Cognitive Diversity: AI & The Future of Work

TATA COMMUNICATIONS

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Motivation and Executive Summary

TATA COMMUNICATIONS

AI will allow us to do what it is that we are uniquely meant to do: to focus on high-level thinking, strategy and paving the way for innovation.

–Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister

Motivation and Executive Summary

The new role of the human being is not to produce; it is to create.

—Reinaldo Pamponet, Founder, Itsnoon

This study began in the summer of 2016 with a series of discussions between Vinod Kumar, CEO of Tata Communications, and Ken Goldberg, professor of engineering at the University of California, Berkeley, about how perceived and potential innovations in artificial intelligence and cloud communications will affect business practices, jobs and worker morale.

Although 5G networking is on a clear road map, the evolution and impact of AI is less certain, due in part to widespread claims of an impending "Singularity" when AI and robots might surpass humans and "steal" a substantial fraction of jobs.

Goldberg's critique of the Singularity as distracting and counterproductive motivated him to propose an alternative concept, "Multiplicity," where groups of machines and humans collaborate to innovate and solve problems. Machine learning theory has established the importance of statistical diversity in algorithms, parameters and data sets.

In *The Diversity Bonus*, Scott E. Page highlights the importance of cognitive diversity—differences in how humans perceive, interpret, reason and solve—in human groups. The more diverse the participants, he argues, the more opportunities to discover insights and novel approaches. Accordingly, the goal of this study is to explore inclusive and constructive future roles for AI that could have a positive impact on work and morale, under the hypothesis:

AI has the potential to enhance collective intelligence and intellectual diversity, allowing human workers to do more diverse thinking, become more efficient, and undertake more creative, fulfilling labour.

Tata Communications, operating at the forefront of a pivotal moment in the evolution of society—the so-called "Fourth Industrial Revolution"—helps customers make sense of and navigate the vast potential offered by emerging and disruptive technologies such as the internet of things (IoT), artificial intelligence (AI), big data, mobility and cloud computing. It is also uniquely positioned to help its customers embrace these new opportunities starting to make their presence felt including edge computing, 5G, blockchain and more—enabling its customers' digital future, now.

The study, conducted by Tata Communications and Prof. Goldberg,[1] began with a literature survey and was influenced

[1] Produced in conjunction with Gershoni Creative (San Francisco, California).

Of our respondents

81%

indicated that demographic diversity in the workplace is important or very important

90%

believe that cognitive diversity is important for management

by discussions at UC Berkeley with Profs. John Zysman, Laura Tyson, Costas Spanos and Shankar Sastry of the WITS[2] group. The study includes a 2018 survey of 120 global business executives who were current or prospective clients of Tata Communications; 15 in-depth interviews with leaders from both emerging and developed markets across the US, Europe, South America, Asia, India and the Middle East, including Tony Blair, executive chair of the Institute for Global Change and former UK prime minister; and two discussion forums with 23 internationally renowned experts from the fields of artificial intelligence, machine learning, design, art, government, politics, ethics, entrepreneurship, behavioural economics, journalism, engineering and human resources.

The data suggests that most business leaders (93%) are actively tracking advances in AI and that small and large organizations may benefit most from AI. The data also reveals similar attitudes toward AI in both emerging and developed markets and a strong correlation between leaders who value cognitive diversity and leaders who have a positive outlook on the impact of AI.

The study revealed many specific ways AI could benefit organizations in the future, in particular the potential for AI to: enhance customer experience and engagement; support human workers by automating tedious subtasks and emphasizing the importance of intuition, empathy, and other uniquely human skills; provide new justification to expand diversity in organizations and teams; increase employment by increasing the quality and demand for goods and services, especially amid changes in demographics and immigration policies; and motivate continuing education and lifelong learning. Four key points from the study are:

1. The structure of work will change and require greater agility and flexibility.
2. AI has the potential to help individuals become more agile, curious and nimble.
3. AI has the potential to enhance human collaboration.
4. AI has the potential to enhance cognitive diversity within groups.

One unique outcome from the study is a vision for a future system that could provide an ongoing “AI-based devil’s advocate” consistent with the theme of Multiplicity, where AI supports humans by providing a novel cognitive perspective. Such an AI system would surface contrarian perspectives for leaders and groups to counter: feelings of intimidation among junior workers, confirmation bias and groupthink. An “AI-based devil’s advocate” might use natural language processing and machine learning to analyze emails and meeting transcripts, learning to be sensitive to keywords and trends in order to generate periodic reminders about the big picture (“Elephant in the Room”) and alerts that challenge unanimous and potentially false assumptions (“Emperor Has No Clothes”).

[2] Work in an era of Intelligent Tools and Systems (WITS). University of California, Berkeley. http://wits.berkeley.edu

The study also suggests that leaders actively develop "AI strategies" that begin to explore the potential upsides of AI for customers and workers. The best way for leaders and workers to prepare for AI is to expand training and education programs (a "Multiplicity Movement," see page 13) that emphasize uniquely human skills: creativity, curiosity, imagination, empathy, human communication, diversity and innovation.

There is no doubt that AI and related technologies are evolving rapidly. In contrast to conventional wisdom and newspaper headlines warning of widespread loss of jobs and threats to humanity, this study provides a much needed inclusive and positive vision for the future.

The important question is not, "When will machines surpass human intelligence?" but instead, "How can humans work together with machines in new ways?"

Vinod Kumar

Ken Goldberg

Part 1

Introduction

1

1.1 Purpose and Goals

The purpose of this study is to put recent advances in AI into historical context, survey current attitudes about AI among global executives, identify potentially positive scenarios where AI could enhance human workers and increase diversity in the workforce, and summarize these in a form that can be used to enhance worker and executive morale with new thought-leadership.

1.2 Approach and Framework

For the purposes of this study, AI is defined as systems that can learn and have the ability to perform reasoning beyond basic computation. In particular, we will take into account opportunities for human-machine collaboration.

Hypothesis

We hypothesize that: *AI has the potential to enhance collective intelligence and intellectual diversity, allowing human workers to do more diverse thinking, become more efficient, and undertake more creative, fulfilling labour.*

This hypothesis is explored on several levels:

- A global survey of 120 leading executives—current or prospective clients of Tata Communications from emerging and developed markets across the US, Europe, South America, Asia, India and the Middle East.
- 15 in-depth interviews with entrepreneurs, executives and thought-leaders, including Tony Blair, executive chair of the Institute for Global Change and former UK prime minister
- Two discussion forums, bringing together internationally renowned experts from the fields of artificial intelligence, machine learning, design, art, government, politics, ethics, entrepreneurship, behavioural economics, journalism, engineering and human resources

1.3 Tata Communications

Tata Communications, a leading provider of global digital infrastructure services

Tata Communications is a global business that enables its customers' digital future now. Through its portfolio of cloud, mobility, IoT, collaboration, security and network services, it provides its customers integrated globally managed services that deliver great experiences locally. The company's own journey as an agile challenger brand has given it intimate and intricate knowledge, and the know-how to uniquely advise and enable companies around the world as they transform.

Of those surveyed

80%

think that AI could facilitate team composition, organisation and communications, especially for global teams

Tata Communications in numbers

- Serves over 7,000 customers globally that represent 66% of the Fortune 500
- Connects 4 out of 5 mobile subscribers worldwide
- Connects businesses to 60% of the world's cloud giants
- Its internet of things network in India will be the world's largest network of its kind, spanning nearly 2,000 communities and touching over 400 million people
- It operates the largest wholly owned and most advanced subsea fibre network which underpins the internet backbone, where its network carries nearly 30% of the world's internet routes

1.4 Historical Context

From stone to steam to signals

Beginning with the discovery of stone tools and on through the evolution of agriculture, the application of iron and steam, and the advent of electricity, computers and the internet, humans have always used technology to enhance their ability to work.

New technologies have multiplicative effects. The steam engine closed the gap between communities separated by rough terrain. These routes fostered connections that led to second-order innovations, such as clocks to synchronize schedules. Innovations in clockmaking led to innovations in machine tools and automata, and inspired a young patent examiner in Geneva to discover remarkable new laws of space and time.

These multiplicative effects accelerated with the advent of the digital computer.

In 1946, the Electronic Numerical Integrator and Computer (ENIAC) was built at the University of Pennsylvania. ENIAC was the first general purpose machine—it could be programmed to solve many different problems.

Shortly after the introduction of the ENIAC, researchers started imagining what the future of computing would look like. Marvin Minsky and John McCarthy were interested in machine intelligence focused on robotics and neural nets. Other early computer scientists and designers took a different approach. Rather than trying to replace human intelligence, these pioneers saw the potential for computers to augment human intelligence.

Two primary leaders were Doug Engelbart and Alan Kay. Engelbart earned his PhD at the University of California, Berkeley, and ran the Augmentation Research Center at the Stanford Research Institute. In the infamous "Mother of All Demos," Engelbart demonstrated live text editing (the kind taken for granted in Google Docs), the first mouse, and the

It is undeniable that AI and machine-learning algorithms have already had world-transforming application in areas as diverse as science, manufacturing and entertainment. Examples range from machine vision and pattern recognition essential in improving quality in semiconductor design and so-called rational drug discovery algorithms, which systematize the creation of new pharmaceuticals.

–John Markoff, Former Senior Writer, *The New York Times*; Fellow, Center for Advanced Study in the Behavioral Sciences, Inc.[3]

concepts of user testing and bootstrapping. Kay's work at Xerox PARC (Palo Alto Research Center Incorporated) focused on graphical user interfaces.

As John Markoff pointed out in *Machines of Loving Grace: The Quest for Common Ground Between Humans and Robots*, the combination of these two schools of thought may be the most productive way forward.

History of "thinking machines"

The concept of the "thinking machine" dates back to the ancient Egyptians and Greeks. But it was the work of mathematicians and logicians, including Alan Turing, John von Neumann and Claude Shannon, that set the founding principles for digital computers.

