Technology Vision 2024

Human by design

How AI unleashes the next level of human potential

Executive summary

accenture

Foreword

Human by design

How AI unleashes the next
level of human potential

Welcome to our Technology Vision for 2024. This year's Vision is grounded in two realities. First, technology is driving a wave of reinvention that is impacting every part of every business. Second, this emerging technology is becoming more "human" in its nature, creating unprecedented capabilities that, in essence, give people superpowers. Collectively, these two realities stand to reshape the way we work and live.

Consider the possibilities. Where once we adapted to technology — such as changing our habits for a new app or computer interface — technology is beginning to adapt to us. GenAI applications create realistic scripts and images as if created by people. New spatial computing mediums have begun to close the physical-digital divide to enable simultaneous activities in multiple spaces.

Body-sensing technology like brain-computer interfaces and ambient computing are beginning to read and understand us like never before.

This year's Technology Vision comes at a time of expansive innovation in technology that is creating massive opportunities for leaders — from new ways to drive productivity to entirely new ways of doing business and tackling grand challenges. We identify actions to take today and also chart the steps to a future where technology transitions from a passive proxy to an active collaborator that engages with us through more natural interaction.

This move to more human-like technology raises questions about the impact on people. In this year's Vision, we explore this issue

from all dimensions, centering on the importance of shaping technology that is human by design. Technology amplifies human creativity and productivity so we can create a positive impact for the most important part of any enterprise. People.

There's a world of opportunities for our industries across Austria, Switzerland, and Germany. What are they, where are we, and how will we drive this reinvention across our industries? Step boldly into this future with us, and together, we can shape our use of technology.

We believe it's **Human by design.**

Human by design

How AI unleashes the next level of human potential

The relationship between humans and technology is at an inflection point. We can recast the relationship between people and technology and design technology to amplify, rather than change, the things that make us human.

It's time to make technology human by design.

Hasn't technology always been human?

It sounds counterintuitive. After all, hasn't technology always been human? Humans invent technology; we build it, and we scale it. We use it to overcome limitations and do more. Creating tools that extend our physical and cognitive abilities is so unique to humanity that some argue it defines us as a species.[1] Examples abound: automobiles expanded our freedom of mobility, cranes let us build skyscrapers and bridges, and machines helped us create, distribute, and listen to music.

Yet, by nature, the tools we build are often distinctly unhuman. They don't look or act "human", which has always been the point of creating them. Extended use of hand tools can lead to arthritis. Years of looking at screens can accelerate vision problems. We have amazing navigational tools, but they still distract us from driving.

Now, for the first time in history, we see strong evidence that we are reversing course — not by moving away from technology, but rather by embracing a generation of technology that is more human. Technology that is more intuitive, both in design and its very nature, demonstrates more human-like intelligence and is easy to integrate across every aspect of our lives.

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95% of executives agree that making technology more human will massively expand the opportunities of every industry.

For more on the evolution of AI, see A new era of generative AI for everyone **from Accenture Research. To learn more about how our interaction experience is changing, go to** Accenture Life Trends 2024.

Our world is becoming a fusion of atoms and bits, and if we want to help people better live in it, we need to design technology in ways that amplify these human-like traits. It's not an entirely new trend: the invention of the graphical user interface (GUI) created images that were friendly and more intuitive than lines of code; the smartphone miniaturized compute to reflect the mobility intrinsic to humans' lives; one of AI's most impactful uses was translating across languages. But now, this slow trickle is about to become a torrential river of deliberate design.

Consider the impact generative AI and transformer models are having on the world around us. What began as chatbots like ChatGPT and Bard has become a driving force in making technology more intuitive, intelligent, and accessible to all. One example is Adobe Photoshop's Generative Fill and Generative Expand features, powered by Adobe Firefly.[2] These innovations let anyone add, expand, or remove content from images non-destructively, using simple text prompts. Users can now experiment with their ideas, ideate around different concepts, and produce dozens of variations faster than ever before. Where AI once focused on automation and routine tasks, it's now shifting to augmentation, changing how people approach work, and is rapidly democratizing the technologies and specialized knowledge work that were once reserved for the highly trained or deep-pocketed.

Now, for the first time in history, we see strong evidence that we are embracing a generation of technology that is more human.

This is a moment for reinvention. In the coming years, businesses will have an increasingly powerful array of technologies that will open new pathways to unleash greater human potential, productivity, and creativity.

Early adopters and leading businesses have kickstarted a race toward a new era of value and capability. And their strategies are underpinned by one common thread — the technology is becoming more human.

Mercedes Benz: The MBUX Virtual Assistant from Mercedes-Benz uses high-resolution game engine graphics from Unity to elevate the "Hey Mercedes" voice assistant to a new visual dimension. Based on artificial intelligence, this assistant integrates the intelligent systems of MBUX and presents users with a new design with natural interaction. The MBUX Virtual Assistant is based on the MB.OS operating system developed in-house. A special feature is that the assistant reacts empathically to the driver's driving style and personal mood to enable a more profound, human-like interaction.[3]

Genentech, a member of the Roche Group, couples Genentech's artificial intelligence (AI) capabilities, extensive biological and molecular datasets, and research expertise with NVIDIA's world-leading accelerated computing capabilities and AI to speed up drug discovery and development. The collaboration is designed to significantly enhance Genentech's advanced AI research programs by transforming its generative AI models and algorithms into a next-generation AI platform, expediting the discovery and delivery of novel therapies and medicines to people.[4]

Can AI have your attention?

The number of mentions of AI in earnings call transcripts has increased by **6x** since the release of ChatGPT in November 2022.

"Generative AI has the potential to impact much more than just the task at hand, and enterprises have a responsibility to shape it into a world we want to live in."

Tobias Regenfuss

The world we will shape from this expansion of economic growth and empowerment of entire populations is still undecided — and **enterprises have a responsibility to shape it into a world we want to live in.** Leaders will face familiar questions: Which products and services are ripe for scaling? What new data is at your disposal? What transformative actions can you take? But they will also be at the center of answering questions they may have never expected:

What kind of oversight does AI need? Who will be included in the digital transformation? What responsibilities do we have to the people in our ecosystem?

Human by design is not just a description of features. It's a mandate for what comes next.

