunities that have huge implications for not only businesses, but also end users.

"It's [AI] going to fundamentally change a designer's role in the creative process," says former Autodesk CTO Jeff Kowalski.[15] "In the future, designers will be more like mentors for computers by providing their guidance and experience."

In this new computational relationship, the role of the designer could shift away from creating design models, to defining design intent so that a computer can do the modelling instead. As computers create and evaluate a range of the design options, designers and engineers will become curators of the best, most appropriate ones. This shift will require a new focus on design intent management.

Design innovators are already on board. The website of Michael Hansmeyer, the founder of Computational Architecture, states: "We've been using computers to increase our efficiency and precision. Let us view the computer as our muse, as a partner in design, and as a tool to expand our imagination."

Rob Girling, co-founder and principal of design and innovation consultancy Artefact, agrees:

"Far from threatening the design occupation, AI offers a huge opportunity. In the future, designers will train their AI tools to solve design problems by creating models based on their preferences," he says. "I can see the potential for a future where our personal AI assistants, armed with a deep understanding of our influences, heroes and inspirations, constantly critique our work, suggesting ideas and areas of improvement." [16]

Mike Haley, senior director of AI & Robotics at Autodesk, envisages a third stage of AI, where data is aggregated across organizations and is used as an intelligent simulator. This process of continual learning will help AI, he predicts, to eventually be viewed as a trusted collaborator: "This is 10 years out, but AI will be anthropomorphized," says Haley. "It will be akin to working with a colleague."[17]

Of course, delivering on the productivity promise of ML will require planning. IT decision makers may do well to heed the advice of IDC's David Schubmehl who issued a clarion call in 2017: "Cognitive/AI systems are quickly becoming a key part of IT infrastructure and all enterprises need to understand and plan for the adoption and use of these technologies in their organizations."[18]

Sources

1 https://www.cio.com/article/3332683/key-learnings-for-your-journey-to-ai-from-people-who-have-been-there.html
2 https://www.idc.com/getdoc.jsp?containerId=prUS44911419
3 https://www.independent.co.uk/news/business/news/jp-morgan-software-lawyers-coin-contract-intelligence-parsing-financial-deals-seconds-legal-working-a7603256.html
4 https://www.ft.com/content/154c12a2-890d-11e8-b18d-0181731a0340
5 https://becominghuman.ai/how-netflix-uses-ai-and-machine-learning-a087614630fe
6 https://www.nii.ac.jp/en/event/2018/1207.html
7 https://arxiv.org/pdf/1903.07820.pdf
8 https://usabilitygeek.com/ai-improve-ux-websites-landing-pages/
9 https://www.cooperhewitt.org/2018/02/16/printing-an-elegant-fashionable-brace/
10 https://www.theengineer.co.uk/generative-design/
11 https://www.3dprintingmedia.network/five-footwear-industry-leaders-using-3d-printing-for-production-today/
12 https://www.autodesk.com/customer-stories/airbus
13 https://www.alphr.com/artificial-intelligence/1005674/the-architects-teaching-ai-to-print-cities
14 https://blogs.unity3d.com/2019/01/30/design-build-and-operate-faster-with-the-pixyz-plugin-for-aec/
15 https://www.oreilly.com/ideas/ai-and-the-future-of-design-what-will-the-designer-of-2025-look-like
16 https://wordsinspace.net/shannon/2019/02/13/the-ethics-of-automating-design/
17 https://www.digitalengineering247.com/article/artificial-intelligence-for-design-gets-real
18 https://www.businesswire.com/news/home/20170403005123/en/Worldwide-Spending-Cognitive-Artificial-Intelligence-Systems-Forecast