Following initial public and scientific interest in the 1960s, AI faced a backlash in the 1970s when technologies failed to live up to expectations. This period, known as the first "AI winter," was marked by decreased interest and funding. In California, development in augmentation and personal computing took a very different path during this period, focusing on user interfaces and education.

"It might take hundreds of years, it might take less than that, but eventually we will understand the machinery that produces the human mind," Marvin Minsky once said, "and we will be able to build machine like that."[4]

Investing in smart machines serves two purposes—first, by further understanding the ways humans think, and then by engineering those findings with new tools and faster machines. This dual pursuit has been taking place in labs around the world for more than 60 years, in the fields of neuroscience, psychology, linguistics, robotics, physics and computer science.

Today, experts agree on the complexity of bridging this gap. There is some understanding of the physicality of the brain but not enough for it to be modelled and re-created. As summarized by cultural anthropologist Mary Katherine Bateson:

One of the most essential elements of human wisdom at its best is humility, knowing that you don't know everything. There's a sense in which we haven't learned how to build humility into our interactions with our devices. The computer doesn't know what it doesn't know.[5]

[3] Markoff, John. *Machines of Loving Grace: the Quest for Common Ground between Humans and Robots*. ECCO, an Imprint of HarperCollins Publishers, 2016.

[4] *Machine Dreams*. Dir. Peter Krieg. Perf. Marvin Minsky. Barfuß, 1988. Film.

[5] Bateson, Mary Catherine. "How To Be a Systems Thinker." Edge.org, Edge Foundation, Inc., 17 Apr. 2018, www.edge.org/conversation/mary_catherine_bateson-how-to-be-a-systems-thinker.

Part 2

New Perspectives

2

Of our respondents

75%

think AI will create new roles in their business

71%

believe that re-skilling workers will be required in the next five years

2.1 "Multiplicity" vs "Singularity"

Artificial intelligence (AI) has surpassed humans at *Jeopardy!* and Go, and driverless cars are widely believed to be around the corner. News articles warn of the approaching Singularity, a hypothetical point in time where AI and robots surpass humans and steal their jobs. From Prometheus to the Terminator, automation anxiety has a long history. The word was first used by John von Neumann (as quoted by Stan Ulam):

The ever-accelerating progress of technology and changes in the mode of human life give the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue.[6]

The term was popularized by Ray Kurzweil in his 2005 book *The Singularity is Near: When Humans Transcend Biology*, and dramatized by Nick Bostrom in his 2014 book *Superintelligence: Paths, Dangers, Strategies*. The "existential threat" of AI has been reinforced by public figures from Stephen Hawking to Bill Gates to Elon Musk to Henry Kissinger. However, almost all computer scientists agree that despite many advances in narrow domains, AI is extremely far from achieving human-level general intelligence.

Warnings of an impending Singularity as an unrealistic, counterproductive distraction. In a *Wall Street Journal* op-ed, Ken Goldberg proposed an alternative: Multiplicity, where groups of machines and humans collaborate to solve problems and innovate.

Multiplicity is not science fiction. This combination of machine learning, the wisdom of crowds and cloud computing already underlies tasks that Americans do every day: searching for documents, filtering spam emails, translating between languages, finding news and movies, navigating maps, and organizing photos and videos.[7]

Multiplicity is a realistic, inclusive alternative to Singularity in which systems of diverse combinations of humans and machines work together to innovate and respond rapidly to complex problems.[8]

Despite years of experience in human factors and human-machine interfaces, more research is needed on the best ways to combine diverse groups of people with diverse groups of machines. The most important question we're facing is not, "When will machines surpass human intelligence?" but instead, "How can humans work together with machines in new ways?"

[6] Ulam, Stanislaw. "Tribute to John von Neumann." Vol. 64, No. 3, Part 2. *Bulletin of the American Mathematical Society*: 5. May 1958.

[7] Goldberg, Ken. "The Robot-Human Alliance." *The Wall Street Journal*, Dow Jones & Company, 11 June 2017, http://www.wsj.com/articles/the-robot-human-alliance-1497213576.

[8] Simon, Matt. "Forget the Robot Singularity Apocalypse: Let's Talk about Multiplicity." *Wired*. 18 January 2018. https://www.wired.com/story/forget-the-robot-singularity-apocalypse-lets-talk-about-the-multiplicity/

The most important question we're facing is not, "When will machines surpass human intelligence?" but instead, "How can humans work together with machines in new ways?"

2.2 Homogeneity vs Diversity Among Humans and Machines

The benefits and challenges of human diversity have been recognized for centuries in political science, economics and sociology. Experiments with group problem-solving show that the diversity of the people involved is more important than their total IQ.

AI and robots can inspire us to think deeply about the kind of work we really want to do, how we can change the way we learn, and how we might embrace diversity to create a myriad of new partnerships.

Diversity takes many forms: diversity of information, diversity of knowledge, identity and cognitive diversity, and discipline diversity.

Identity diversity can produce cognitive diversity, both directly, by engaging unique repertoires derived from particular experiences, and indirectly, as individuals with particular identities elicit novel ideas from others in a team.[9]

2.3 Continuing Education

In 1910, only 10% of American students finished high school. In that year, emerging advances in farm automation gave rise to what was called the High School Movement, which focused on the goal of transforming education to prepare students for jobs other than farming. In a relatively short span of time, thousands of high schools were built and new curricula developed. The result? By 1950, 80% of Americans finished high school.

A new version of the High School Movement has been proposed, the "Multiplicity Movement".[10] This time the goal is to evolve ways of learning to emphasize the uniquely human skills that AI and robots cannot replicate: creativity, curiosity, imagination, empathy, human communication, diversity and innovation. AI systems can provide universal access to sophisticated adaptive testing and exercises to discover the unique strengths of each student and to help each student amplify his or her strengths. AI systems could support continuous learning for students of all ages and abilities.

[9] Page, Scott E. *The Diversity Bonus: How Great Teams Pay off in the Knowledge Economy*. Princeton University Press, 2017.

[10] Goldberg, Ann, & Goldberg, Ken. Chapter in *Back to the Sandbox: Art and Radical Pedagogy* by Jaroslav Andel, MIT Press (forthcoming).

“We haven’t quite woken up to the need to change the way we educate, how we educate, and the time over which we educate.”

–Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister[11]

[11] Blair, Tony. Interview. 26 April 2018.

"The companies that may have cracked the code are those that can assign repetitive, precise tasks to machines, freeing human workers to undertake empathetic, creative, duties that machines aren't very good at."

–William Wilkes[12]

Much of education today still emphasizes conformity, obedience and uniformity. The important question is not when machines will surpass human intelligence, but how humans can work and learn with computers in new ways. This requires combining AI with IA, Intelligence Augmentation, where computers help humans learn and work.

2.4 Structured vs Unstructured Decisions

AI has demonstrated progress only in narrow and well-structured domains, where training data is available and when decisions require weighing the same type of considerations again and again, at scale, to produce the statistically best value. For example, airlines use machine learning to estimate how many seats to overbook to compensate for potential no-shows based on a huge data set of prior passenger check-in behavior.

However, bankers deciding whether or not to grant a mortgage use a variety of well-structured data including income, monthly expenses, liabilities, assets and so on. However, in the presence of a customer, a banker contextualizes this, relying on a slew of subliminal signals and contextual information—tone of conversation, body language, background knowledge of the applicant's employer—to make a decision whether or not to approve the loan.

2.5 The Future of Work and Jobs

The digital spreadsheet revolutionized the planning of budgets, working forward with initial estimates and then backward to adjust expenses to match available resources. That productivity has been enhanced now that Google Sheets allows this process to be shared simultaneously with multiple participants across different devices and time zones. Gmail search functions provide analogous benefits; it's easier than ever to find in an email a taxi or Lyft receipt from last year.

According to Hal Varian, age demographics are one aspect of the future that is not speculative. In the US and Japan, he noted, the working age population will continue to shrink, leading to an employment shortage.[13] This, combined with recent changes in immigration policies, has the potential to *increase* the need for human labour.

Even when machines do take over some human activities in an occupation, this does not necessarily spell the end of the jobs in that line of work. On the contrary, their number at times increases in occupations that have been partly automated, because overall

[12] Wilkes, William. "How the World's Biggest Companies Are Fine-Tuning the Robot Revolution." *The Wall Street Journal.* 14 May 2018.

[13] Castellanos, Sara. "Google Chief Economist Hal Varian Argues Automation Is Essential." *The Wall Street Journal.* 8 Feb 2018.

AI has the potential to enhance uniquely human abilities: judgment, empathy, creativity, communication and insight. These are the qualities that machines are not close to acquiring.

demand for their remaining activities has continued to grow. For example, the large-scale deployment of bar-code scanners and associated point-of-sale systems in the United States in the 1980s reduced labor costs per store by an estimated 4.5 percent and the cost of the groceries consumers bought by 1.4 percent. … But cashiers were still needed; in fact, their employment grew at an average rate of more than 2 percent between 1980 and 2013.[14]

This positive view of automation focuses on how certain tasks are replaced, freeing workers to focus on other tasks. A bank teller liberated from dispensing cash will be available to improve customer experience and advise leadership on options for new services.

According to the study conducted by McKinsey Global Institute, "in about 60 percent of occupations, at least one-third of the constituent activities could be automated, implying substantial workplace transformations and changes for all workers."[15]

2.6 The Future of Collaboration

Web-based video-conferencing, screen-sharing and meeting-scheduling tools have transformed the way companies around the world do business. In the future, advances in AI could increase connection within teams and between organizations while minimizing the time spent on tedious administrative tasks.

In terms of AI's effect on teams, leaders have explored new and innovative ways to develop empathic interaction. At Mattel, former senior vice president Ivy Ross employed a novel technique to inspire her team during a creative project:

Over the course of 12 weeks, Ross was able to establish deep trust among 12 colleagues by embedding sounds with a unique frequency that resonated with all 12 team members. After listening to these sounds together each morning, the team would engage in a brain-storm. Ross proved that … (o)nce trust is developed, collective curiosity soars.[16]

This experience reinforces what makes us uniquely human: the ability to empathize and connect with one another.