As enterprises look to reinvent their digital core, human technology will become central to the success of their efforts. Every business is beginning to see the potential emerging technologies have to reinvent the pillars of their digital efforts. Digital experiences, data and analytics, and products all stand to change as technologies like generative AI, spatial computing, and others mature and scale.
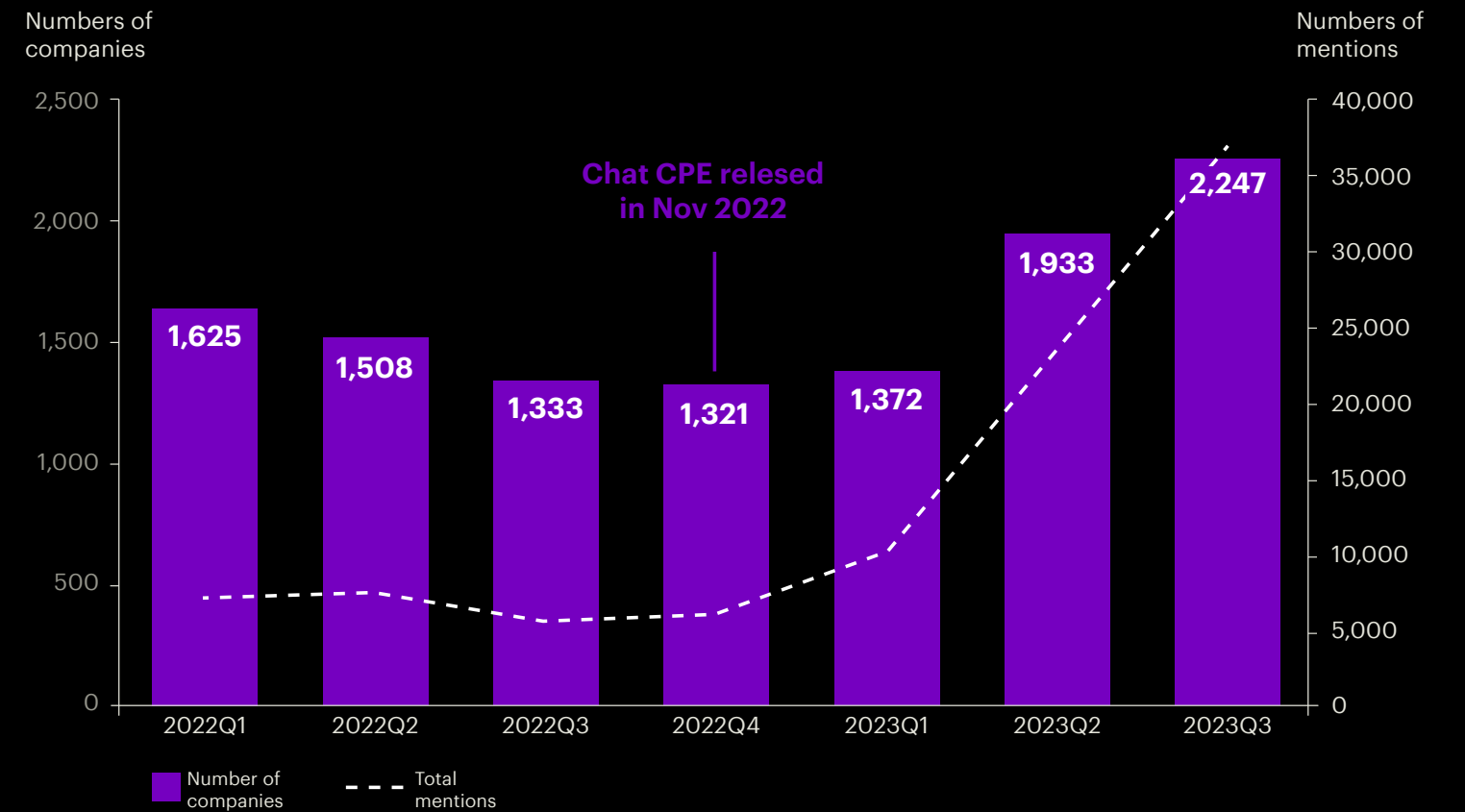
It's on leaders' minds.

Number of companies mentioning AI, along with total number of mentions in earnings call transcripts, 2022Q1 – 2023Q3

Numbers of companies

Numbers of mentions

Chat CPE relesed in Nov 2022

| | Number of companies | Total mentions |

Source: Accenture Research NLP analysis on earnings call transcripts (S&P Global Transcripts) across 10,452 companies and over 70K transcripts; Jan 2022 – Sep 2023

To learn more about how our interaction experience is changing, go to Accenture Life Trends 2024.

When technology is more human, it's more accessible.

Of course, the advent of more human technology is happening across many more dimensions than AI alone. And in the process, it's starting to solve many of the pain points that exist between us and technology, paving the way for greater human potential.

To solve challenges innate to digital work, like video fatigue, Microsoft made major updates to **Microsoft Mesh**, their platform for creating immersive spaces that blend digital and physical[5]. The company is trying to use immersion to solve pain points today and drive new collaborative ways of working.

Recognizing social media's importance in many people's lives and the friction it can create, social media newcomers **Discord and Mastodon** built social networks not driven by a centralized recommendation algorithm but one more reflective of the communities and relationships we build in our personal lives.

We are about to see a massive expansion of every industry through every business dimension. By building fundamentally intuitive bridges between people and the most advanced technologies of our age, productivity and value creation are poised to grow exponentially across every industry.

It's an entire universe of new ideas and actions for businesses and consumers. The world is watching. Will you be a role model or a cautionary tale?

Make it human:
The 2024 trends

Think about the things that make us human: how we think, act, feel, and understand one another. Now, technology is starting to reflect that range of human experience. It's a transformation that will reset our relationship with technology and completely change how we use it and what we do with it.

Last year, Technology Vision explored how the convergence of atoms and bits is building the foundations of our new reality. We described a world where the dissolving barrier between our digital and physical realities was opening up innovations in nearly all dimensions of technology, from artificial intelligence to identity and science tech — and, importantly, how each piece would become a critical part of the enterprise core moving forward.

In this year's Technology Vision, we investigate where the impact of that foundation matters most: people.

The advent of more human technology is a highly concentrated example and the result of the broader trend towards a world where atoms meet bits. This year's four trends outline to enterprise leaders the key dimensions where technology is becoming human by design and how organizations will need to prepare.

Human by design

Based on our 2024 research, we distinguish four trends:

A match made in AI

Reshaping our relationship with knowledge

People are asking generative AI chatbots for information — transforming the business of search today, and the futures of software and data-driven enterprises tomorrow.

Meet my agent

Ecosystems for AI

AI is taking action, and soon whole ecosystems of AI agents could command major aspects of business. Appropriate human guidance and oversight is critical.

The space we need

Creating value in new realities

The spatial computing technology landscape is rapidly growing, but to successfully capitalize on this new medium, enterprises will need to find its killer apps.

Our bodies electronic

A new human interface

A suite of technologies — from eye-tracking to machine learning to BCI — are starting to understand people more deeply, and in more human-centric ways.

More human technology means more ethical questions, and many of these questions require answers before we can proceed.

Positive engineering: Our technology crossroads

Human by design technologies can benefit people and enterprises, but the path forward isn't so simple. The world is arriving at what might be technology's biggest inflection point in history, and enterprises and their leaders' decisions are at the heart of shaping how we move forward.

Enterprises will face the delicate balancing act of needing to act fast versus carefully and the expectation that competitors or other countries may not share the same concerns or impose the same guardrails.

The choices enterprise leaders make, the values they uphold, and the priorities they set will reverberate far beyond profit margins and shareholder returns — making it more important than ever that enterprises innovate with purpose. As we strive to make technology human by design, we need to think of security as an enabler — an essential way to build trust between people and technology — rather than as a limitation or requirement.

And we need to build technology without overshadowing or upending what it means to be human. It's a concept we call "positive engineering". Over the last few years, ethical questions have entered the technology domain from several different directions. Inclusivity, accessibility, sustainability, job security, protection of creative intellectual property, and so much more. Each of them roots back to one single question: how do we balance what we can achieve with technology with what we want as people?

As some humans enter the digital world for the first time and others dive deeper and deeper into it, companies must prioritize their well-being, privacy, and security. Companies striving for technological inclusivity will bridge societal gaps and the voids between the organization, its employees, and its customers. As technologies become more human and expand opportunities for enterprise growth, they must also create new paths for humans to thrive.

93% of executives agree that rapid technological advancements make it more important than ever for organizations to innovate with purpose.

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Responsible AI (RAI):

Taking intentional actions to design, deploy, and use AI to create value and build trust by protecting from the potential risks of AI.

Companies are not the only ones involved in this act. Regulators play a crucial role, balancing caution with providing a stable framework to help increase trust and transparency for the benefit of society. They also work to ensure their economies benefit from the innovations made possible through AI.

For companies, Responsible AI (RAI) starts with adopting and enforcing a comprehensive set of AI governance principles. These principles are structured around seven key pillars: Human-Centric Design; Fairness; Transparency, Explainability & Accuracy; Safety; Accountability; Compliance, Data Privacy & Cybersecurity; and Sustainability.

"Indeed, this is the moment when the importance of this definition becomes clear. By harnessing data, analytics, and artificial intelligence, we unearth new possibilities and harness profound insights to cultivate smarter lives. Ultimately, we all strive to create a positive and safe impact through our work and foster human trust in AI."

Kathrin Schwan

This is a transformative moment for technology and people alike, and the world is ready for you to help shape it.

Accenture's Responsible AI principles

Human by Design

Understand the impact on humans every time you deploy AI and ensure that potential negative impacts are identified and managed consistently with our purpose and core values.

Fairness

All models should treat all groups equitably, and action must be taken to mitigate the potential for unwanted bias and other negative unintended consequences (e.g., unfair impact to gender, race, and ethnicity).

Transparency, Explainability & Accuracy

Disclose the use of AI where appropriate and all should be able to understand and appropriately evaluate AI outputs and decision-making processes. We will use relevant and high-quality data responsibly so that outputs are reliable.

Safety

Evaluate potential safety concern and take action to mitigate harm (e.g., with respect to human life, health, property, and the environment) when deploying AI.

Accountability

Document enterprise-wide governance structures, with clear roles, policies, and responsibilities.

Compliance, Data Privacy & Cybersecurity

All use of AI will comply with relevant laws. We will secure data with appropriate privacy protection and secure AI from cyber-attack. Our respective compliance programs for data privacy and security will be integrated where relevant to ensure compliance with these AI governing principles.

Sustainability

Deploy AI taking into account the impact on the planet, with appropriate steps taken to mitigate negative impacts. Our sustainability program will be integrated where relevant to ensure compliance with AI governing principles.

The EU AI Act is the most comprehensive AI legislation to date — critical for all multinational companies. The act covers any systems developed/deployed in the EU. The act distinguishes between four AI Risk categories: minimal risk, limited risk, high risk, and unacceptable risk. Regulatory obligations intensify with the level of risk — up to banning uses.

Companies need to proactively assess and prepare to comply with the Act's obligations, which can include:

- Fundamental rights impact and conformity assessments
- Operational monitoring
- Risk and quality management systems
- Public registration and other transparency requirements[6]

EU AI in a Nutshell
- Prevent availability or use of prohibited AI systems on the EU market.

- AI providers design and develop High-Risk AI systems and hence must meet conformity requirements and should voluntarily develop Code of Conduct for Medium-Low Risk AI systems.

- AI users must use, monitor and control High-Risk AI systems appropriately and adhere to voluntarily Code of Conduct for Medium-Low Risk AI systems.

Trend 1:
A match made in AI

Reshaping our relationship with knowledge

I think, therefore, I am.

How we collect, store, and access information has always been a deeply rooted part of the human experience. In **A match made in AI** we explore how technology is starting to imitate how we process information. These are not just superficial changes to how we interact with technology but are rooted in memory structures designed and organized similarly to people's brains. The earliest changes are starting in search and will disrupt how we approach knowledge and knowledge management.

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People are asking generative AI chatbots for information — transforming the business of search today and the future of software- and data-driven enterprises tomorrow. Instead of combing through mountains of search engine results, people will receive curated, personalized responses in the form of advice, a summation of a vast set of results, an essay, an image, or even a piece of art.

Companies have the chance today to reimagine how information works throughout their organization and, in doing so, invent the next generation of data-driven business.

Swiss executives see large transformative changes to their business processes to embed this new relationship with knowledge into their companies. Not so German executives, who see mainly their technology architectures impacted. Many also mention that their data and information systems will be highly impacted.

Who wouldn't appreciate instant solutions to their IT inquiries? **Merz**, the parent company of entities in aesthetic medicine, therapeutic medicine, wellness, and beauty products, has transitioned from a traditional librarian approach to a more consultative advisor model for its IT support. This change reflects the information people receive and how they prefer to receive it. By leveraging Generative AI, Merz has investigated how to drastically reduce the response time for IT support queries from 18 hours to instant resolution, successfully resolving 70% of these inquiries immediately. Moreover, the application accommodates global users by offering support in 30 local languages, allowing users to interact in their preferred language.[7]

In the next three to five years, what level of impact do you anticipate generative AI chatbots will have on each of the following aspects of your organization?