[14] Chui, Michael; Manyika, James, & Miremadi, Mehdi."Where Machines Could Replace Humans—and Where They Can't (Yet)." *McKinsey Quarterly*. McKinsey & Company. July 2016.

[15] Manyika, James, et al. "What the Future of Work Will Mean for Jobs, Skills, and Wages." McKinsey Global Institute. McKinsey & Company. November 2017.

[16] Boshernitsan, Rimma. "Google's VP Of Design Says Human Connection Is Essential To Your Bottom Line." *Forbes*. 15 November 2017.

Part 3

Opportunities

3

Of those surveyed

17%

viewed their organisations as Pioneers when it comes to adopting AI

43%

viewed their organisations as Experimenters when it comes to adopting AI

Fears of an impending Singularity have positioned AI as a job killer. While some people will lose their jobs, history shows that most economic revolutions are net positive.

Despite what you read on the news, humanity has been getting better off. We live longer, fewer of us die of disease or starvation, fewer of us are illiterate, fewer of us are victims of violent crimes, fewer of us die in wars, fewer of us live under dictatorships. These are facts you can't appreciate from the headlines; you only grasp them when you see lines plotted on graphs. (Net welfare for humankind has) never been better.[17]

Compared with the pre-Enlightenment era, jobs are more creative, filled with less monotonous tasks, in vastly more versatile environments.

Participants in the study suggested examples of how their jobs could be enhanced by AI in the future.

3.1 CEOs

Making decisions is the primary job of a CEO, for whom it is vital to avoid bias and remain objective. In the future, an AI-based system could support this working as an "AI-based devil's advocate" that challenges decisions with insightful questions, exposing the CEO with alternative viewpoints, throwing "high-quality curveballs" to enable more creative and critical thinking. Such an AI system could surface contrarian perspectives to counter: feelings of intimidation among junior workers, confirmation bias and groupthink. An "AI-based devil's advocate" might use natural language processing and machine learning to analyze emails and meeting transcripts, learning to be sensitive to keywords and trends so that it could generate periodic reminders about the big picture ("Elephant in the Room") and alerts that challenge unanimous and potentially false assumptions ("Emperor Has No Clothes").

In the future, AI systems could also help CEOs assemble teams with cognitive diversity in mind, teaming people who think differently in order to solve problems in new and innovative ways.

3.2 Human Resource Leaders

The role of human resource leaders has become increasingly difficult. With the popularity of the sharing economy, HR organizations and departments are finding themselves in a constant state of change. Keeping workers engaged and invested in full-time employment is becoming increasingly difficult.

[17] Pinker, Steven. Interview. *PBS News Hour*. PBS. 22 Feb 2018. https://www.pbs.org/newshour/show/if-youre-worried-about-the-world-heres-reason-to-be-hopeful-and-keep-worrying

AI has the potential to track organizational cues and critical performance metrics, enabling HR leaders to anticipate conflicts before they arise, offering advice, training opportunities or suggestions for intervention by human managers.

3.3 Supply Chain Managers

A supply chain manager oversees the procurement and delivery of raw materials, equipment and hardware so that companies meet production quotas, customer demand and delivery schedules. Understanding how materials are transported, the supplies needed for production, and the best and most efficient manner to transport product to retail outlets requires a comprehensive skill-set. Relationships must be established and maintained at both ends of the process, and the decisions made impact numerous vendors along the way. AI could help with such decisions, learning reliability and transport time patterns in order to reduce risk.

3.4 Project Managers

Recording notes of every good idea and then indexing them in a centralized location takes a certain level of intentionality and discipline. However, AI-enhanced note-taking could save time, help generate more ideas and lead to increased ROI during meetings.

So much time is spent in conference calls and meetings, leaving precious little time for creative work. In the future, AI algorithms could communicate with each other to determine the best time of day to schedule calls and meetings.

3.5 Office Managers

Office space is expensive and many companies promote working remotely (either at home, when travelling or at customer locations). Sharing desks and office space can be extremely efficient but requires complex scheduling. AI systems could learn work patterns to optimally allocate desk space on demand, making better use of physical space while keeping workers inspired, engaged and productive.

3.6 Customer Service Representatives

Technical support personnel are very expensive and often deal with customers who are unhappy or in moments of crisis. Recognizing the sensitivity of these situations, AppleCare encourages its staff to be warm and attentive on the phone, reassuring customers as back-end technicians diagnose

I think that treating empathy as an abstract concept that some people have and some people don't, that you can be taught or unlearned—it misses the point that it's actually a process. One of the things that better technology and AI can do is make that process easier to handle. (Let's say) we're friends, and I live in Los Angeles and you live in San Francisco, and you have an especially (bad) day. Wouldn't it be great if I got a little notification that said, "Hey, your friend needs a call right now. This would be a great time for you to reach out to your friend." That would be so powerful.

–Gabe Zichermann, CEO, Onward[18]

[18] Zichermann, Gabe. Artificial Intelligence and the Future of Work Discussion Forum (San Francisco). 25 April 2018.

Of our respondents

99%

feel that AI allows teams to be more productive and efficient

93%

see decision-making as positively impacted by AI

problems with remote desktop access. In the future, AI systems could enhance the work of the back-end technicians and provide insights and advice to the human representative about specific customer moods based on voice analysis.

3.7 Computer Programmers

Programming languages change on a regular basis. A professional programmer has a hard time keeping up to date with new capabilities and libraries, and could risk becoming irrelevant in the workforce. An AI system could track innovations that are starting to become prevalent. By identifying the trends at large, new academic developments or new innovations, the system could suggest online courses to take, benefitting both the programmer and the business.

3.8 Personal Coaches

In a future of Multiplicity and cognitive diversity, developing a strong network of weak ties is crucial.[19] It's important for a programmer to stay in touch with a philosopher or an AI scientist to know what is top-of-mind for their psychology department colleague. Given the difficulty of staying in touch with each other's day-to-day roles, AI could help keep such channels open, fostering stronger cognitive diversity.

AI might also flag interpersonal situations at work where empathy or voice-to-voice interaction were needed. With so many web-based tools helping us keep in touch with one another, sometimes the best thing to do is just reach out and see someone in person. Connect emphatically with a colleague—another human being—and think together of the best way forward.

An AI-assisted personal reading list could flag topics as being interesting and useful. When connected to a personal calendar, the AI could suggest actions that would support hobbies, optimize meetings and enhance routines, such as downloading a new podcast before a long drive or retrieving the most recent version of a Google Doc before heading to the subway.

3.9 Truck Drivers

The interaction between humans and machines is central to mobile navigation systems such as Waze. These systems increasingly use AI to predict traffic patterns and re-route drivers in real time. In the future, truck drivers could use AI systems not only to automate driving for some sections of open freeway (allowing the driver to nap briefly) but also to plan routes to optimize time, energy consumption and profit.

[19] Granovetter, Mark S. "The Strength of Weak Ties." *American Journal of Sociology*. Vol. 78, No. 6. May 1973. 1360-1380.

Steering clear of my inbox for most of the day has become my best strategy for staying true to my priorities. My inbox has its own priorities which are different than mine. I am so much more than my inbox.

–Jane Metcalfe, Founder, CEO, Editor-in-Chief at New.life; Founder, *Wired* magazine[20]

3.10 Retail Store Owners

The emergence of e-commerce has raised expectations with consumers—at the tap of a screen, consumers can now have whatever they want, whenever they want it. The shifting landscape has been beneficial for the public but problematic for retailers, who are limited by available inventory. The alternative? AI systems could help optimize inventory and promotions by learning seasonal trends in each customer's purchases.

3.11 Entrepreneurs

Communication signals bombard us all day long: emails, text messages, instant messages, group chats. All demand attention, but not all are of equal importance. An AI system could respond to its user's settings and thematically filter out all messages (by either humans or robots) that are not deemed important, removing unsolicited distractions and allowing users to focus on what they set out to do.

3.12 Journalists

Journalists must gather huge amounts of timely and often obscure information about breaking stories and finish them under a very tight deadline. This can be especially challenging in a global context where events occur throughout the night. A future AI system could be used to track reports of a story as they emerge, cross-referencing each article to discover consistent elements and estimate the reliability of the sources. Such a system could also automatically initiate searches about new terms that appear in articles, freeing the journalist to step back and focus on the big picture and what can be reliably reported.

[20] Metcalfe, Jane. Artificial Intelligence and the Future of Work Discussion Forum (San Francisco). 25 April 2018.

I'm now doing a lot of historiography, and I'm in the special collections at Stanford. When I was in there 16 years ago, it was all paper notes—that was historical research. Now I largely work with an iPhone, and Evernote does OCR, and the stuff gets sent up to the cloud and it's magic. But it's also incredibly brain-dead considering where we are at this point. I have this growing corpus of gigabytes of text and images, and the only tool I have is search. Here we are, 30 years in, and I can't believe that there are not more sophisticated tools for dealing with unstructured text. This is why I'm waiting for this breakthrough in natural language processing.

–John Markoff, Former Senior Writer, *The New York Times*; Fellow, Center for Advanced Study in the Behavioral Sciences, Inc.[21]

[21] Markoff, John. Artificial Intelligence and the Future of Work Discussion Forum (San Francisco). 25 April 2018.

Part 4

Four Themes

"AI could suggest qualified people with skills that are validated, so I could form teams quickly, regardless of where they live or what type of work they are (doing). It's an on-demand way of forming teams."

–Michael McCreary, HR Business Partner, CIO Organization, Intuit[22]

4.1 Summary and Insights

The 2018 study surveyed more than 120 business leaders—CXOs and top executives from clients or prospective clients of Tata Communications. These leaders represent companies in industries ranging from telecommunications and technology to manufacturing and transportation across four continents, taking into account both emerging and developed countries.