High transformational change on business processes

Global	Germany	Switzerland
38%	35%	52%

High transformational change on technology impact

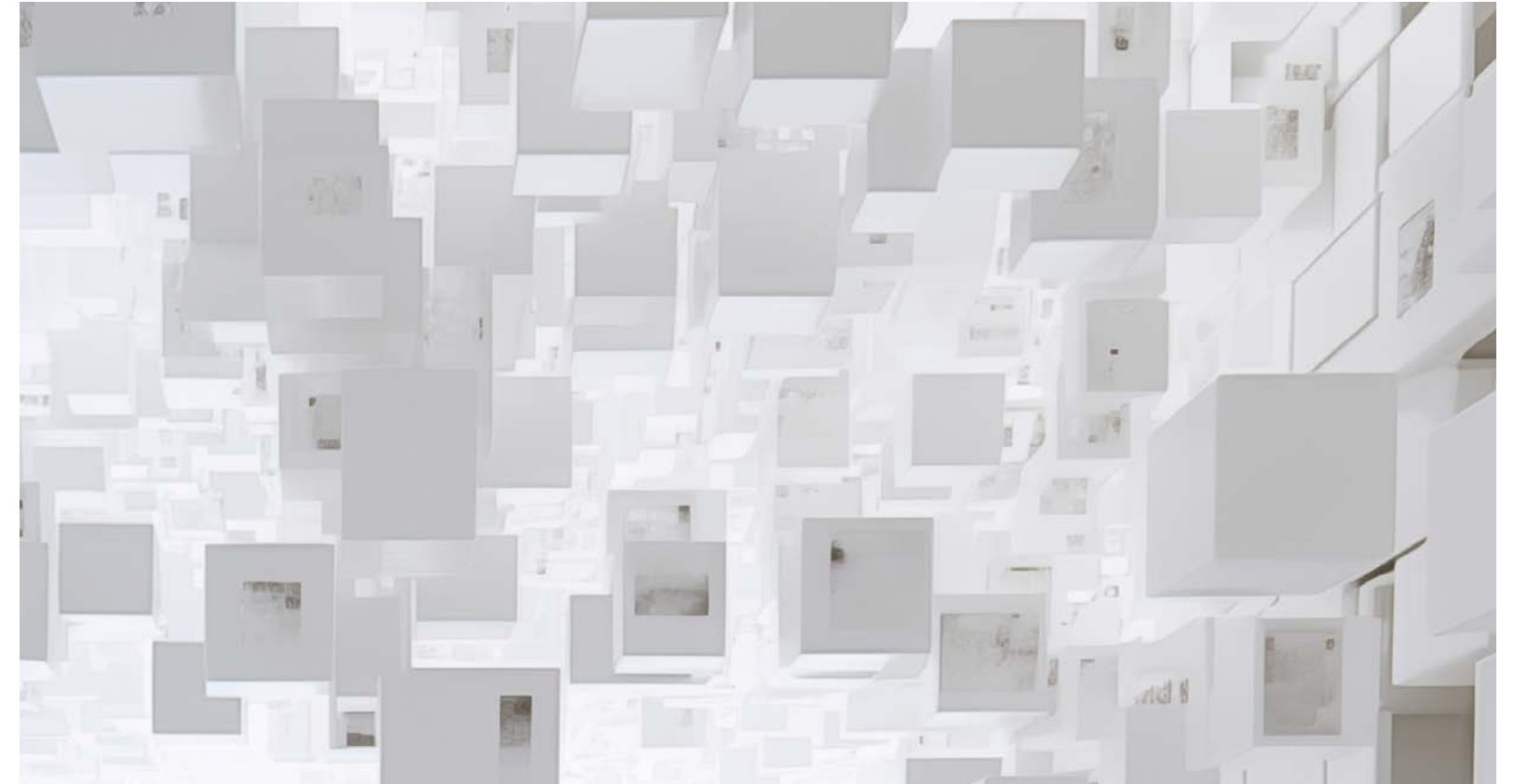| Global	Germany	Switzerland
48%	64%	32%
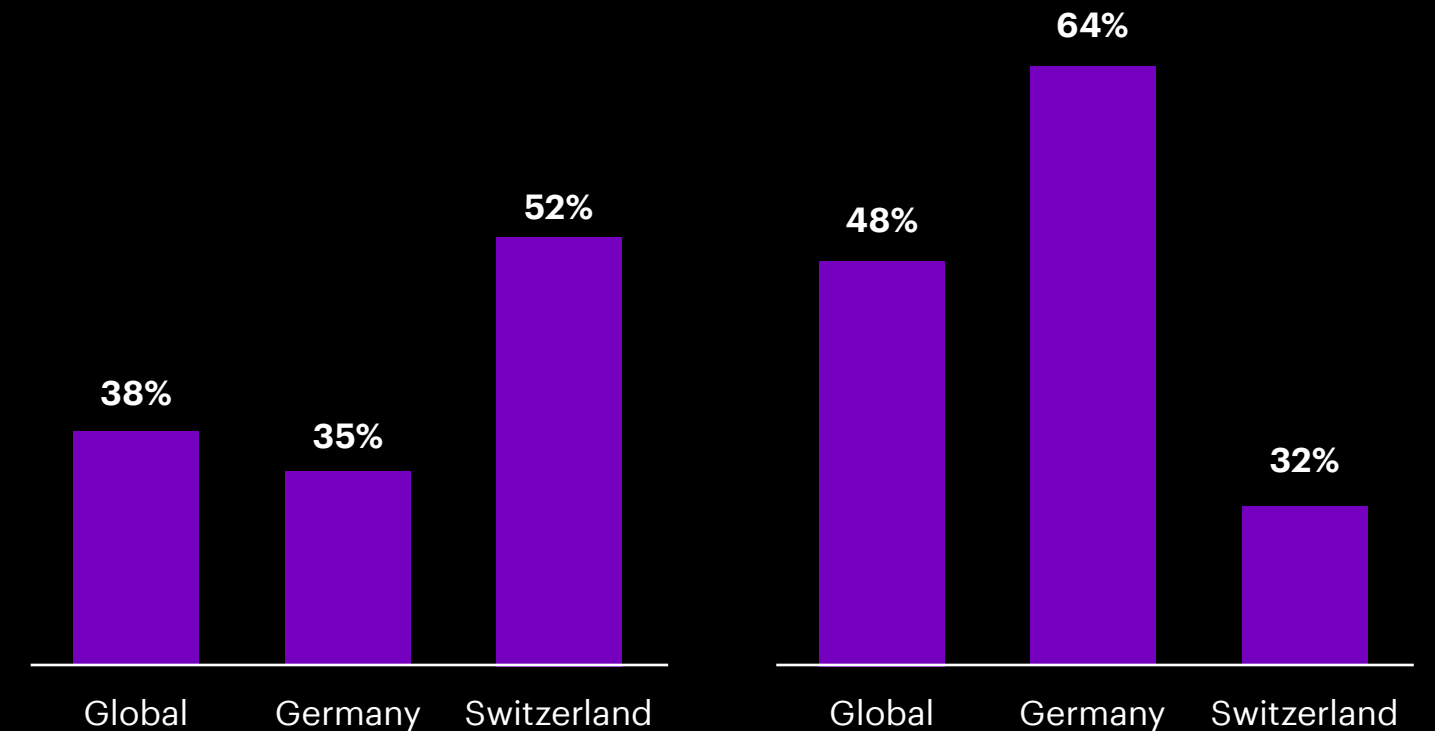
SAP: Joule, an AI assistant integrated throughout SAP's cloud enterprise portfolio, delivers contextualized insights from SAP solutions and third-party sources, expediting workflows and enhancing business outcomes securely and compliantly. Joule's integration into SAP applications streamlines user interactions, providing intelligent responses and solutions drawn from extensive data sources while preserving context. Currently available at SAP SuccessFactors, the AI assistant will become available across other SAP solutions such as SAP S/4HANA Cloud, SAP Customer Experience, and SAP Ariba solutions.[8]

Volkswagen, for instance, integrates ChatGPT into its vehicles. In the future, customers will have seamless access to the constantly growing artificial intelligence database in all Volkswagen models equipped with the IDA voice assistant. They will also have researched content read out to them while driving. Cerence Chat Pro from technology partner Cerence Inc. is the foundation of the new function, which offers a uniquely intelligent, automotive-grade ChatGPT integration. Volkswagen will be the first volume manufacturer to offer Chat GPT as a standard feature in many production vehicles from the second quarter of 2024.[9]

Lakera AI in Switzerland specializes in securing generative AI applications, particularly focusing on LLMs. Their Lakera Guard solution offers enterprise-grade security for various AI models, using a proprietary database with crowdsourced insights and open-source data. With nearly 30 million attack data points, the LLM-agnostic solution focuses on securing Q&A use cases by addressing prompt injections, PII detection, content moderation, and hallucinations. Developers can easily integrate Lakera Guard with one line of code to embed a security layer into AI applications in production.[10]

In this context, a slight variation in LLMs is gaining traction. Enterprises are beginning to fine-tune smaller language models (SLMs) for specialized use cases. SLMs like DeepMind's Chinchilla and Stanford's Alpaca have started to rival larger models while requiring only a fraction of the computing resources. These SLMs are more efficient, run at lower cost with smaller carbon footprints, and can be trained quickly and used on smaller edge devices.[11]

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The implications: The future of enterprise knowledge

As companies begin to navigate the exciting prospects offered by LLM (Large Language Models) advisors, it's critical to recognize and understand the potential risks involved.

Issues such as "hallucinations" or inaccuracies in the generated content are notable, alongside concerns about data security, computing costs, explainability of AI decisions, and the necessity for user training and expertise. Rather than viewing these challenges as obstacles, they should be seen as motivators for adopting the technology with proper safeguards.

Internally, deploying generative AI chatbots allows employees and customers to access a broader range of knowledge and context-specific solutions in previously unattainable ways.

Externally, the focus shifts to how these generative AI chatbots can revolutionize how customers discover information about a company's products or services, enhancing the buying experience.

The moment has arrived to fully leverage the capabilities of LLM advisors, marking the dawn of a new era in technological advancement.

Security Implications

Companies should also consider how LLM advisors may change user data dynamics. Historically, search providers have held all the power, storing a treasure trove of data about companies and their customers, and often leaving people wary of how their information was used and who even had access to it.

Now we have an opportunity to reinvent the ethos of search and restore trust between businesses and their customers.

Companies can now act as stewards of their information — storing, securing, analyzing, and disseminating their data and institutional knowledge directly to customers through digital advisors. This is a big responsibility: your company must ensure your data remains secure while yielding high-confidence responses in your advisory services. It's an even bigger opportunity: without search providers mediating the exchange of information, companies can serve as a direct source of reliable insight and win back their customers' trust.

Conclusion

Generative AI is the ultimate game-changer for data and software. LLMs are changing our relationship with information, and everything from how enterprises reach customers to how they empower employees and partners stands to transform. Leading companies are already diving in, imagining and building the next generation of data-driven business. And before long, it won't just be leaders. It'll be the new way digital business works.

Trend 2: Meet my agent

Ecosystems for AI

Autonomy and the ability to act are even more innate to the human experience — before people could write or build, we were hunting and gathering, making decisions, and engaging the world around us. Now, in **Meet my agent** we are tracking the evolution from AI that can perform singular tasks to AI agents that, with appropriate oversight, can work with one another and act as proxies for people and enterprises alike. Today, we might think of it as automated assistants for individual interactions, but tomorrow, the agent ecosystem has the potential to underpin the entire business-to-business landscape.

AI is taking action, and soon, entire ecosystems of AI agents could command major aspects of business. Appropriate human guidance and oversight is critical.

Executives agree that AI is transitioning from acting as generators of ideas to agents that can act together and complement humans to accomplish specific tasks. Globally, 94% of executives agree that AI's capabilities are expanding, moving from assisting to acting independently. In Germany, that's similar at 95%. Swiss executives express a more careful view on the matter, with 85% agreeing.

A similar picture emerges when executives are asked about the opportunities they see for their companies, as Swiss executives are more cautious.

Siemens Industrial Copilot will allow users to rapidly generate, optimize, and debug complex automation code and significantly shorten simulation times. This will reduce a task that previously took weeks to minutes. The Copilot ingests automation and process simulation information from Siemens' open digital business platform, Siemens Xcelerator, and enhances it with Microsoft's Azure OpenAI Service. Customers maintain full control over their data, which is not used to train underlying AI models. Siemens Industrial Copilot promises to boost productivity and efficiency across the industrial lifecycle. Using natural language, maintenance staff can be assisted with detailed repair instructions, and engineers with quick access to simulation tools.[12]

ABB unlocks insights hidden in operational data for its customers by deploying Copilot capabilities with the ABB Ability™ Genix Industrial Analytics and AI Suite. Its Genix Copilot can generate code, images, and text, and provide advanced monitoring and optimization insights into industrial greenhouse gas emissions and energy usage. It also captures operators' knowledge and facilitates collaborative decision-making across various roles, with a strong emphasis on safeguarding data and knowledge within the enterprise. Industry executives, functional specialists, and shop floor engineers receive real-time actionable insights, enabling them to extend asset lifespan by up to 20% and minimize unplanned downtime by up to 60%.[13]