The survey gauged current interest in and understanding of AI (e.g., how closely participants follow AI-based trends, how likely AI will impact positive trends within their organizations), demographic and cognitive diversity, and how these trends and perceptions will impact the implementation of AI in their organizations.

The interviews focused on understanding the structure of work, the future of AI, the most meaningful use cases for implementation and the role of humans in a world of automation.

The discussion forums dove deep into intellectual diversity, the positive impact of human-machine collaboration and the cultural impact of automation on society.

These three research methods suggested four overarching themes:

1. The structure of work will change and require greater agility and flexibility.
2. AI has the potential to help individuals become more agile, curious and nimble.
3. AI has the potential to enhance human collaboration.
4. AI has the potential to enhance cognitive diversity within groups.

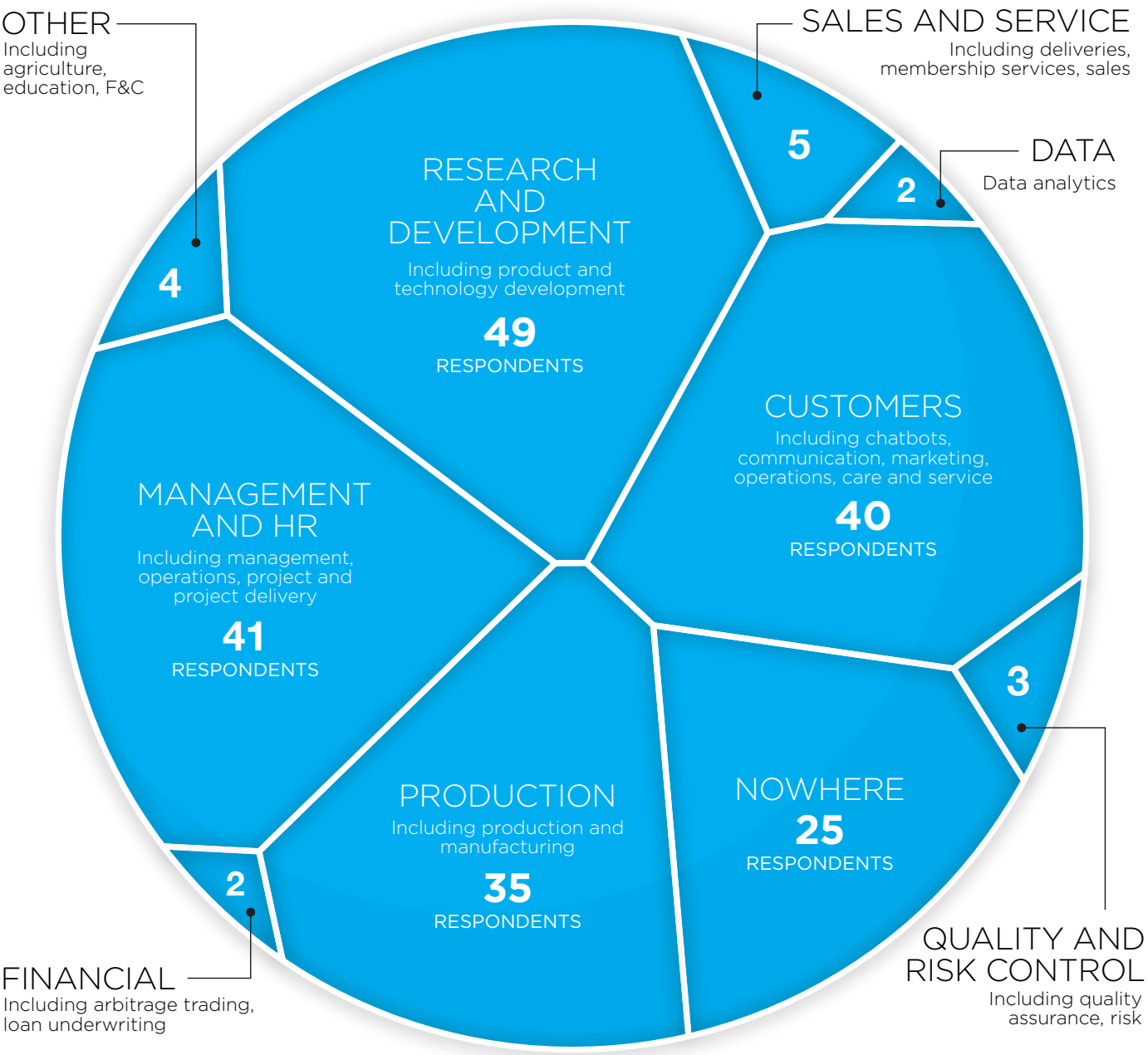
With autonomous processes becoming more scalable, original and diverse ideas will create competitive advantages. By building diverse teams through a combination of workers and machines, the number of new cognitive skills will be multiplied, increasing the ability to turn a problem around, look at it from different directions, and deploy different skills to find creative solutions. (See Positive Outcomes from AI on page 41 and Leaders Who Value Cognitive Diversity Also Believe That AI Could Impact Positive Change on page 43.)

Talent will be nonlinear—less about skills and more about ways of thinking. An HR department will no longer assemble teams based on checklists but rather a much deeper matrix of interests, backgrounds, past experiences and cultural viewpoints.

[22] McCreary, Michael. Artificial Intelligence and the Future of Work Discussion Forum (San Francisco). 25 April 2018.

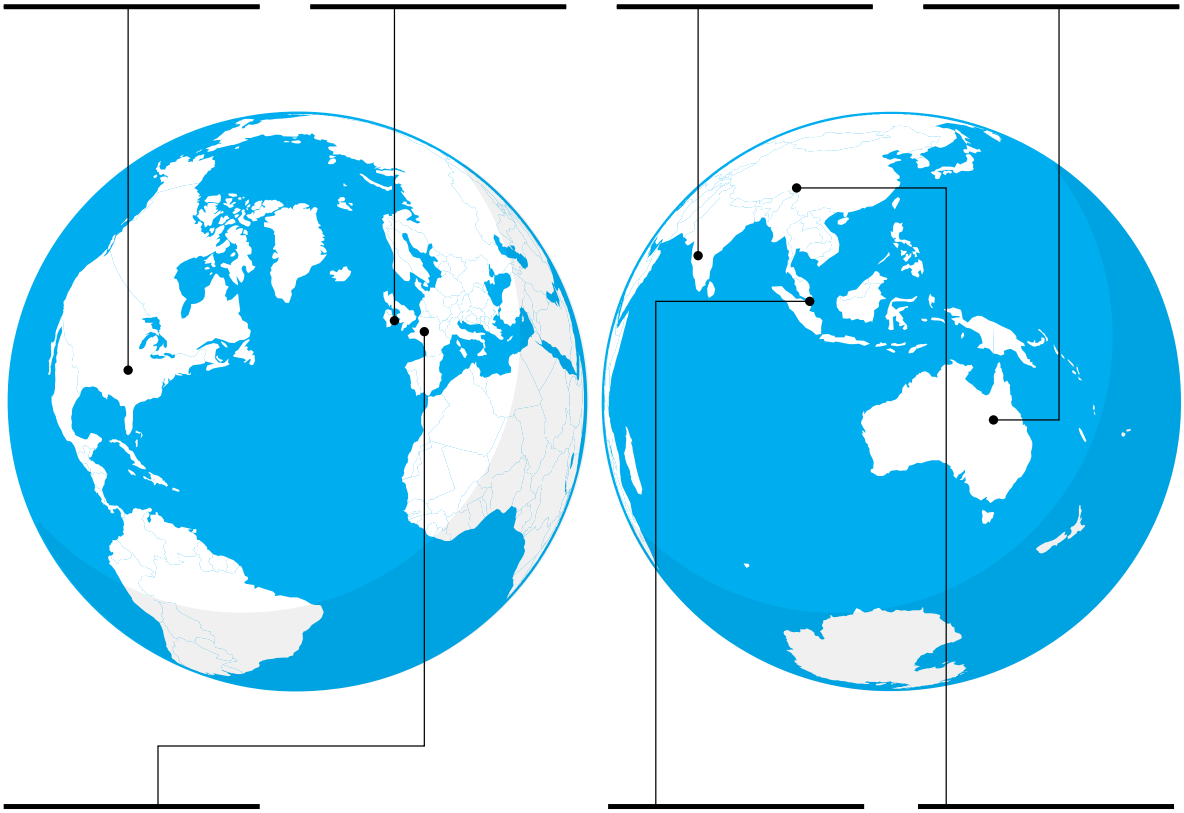
AI is already being used by 80% of companies, including research and development, management and human resources, customer service and production

Number of respondents



Attitudes toward AI are similar around the world

	USA	U.K.	INDIA	AUSTRALIA
LIKELIHOOD THAT AI COULD IMPACT POSITIVE CHANGE	3.5	3.4	3.2	3.3
AI ADOPTION STAGE	4.2	3.0	2.8	3.3
LIKELIHOOD AI WILL REPLACE EXISTING JOBS	3.0	2.8	2.4	2.0
LIKELIHOOD AI WILL CREATE NEW JOBS	3.5	2.4	2.9	3.7



	EUROPE (non-U.K.)	SINGAPORE	REST OF ASIA
LIKELIHOOD THAT AI COULD IMPACT POSITIVE CHANGE	3.5	3.4	3.7
AI ADOPTION STAGE	3.3	3.0	2.2
LIKELIHOOD AI WILL REPLACE EXISTING JOBS	2.9	2.4	3.0
LIKELIHOOD AI WILL CREATE NEW JOBS	3.4	2.8	3.0

The average company is going to be much flatter. … A flatter structure allows companies to be more nimble.