AI moves from assisting to acting independently

	Global	Germany	Switzerland
	94%	95%	85%
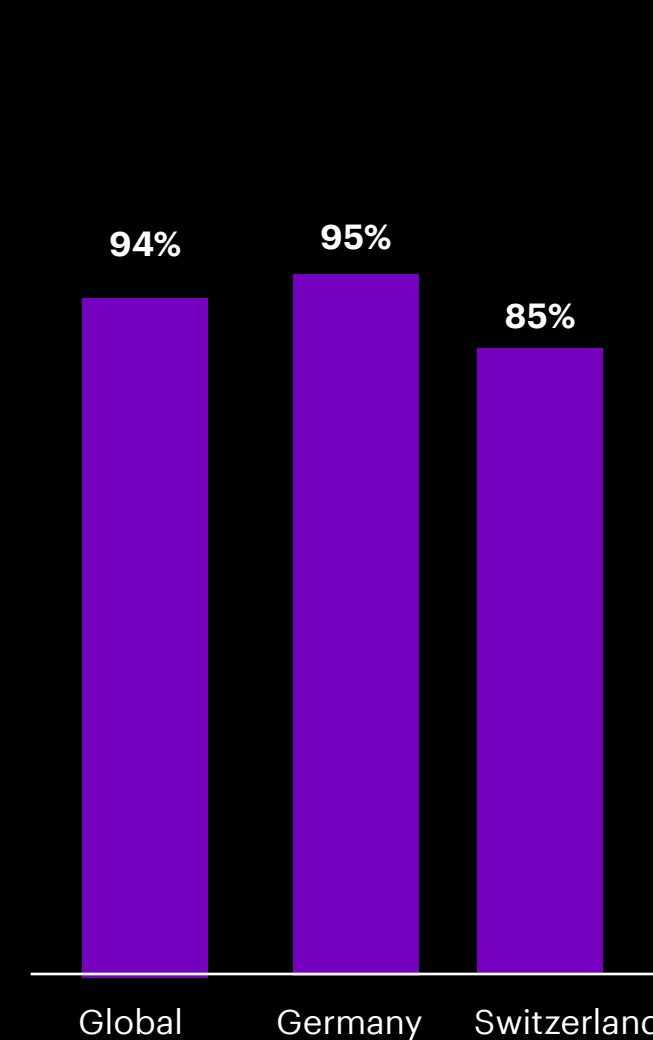
Building/plugging into an ecosystem is a significant opportunity

	Global	Germany	Switzerland
	96%	98%	80%
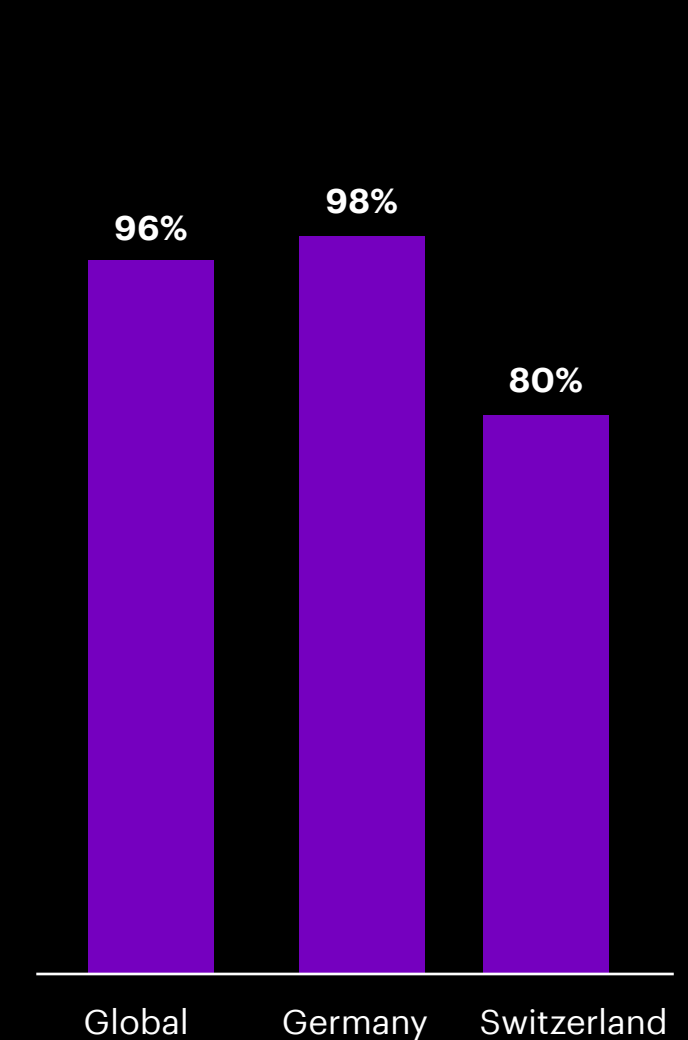
The implications: Aligning tech and talent in the workforce

What happens when the agent ecosystem gets to work? Whether as our assistants or proxies, the result will be explosive productivity, innovation, and the revamping of the human workforce. As assistants or copilots, agents could dramatically multiply the output of individual employees. In other scenarios, we will increasingly trust agents to act on our behalf. As our proxies, they could tackle jobs currently performed by humans, but with a giant advantage — a single agent could wield all of your company's knowledge and information.

Businesses will need to consider the human and technological approaches needed to support these agents. From a technology side, a major consideration will be how these entities identify themselves. The impacts on human workers — their new responsibilities, roles, and functions — demand even deeper attention. To be clear, humans aren't going anywhere. Humans will make and enforce the rules for agents.

Security implications

From a security standpoint, agent ecosystems must provide transparency in their processes and decisions. Consider the growing recognition of the need for a software bill of materials — a clear list of all the code components and dependencies that make up a software application — to let companies and agencies under the hood. Similarly, an agent bill of materials could help explain and track agent decision-making.

What logic did the agent follow to make a decision? Which agent made the call? What code was written? What data was used, and with whom was that data shared? The better we can trace and understand agent decision-making processes, the more we can trust agents to act on our behalf.

Rethinking human talent

In the era of agent ecosystems, your most valuable employees will be those best equipped to set the guidelines for agents. A company's level of trust in its autonomous agents will determine the value those agents can create, and your human talent is responsible for building that trust.

And agents also need to understand their limits. When does an agent have enough information to act alone, and when should it seek support before taking action? Humans will decide how much independence to afford their autonomous systems.

Conclusion

Agent ecosystems have the potential to multiply enterprise productivity and innovation to a level that humans can hardly comprehend. But they will only be as valuable as the humans that guide them; human knowledge and reasoning will give one network of agents the edge over another. Today, artificial intelligence is a tool. In the future, AI agents will operate our companies. It is our job to make sure they don't run amok. Given the pace of AI evolution, the time to start onboarding your agents is now.

Trend 3:
The space
we need

Creating value in new realities

In **The space we need**, we're watching the emergence of a new spatial computing medium and the applications taking advantage of its capabilities to pierce the physical-digital divide. The metaverse struggled under the weight of ever-expanding definitions and expectations, but the value in the technology behind it has never been in doubt. Ultimately, we are physical beings, and the digital world has always been a strange environment. Now, spatial computing is letting the digital world reflect what it means to be human and in a physical space.

The spatial computing technology landscape is rapidly growing, but enterprises will need to find killer apps to capitalize on this new medium successfully.

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Globally, consumers are interested. A third (33%) indicate they are, or would be interested in, using spatial computing technologies or devices for shopping today. German and Swiss consumers are yet to be convinced. At most, a quarter sees it enhancing their shopping experience, their learning environment, or, simply, their online fun. A full 40% of consumers in Germany and 34% in Switzerland currently see no interest.

German and Swiss executives, on the other hand, see a great use for spatial computing. Very much in line with their global counterparts, more than 90% will be using it as it provides a realistic alternative or enhancement of the in-person experience. The vast majority see it as an opportunity to create a competitive advantage for their company.

BMW: Are you eager to witness your dream car in action but pressed for time? Imagine virtually taking it for a spin down to the slopes and then, just moments later, arriving in the midsummer sun at your luxurious coastal residence — all accessible from the nearest screen. The BMW content team can swiftly create personalized experiences for you, utilizing 2.5 km of exquisitely detailed virtual coastal road. They can simulate weather, lighting, environment, and terrain types across web platforms, mobile devices, configurators, and retail displays with exceptional realism. Experience the sensation of the (virtual) breeze through your hair at: BMW Group — BMW OPEN BRAND WORLD (en) on Vimeo[14]

Vitesco Technologies: You enter Vitesco Technologies' production facilities in Foix, France. You pass through a few doors and security checks and stand before one of the company's production lines. The line is running smoothly; the monitors show the latest performance data from different sources like Overall Equipment Effectiveness (OEE) and Operational Performance Management (OPM), parts of the Manufacturing Execution System (MES), but something is odd. There is no noise. Suddenly, you hear someone. People appear next to the production line. You recognize colleagues from Mexico, Germany, and Shanghai from different departments.

Welcome to Vitesco Technologies' metaverse platform. Colleagues at Vitesco Technologies, a German-based automotive supplier of powertrains and pioneer of powertrain electrification, can seamlessly collaborate in real-time without the need for business travel.

This innovative approach enhances productivity and fosters innovation by leveraging digital twins and representations of company assets.[15]

TeamViewer: Frontline is an enterprise productivity platform with fully integrated AR solutions. Modern computing technology for wearables optimizes manual work processes in any industry. Frontline xPick: With smart glasses, it enables pick-by-vision, keeping employees hands-free while working and supporting various logistical processes, including manual picking and warehouse management. Frontline xMake: AR-supported make-by-vision solution that speeds up assembly processes by providing paperless instructions directly in the mechanic's field of vision. Frontline xInspect: With the inspect-by-Vision tool, time-consuming inspection, service, and maintenance work can be done more efficiently. Frontline xAssist: Support process, the remote expert sees exactly what the technician on site sees and can give him instructions in real-time.[16]

Wien Energie: Say goodbye to the hassle of dog walking! Meet Energy Dog, the autonomous watchdog that takes itself for a stroll, keeping humans safely away from potentially hazardous areas. With regular inspections needed at plant facilities, Energy Dog is eager to conduct these checks, helping to overcome workers shortage due to the demographic change and mitigating risk exposure for human inspectors. And that's not all — it also excels in sharing its findings in a format that's effortlessly accessible and digitally friendly, ensuring that plant inspections are now more safe, swift, and highly efficient. This is where cutting-edge functionality meets practicality — indeed, it is a case of having both bark and bite![17]

The Industrial Metaverse — it's now table stakes

In his recent keynote at CES, **Siemens CEO Roland Busch** underscored several pivotal themes, notably the industrial metaverse and digital twins, as the gateway to this new digital frontier. Data and AI are key in driving their realization by anchoring these concepts.

In industry, while tangible goods are manufactured in the physical realm, the convergence of real and virtual domains is rapidly unfolding. Busch emphasized the criticality of amalgamating these realms across all developmental phases, from initial plant design to product development, manufacturing, and maintenance. This global collaboration entails engineers and professionals leveraging digital twins that replicate the characteristics and functionalities of their real-world counterparts within a digital realm.

The practice of virtually constructing an entire plant before physical construction has emerged as a foundational strategy. This approach expedites construction timelines and ensures readiness for production far more swiftly than traditional methods permit.[18]

Implications

Spatial computing is not coming to replace desktop or mobile computing, but it is becoming an important piece of the computing fabric that makes up enterprise IT strategy. We've already seen the early stages. Digital twins make more sense when you walk through them. Training is more impactful when you can live the experience rather than watch a video. While these were often standalone pilots, a careful consideration of the unique advantages of spatial computing can help shape and guide enterprise strategy. The market is still maturing, but it is quickly becoming clear that spatial apps thrive when applied in three ways: conveying large volumes of complex information; giving users agency over their experience; and, perhaps counterintuitively, allowing us to augment physical spaces.

When it comes to conveying complex information, the advantage of the spatial medium over the alternatives is probably clearest. Since a space can let users move and act naturally, information can be conveyed in more dynamic, immersive ways. We've already seen it in action. Some of the earliest examples of successful spatial apps were industrial digital twins, virtual training scenarios, or real-time remote assistance.

The second advantage spatial has over older mediums is the ability to give users agency to shape their in-app experiences.

Security implications

As the working world goes spatial, businesses will also need to think about security. There will be more devices than ever — employees will use spatial devices for work, and customers will use them to access experiences. And with this ever-expanding device ecosystem, there will be more entry points for attackers too. So how do you put borders on the borderless? Businesses' spatial strategies will need to be designed with zero trust principles.

Additionally, businesses should recognize that spatial is unfamiliar territory, so both vendors and users should expect to have blind spots. One line of defense won't be enough, but Defense in Depth strategies that leverage multiple layers of security (like administrative, technical, and physical) can be deployed to defend this new frontier.

Because spatial computing lets us build digital experiences that embody a physical sense of space, we can design experiences that give users more flexibility to move and explore.

Lastly, spatial applications bring advantages to physical spaces; they can augment, enhance, and extend physical places without materially changing them. Imagine a future office where physical monitors, projectors, and displays are replaced by spatial computers and apps. People will have the flexibility to design simpler spaces, lowering overhead costs, and to change their surroundings more easily.