–Yorgen Edholm, Former CEO, Accellion

4.2 Four Themes

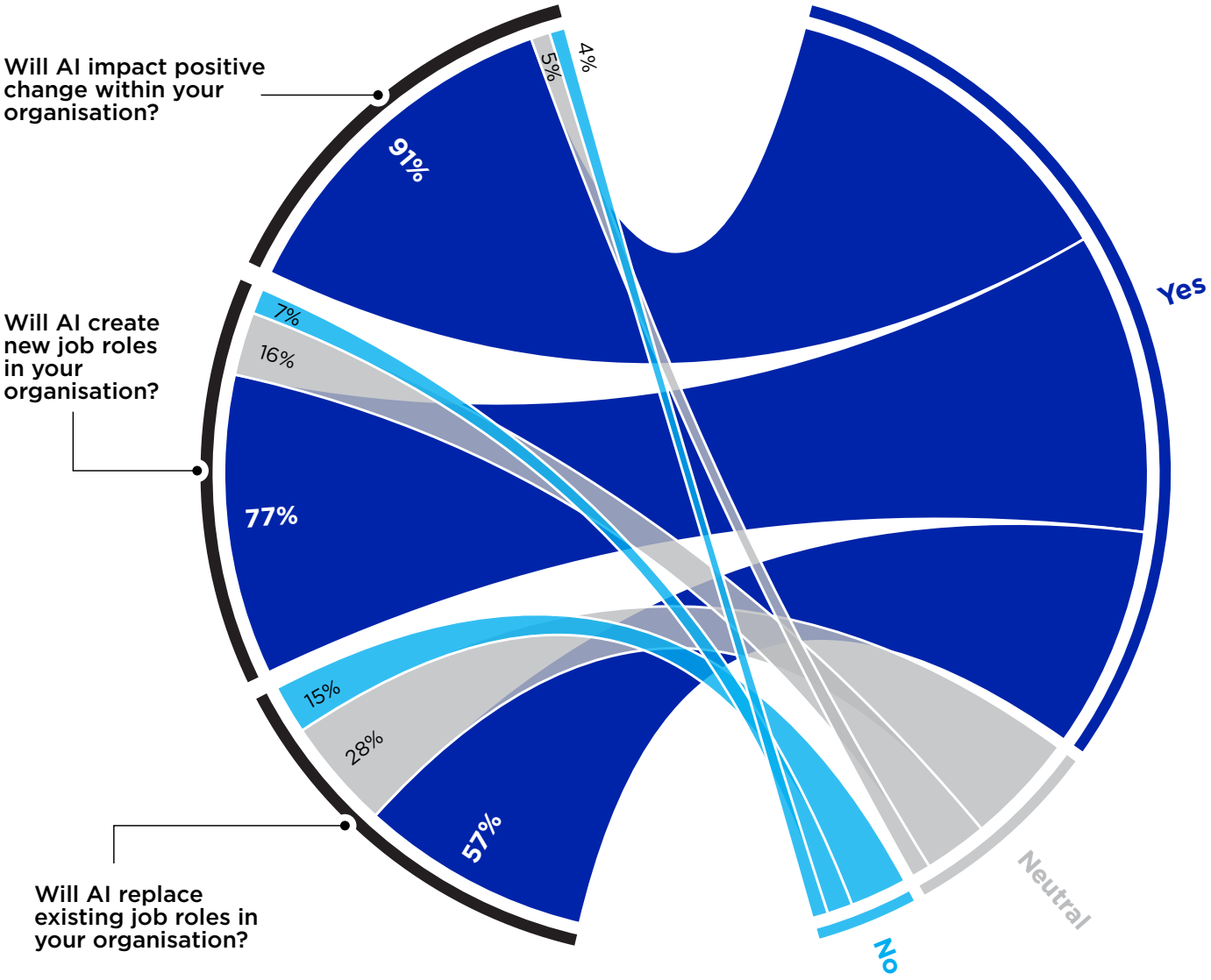
Theme 1: The structure of work will change and require greater agility and flexibility

Over 75% of respondents think it is likely or extremely likely that AI will create new roles in their business, and a majority (71%) believe that re-skilling workers will be required in the next five years.

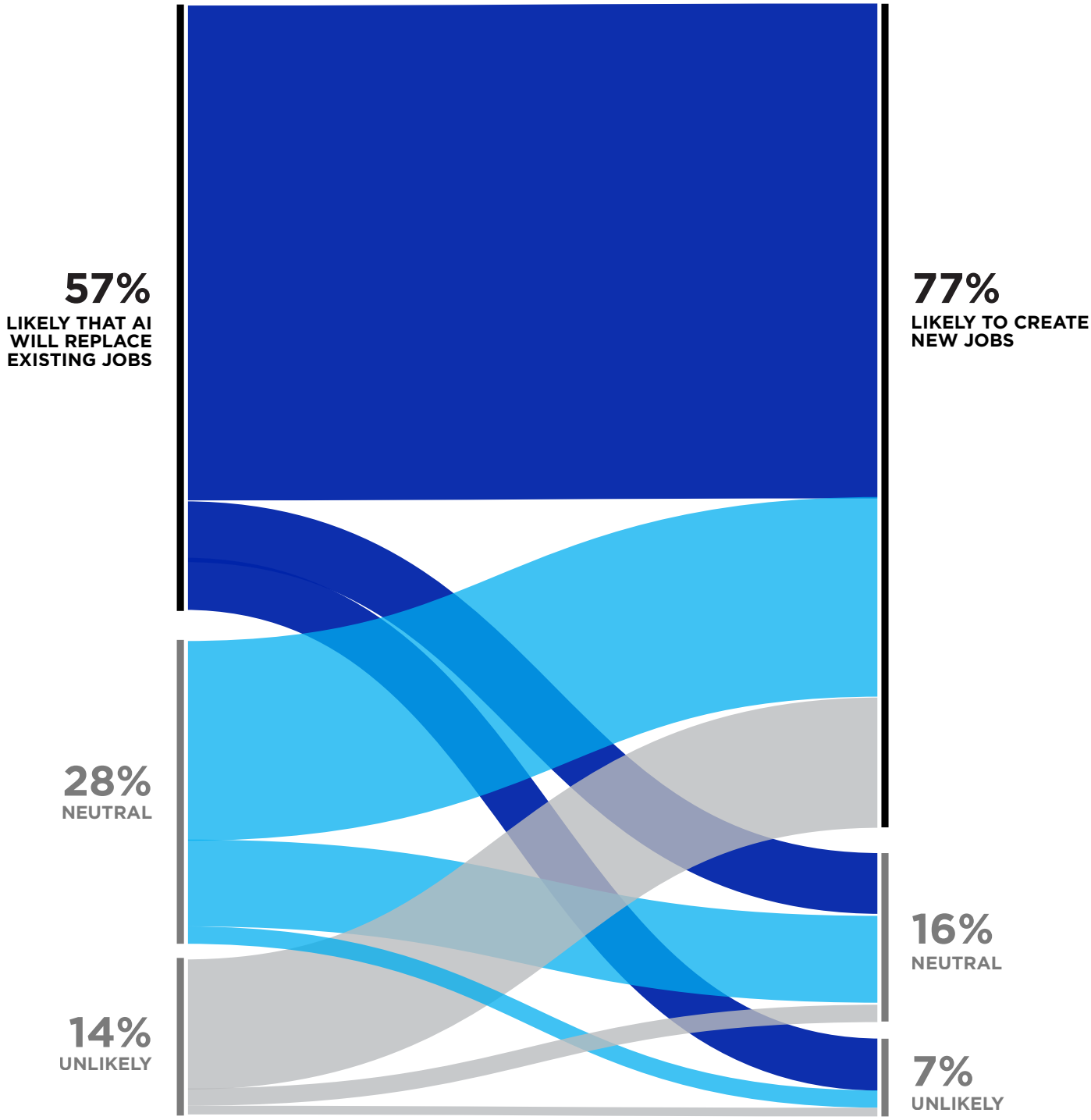
Examples of agility and flexibility in the future:

- Today it is up to individuals to consider their opportunities in the face of automation. As the market changes and certain roles become less valued, an individual could easily begin to acquire new skills through internal or external online training.
- HR managers will rethink the duration of roles and how they are structured within the organisation. Imagine a role being scoped for a specific duration of time, with the individual having the opportunity to shape how long they'd like to be in it, and where they move within the organisation next.
- Today, candidates are hired for a specific role based on overall fit. In the future, candidates could be hired for multiple roles at the same time, using technology to map the talent opportunities within a company, given a candidate's talent and interests. Individuals could see where their skills are most needed and make a decision on whether or not to take on the challenge.
- The type of roles within organisation will shift. Roles will move from being task-based to strategic, enabling teams to support maximum curiosity and innovative thinking.

A majority of leaders believe that while AI will replace existing job roles, it will also create new ones



Job replacement vs job creation as result of AI



People will make a commitment to lifelong learning ... so they could pivot if the thing they were doing ends up being done by software.

–Don Proctor, CEO, Cisco Heritage

(AI) has the possibility of transforming things that, at the moment, are very mundane, very difficult and sometimes very slow to do.

–Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister

Theme 2: AI has the potential to help individuals to become more agile, curious and nimble

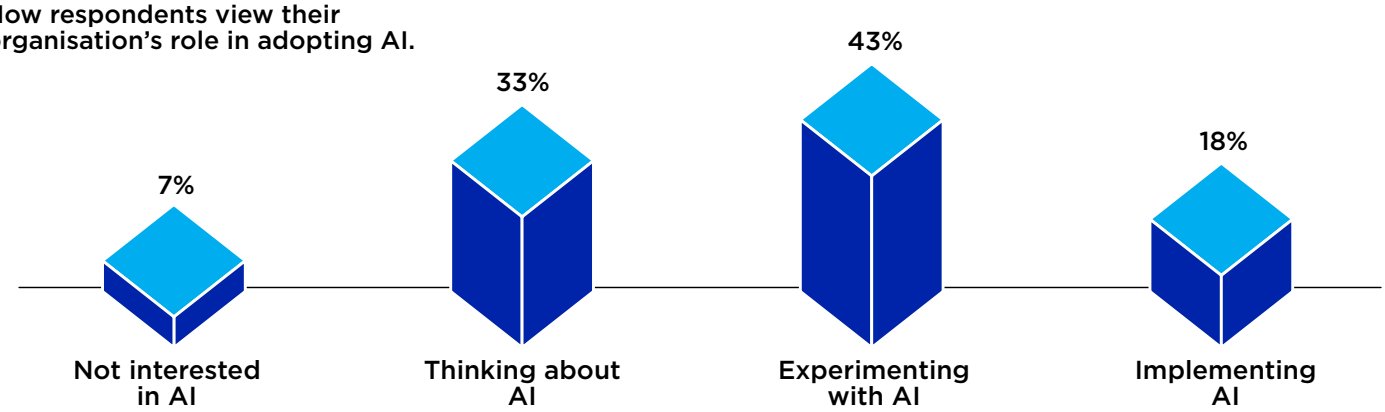
Curiosity and experimentation enhance adaptability, keeping individuals relevant to their business, customers and workers. Our findings indicate that 36% of respondents closely keep up with trends regarding the adoption of AI tools within the workplace, 26% very closely and 17% extremely closely.

As experimentation becomes a greater part of a company's organisational culture, AI has the potential to enhance the abilities of workers, freeing up more time. Identifying what truly improves a company's output, client relationships, R&D, productivity, creativity and connection will enable the organisation to remain relevant and attract the best talent. A majority of those surveyed viewed themselves as Pioneers (17%) or Experimenters (43%), indicating they have implemented or are experimenting with AI tools in the workplace. An additional 33% viewed themselves as Investigators, or are thinking about implementing AI tools.

As more time is freed up through the use of AI, workers will have more personal time and more time to spend with one another, leading to stronger teams, higher job satisfaction and overall happiness. More free time leads to more opportunity and more creativity, freeing people up to do that which make us uniquely human—the ability to think in nonlinear ways and the ability to create.

AI is on the mind of 93% of business leaders

How respondents view their organisation's role in adopting AI.



In the future, we will see people being paired with a companion that helps them do their job. The AI companion will denote where the human is making mistakes, ask questions to make the output better, let the individual know that something in another part of the company is happening that can inform the work.

–Dor Skuler, CEO, Intuitive Robotics

We hire incredibly expert people and then we put them on jobs that could be done by non-experts. Let those experts we hire play at the top of their game. In my field, almost 80 percent of that (time) is spent on less than what their expertise is. Not only would (AI) be better for employee satisfaction because I don't have to deal with the mundane stuff but I (would also) get to deal with the big problems and creation.

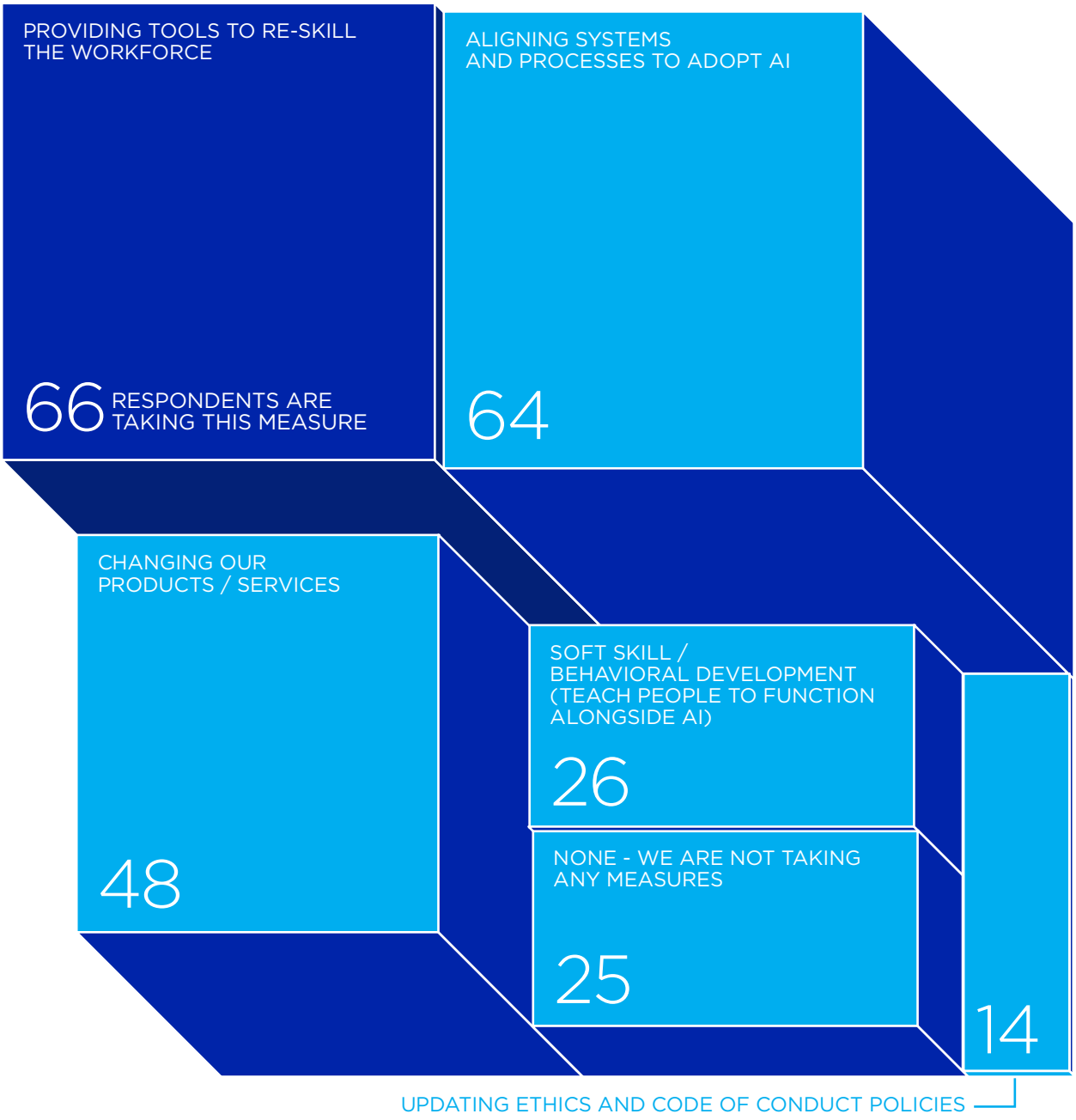
–Executive team member, major national hospital, US

Day-in-the-life scenarios enhanced by AI:

- The process of prioritizing projects is almost completely manual today, with teams using Trello, Asana and other tools to keep track of tasks. In the future, AI has potential to keep track of the cross-functional priorities and make suggestions on what decisions need to be made to expedite projects, initiatives and customer-related activities.
- In the future, AI could assess the innovation priorities of a given team and suggest activities and events that spark creative thinking up and down a company's organisational hierarchy, democratizing the creative process and increasing engagement.
- Using AI, even non-technical workers can experiment with new ideas and features by using a simple graphic user interface (e.g., Dexter).

What companies are doing to prepare for AI

Number of respondents of 120, multiple choices possible



Leaders of both small and large companies believe AI could impact positive change

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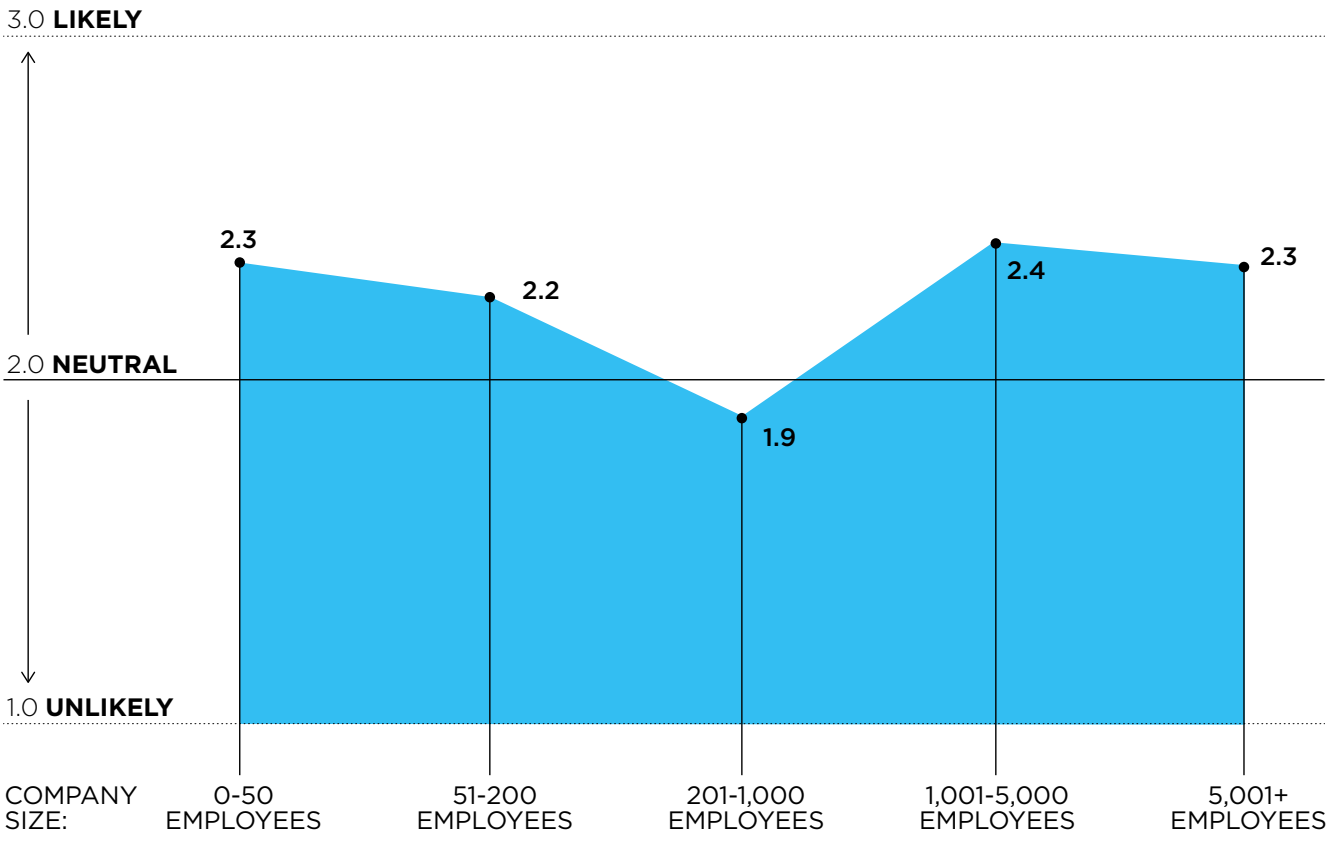
Sentiment index on the likelihood that AI could impact positive change within a respondent's organisation.



Theme 3: AI has the potential to enhance human collaboration

Tools like Zoom, GoToMeeting or BlueJeans are frequently used by major global companies to enhance collaboration, improve workplace culture and drive innovation. Such tools could be enhanced by AI. Our survey found that more than 80% of respondents think that AI could facilitate team composition, organisation and communications, especially for global teams. And more than 80% believe AI could positively impact collaboration in their organization.

Almost all (99%) of respondents feel that AI allows teams to be more productive and efficient, while 93% of respondents see decision-making as positively impacted by AI. With the

There is a divergence in people's objectives when they think about advanced technologies, including AI. One school of thought: "Wouldn't it be cool to build machines that can do what people can do?" The other school of thought is, "What can we do with humans and machines together that has never been possible separately?" The former is about engineering curiosity, and the latter is about impact and changing the world.

–Arati Prabhakar, Former DARPA director

Almost all leaders believe that AI will increase productivity

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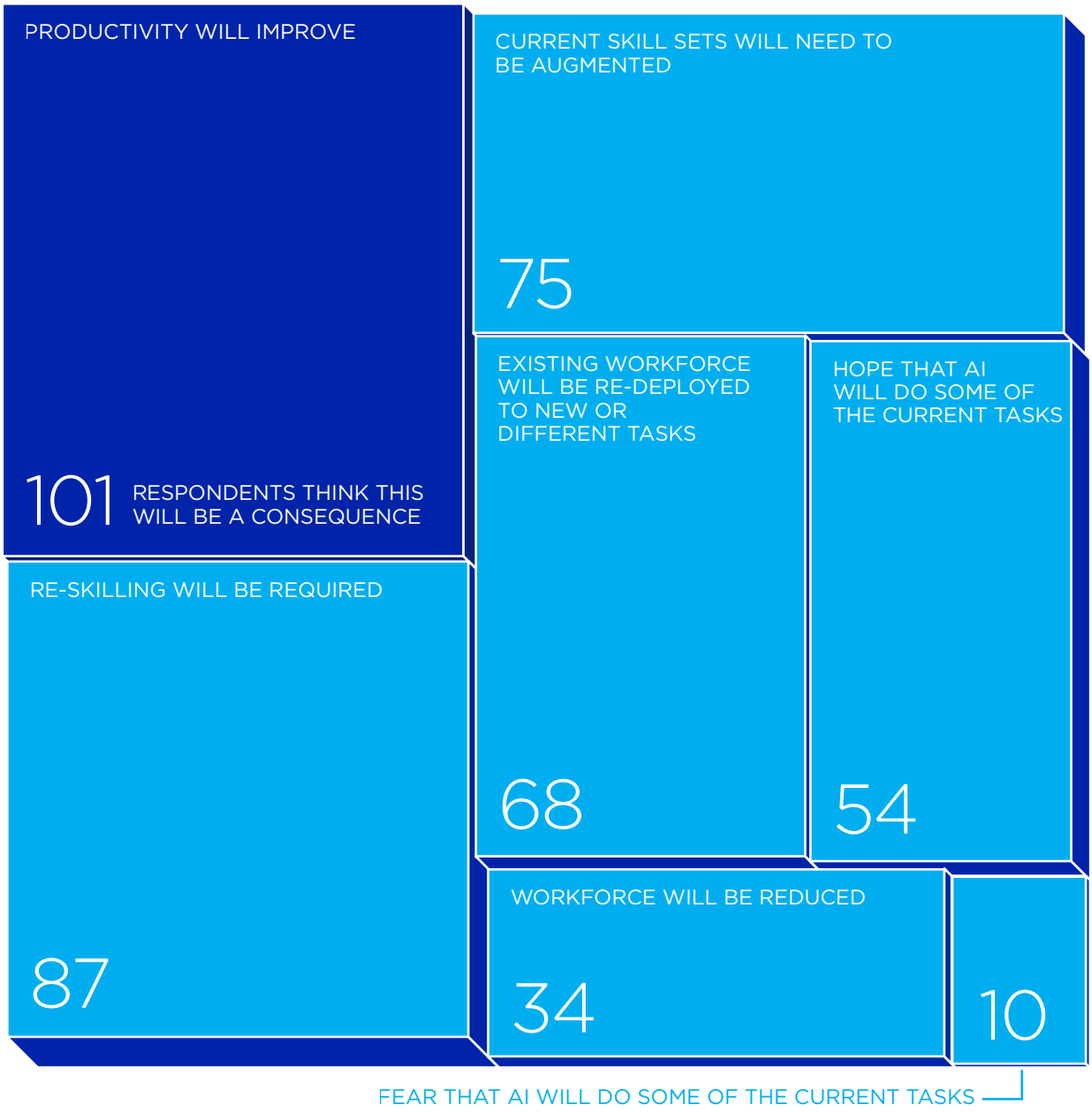
Number of respondents of 120, multiple choices possible



With AI, there will be a far greater emphasis on human interaction. This is not negative.

–Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister

help of AI tools, decision-making, project management and data collection could be faster, contributing to overall productivity. Sixty-eight percent of respondents confirmed that this increase in productivity can lead to an increase in market-share and profits.

Day-in-the-life scenarios enhanced by AI:

- Given the increasingly global nature of business, an international conference call requires advance knowledge of the customs of a culture, or perhaps many cultures at once. In the future, AI could detect cultural sensitivities (through tone of voice and previous inputs) and suggest alternative ways of approaching a team session, a dialogue with a customer or a tough conversation with a direct report.
- Connecting remotely with collaborators is currently a clumsy, manual process: locating the right platform, searching through emails for the correct video-conferencing link, dialling in, etc. In the future, we could ask an AI system to dial a person by name and determine whether it is a Zoom call, a Google Hangout or a GoToMeeting. Such a system could also provide context before that person joins and could later send participants notes and summary of the call.
- Language is probably the most obvious barrier to collaboration. Conversations can only occur between people who share a common language. AI has the potential to provide support, leveraging knowledge of multiple languages and translating in real time.

Positive outcomes of AI

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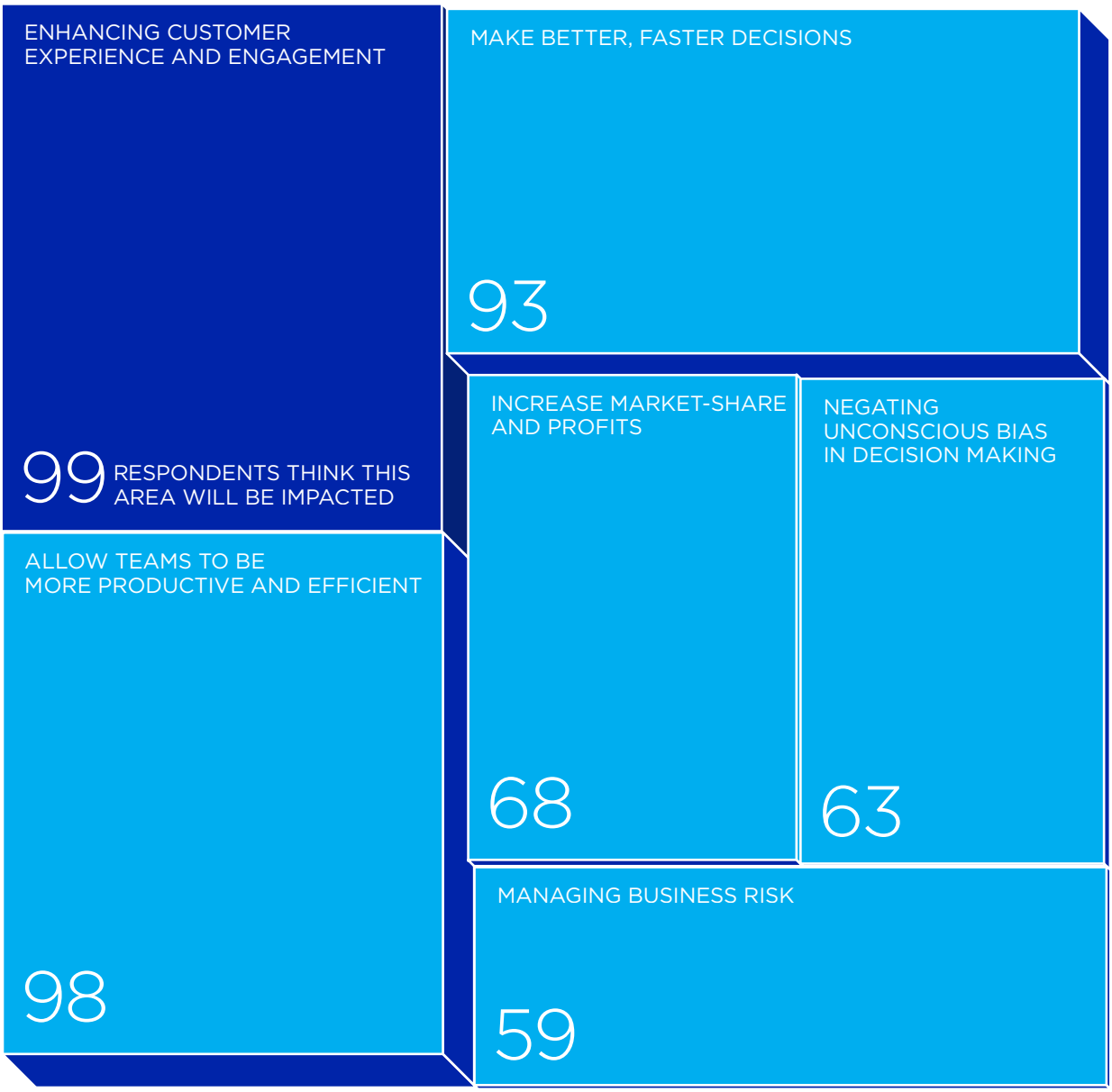
Number of respondents of 120, multiple choices possible



The more intellectual diversity in the room, the more tension and friction, which leads us to find the underlying, universal truth among our differences. That's the Holy Grail.

–Garance Choko, Founder/CEO, Coda Societies

Theme 4: AI has the potential to enhance cognitive diversity within groups

Current competency models within organizations are designed to bring together like minds to work on projects. However, new research suggests that a diversity of minds will yield the greatest output. Companies are embracing new thinking around intellectual diversity as they invest in building the workforce of the future. In our survey, 81% of respondents indicated that demographic diversity in the workplace is important or very important, while 90% believe that cognitive diversity is important for management.

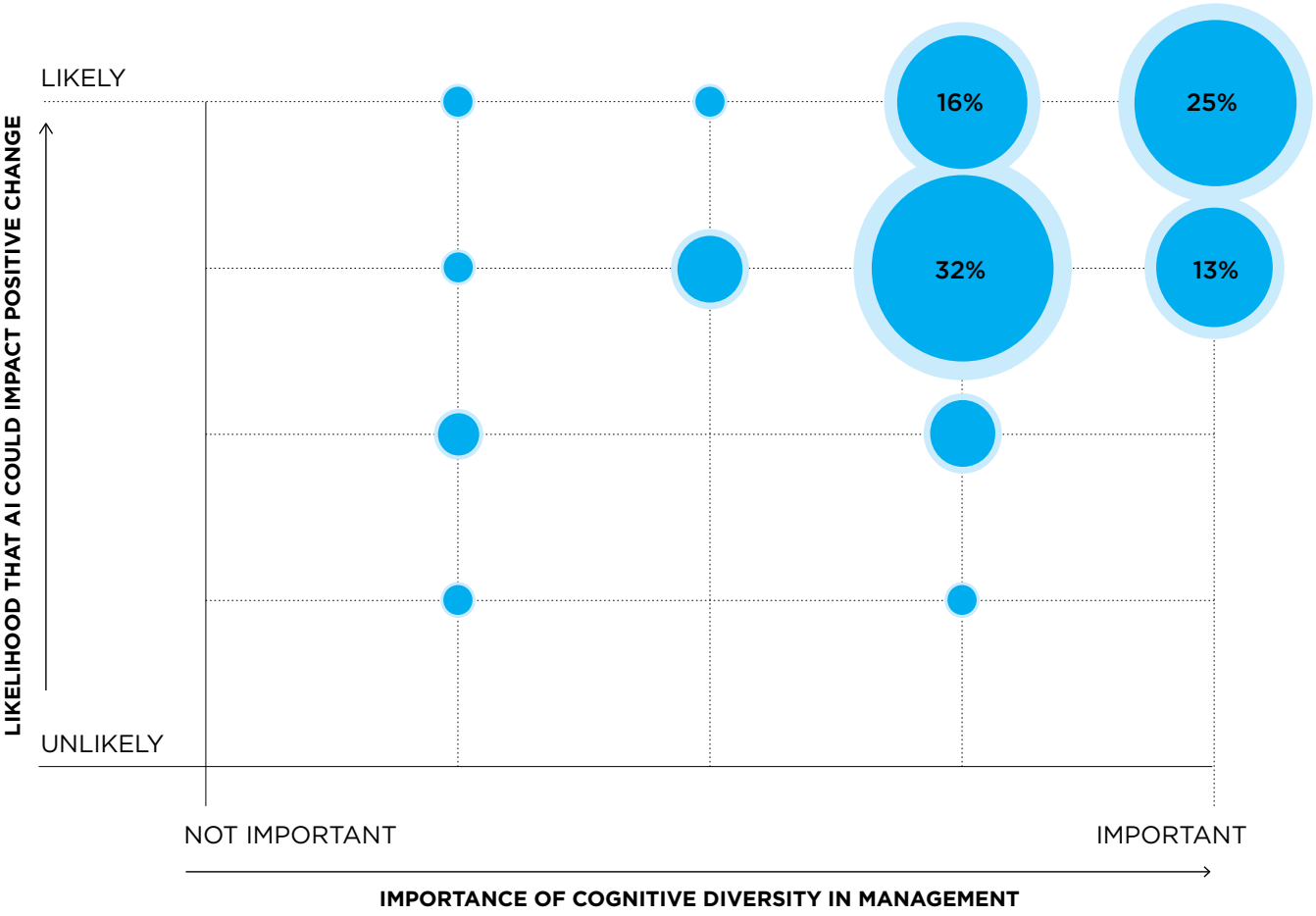
Respondents also agreed it is vital to increase cognitive diversity in teams.

How AI could enhance cognitive diversity in groups:

- Today, team-building is an outbound process, where needs are identified and recruiters are tasked with finding the right person via a talent management tool (e.g., Taleo). In the future, an internal AI system could source candidates and suggest those individuals who are currently available based on intellectual diversity criteria set by the team/organization.
- An AI-enhanced project management tool (e.g., Asana) could suggest the right people to CC on every communication and who should be called to and dismissed from a task, resulting in much more informed team distribution and opportunity for cognitive diversity.
- Designers and product managers often make unilateral judgments about critical product decisions (e.g., building an app that involves multiple inputs, design elements and data sets). To encourage communication between departments, an AI system could recruit expert advice from elsewhere in an organization (an analyst or someone with previous experience), breaking down silos and bringing together a more diverse and informed set of viewpoints.
- When working on a deliverable that requires multiple collaborators, a document is shared by manually entering names into a tool of choice (e.g., Google Docs). With the addition of AI, collaborators could be suggested based on the type of account, current team or people working on similar projects within the organization. The AI system could ask a qualified colleague if they're available to help and then add them to the document.

Leaders who value cognitive diversity also believe that AI could impact positive change

Percentage of respondents



- It might be possible to develop an "AI-based devil's advocate" consistent with the theme of Multiplicity, where AI supports teams by providing a novel cognitive perspective. Such an AI system would surface contrarian perspectives for groups to counter feelings of intimidation among junior members, confirmation bias and groupthink. An "AI-based devil's advocate" might use natural language processing and machine learning to analyze emails and meeting transcripts, learning to be sensitive to keywords and trends so that it could generate periodic reminders about the big picture ("Elephant in the Room") and alerts that challenge unanimous and potentially false assumptions ("Emperor Has No Clothes").

AI could allow us to distil the diversity, both cognitive and identity diversity, so that we can actually see each other for who we really are. I think a machine could help us come to a place of understanding our similarity and our diversities, and then allow us to work with those to create something new.

–Lauren Evanow, CEO/Co-Founder, JITGA

Part 5

Appendix

5

5.1 Participants

Study Participants

Noni Allwood, Founder, Noni Allwood & Associates (Culture Transformation/Diversity & Inclusion Consulting)

Chris Ategeka, Entrepreneur & Investor; Founder, TEDxOakland

Roy Bahat, Head, Bloomberg Beta

Leah Belsky, Vice President of Global Enterprise Development, Coursera

Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister

Winslow Burleson, Associate Professor, New York University

Garance Choko, Founder and CEO, Coda Societies

Aymee Coget, Founder and CEO, Happiness for Humankind

Greg Cross, Chief Business Officer, Soul Machines Limited

Yorgen Edholm, Former CEO, Accellion

Karina Edmonds, Google Cloud University Liaison

Lauren Evanow, Co-Founder and CEO, JITGA

Claudio Garcia, EVP Strategy and Corporate Development, Lee Hecht Harrison

Susan Hassler, Editor-in-Chief, *IEEE Spectrum Magazine*

Michael Joaquin Grey, Artist

Himanshu Kalra, SVP, HR, The Blackstone Group

Phil Libin, Co-Founder and CEO, All Turtles

Kate Machtiger, Design Strategist, Luminary Labs

James Manyika, Chairman and Director, McKinsey Global Institute; Senior Partner, McKinsey & Company

John Markoff, Former Senior Writer, *The New York Times*; Fellow, Center for Advanced Study in the Behavioral Sciences, Inc.

Michael McCreary, HR Business Partner, CIO Organization, Intuit

Jane Metcalfe, Founder, CEO, Editor-in-Chief at New.life; Founder, *Wired* magazine

Debbie Millman, Designer, Author, Illustrator, Educator, Brand Consultant; Host, Design Matters

Reinaldo Pamponet, Founding Partner, Itsnoon

Christiane Paul, Professor/Curator, The New School/Whitney Museum

Léa Peersman Pujol, Chief Curator & Senior Strategist, SYPartners

Jorn Poldermans, Innovation Fellow, Institute of International Humanitarian Affairs

john a. powell, Director, UC Berkeley Haas Institute for a Fair and Inclusive Society

Arati Prabhakar, Technologist; Former Director, DARPA

Don Proctor, CEO, Cisco Heritage

Alexander Rose, Founder and Curator, The Interval; Executive Director, Long Now Foundation

Kei Shimada, Leader, Digital Maker Lab, IBM Innovation and Incubation (Japan)

Dor Skuler, CEO & Co-Founder, Intuition Robotics (Israel)

Mike Sutten, Chief Technology Officer, Kaiser Permanente

Ari Wallach, Founder and CEO, Longpath Labs

Edith Yeung, Partner, 500 Startups (Greater China)

Mushon Zer-Aviv, VP Design, Localize (Madlan)

Gabe Zichermann, CEO, Onward

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