Conclusion

Spatial computing is about to hit its stride, and the race is on for leaders to get ahead. To position themselves at the top of the next era of technology innovation, enterprise leaders will need to rethink their position on spatial and recognize the effect recent technology advances are about to have. New computing mediums are few and far between, and they can have immeasurable impact on businesses and people for decades. Are you ready to immerse yourself in the moment?

Trend 4:
Our bodies electronic

A new human interface

Lastly, it's always been a challenge to understand people. While technology can track and observe what people do, it often lacks the specificity of what was intended. **Our bodies electronic** looks at an emerging suite of technology that is starting to sidestep the unnatural technology interactions of the past to read and understand people more closely than has ever been possible.

A suite of technologies — from eye-tracking to machine learning to BCI — are starting to understand people more deeply, and in more human-centric ways.

While globally, about a third of consumers are frustrated that current technology does not seem to understand their intent, or at least not easily, German and Swiss consumers are less so. Only one in five consumers feel misunderstood. Still, while less frequently than their global counterparts, more than half of German and Swiss consumers want organizations to develop responsible guidelines on biometric privacy and neurotech ethics and standards.

> "To think, feel, understand, and act — these are human qualities. By surrounding ourselves with wearables, we make it easier to connect to the world on a deeper level and empower people to take an instrumental role in shaping it. Individuals, companies, and governments — all empowered to do more."

Kathrin Schwan

>

#TechVision2024

Zander Labs proposes the **"Neuroadaptivity for Autonomous Systems"** (NAFAS) project, aiming to revolutionize human-machine interaction by addressing the limitations in machines' understanding of human emotions, mental states, and cognitive decision-making. It utilizes a passive Brain-Computer Interface (pBCI), allowing users to perform actions without actively imagining them. The project aims to set new scientific standards in neuroscience with its unique implicit approach.[19]

ETH Zurich: MetaSuit — The MetaSuit is a suit with artificial muscles that enables more intensive interaction with virtual reality. The HASEL muscles (hydraulically amplified self-healing electrostatic actuators) send haptic feedback so the wearer can "feel" the virtual environment. The artificial muscles contract through the application of electrodes and special fluid. The suit can also track movements without camera systems by using the method of "proprioception", which is particularly advantageous in poor lighting conditions.[20]

When technologies can better understand us — our behavior and our intentions — they will more effectively adapt to us.

## Connected is best during emergencies

When every second counts, "Telenotarzt" brings instant emergency medical expertise directly where needed. This is where telemedicine shines.

A push of the button directly from the responder's headset suffices to access a specialized emergency doctor wherever the ambulance is in Germany.

It's how emergency medicine, tele-communications, IT security, and data management come together efficiently and reliably. Since 2014, this has made a difference in patients' lives in more than 50,000 cases, with a typical intervention lasting 12 minutes.[21]

"I am often frustrated that technology fails to understand me and my intentions accurately"

"To gain my trust, organizations will need to develop responsible guidelines on biometric privacy and neurotech ethics and standards"

	Global	Germany	Switzerland
	31%	21%	22%

	Global	Germany	Switzerland
	69%	58%	62%
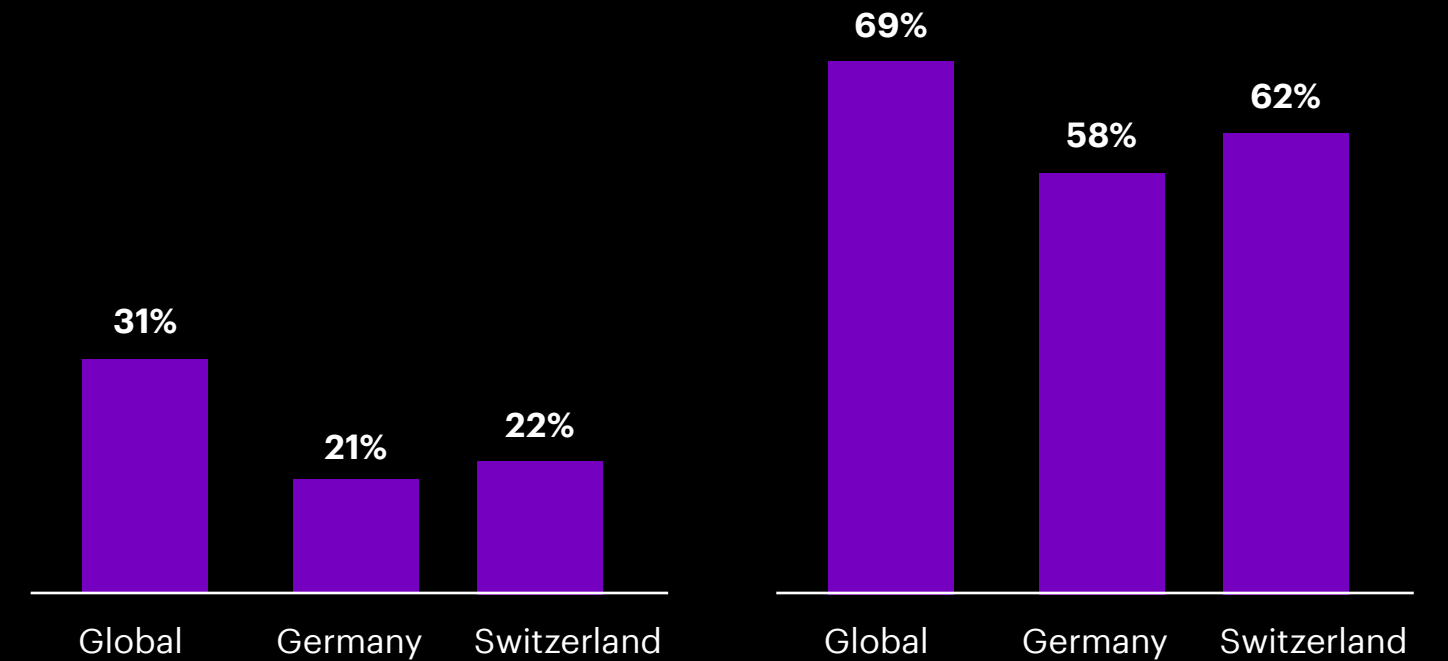
The implications: Getting started — the right way

As more enterprises start to build "human interface" strategies, they should begin by scoping out the different business areas and challenges that can be transformed.

First, consider how "human interface" technologies are raising the bar when it comes to anticipating people's actions. Some of the most promising use cases are in areas where people and machines operate in shared spaces. For instance, enterprises could create safer and more productive manufacturing systems if robots could anticipate what people were about to do.

Another area that can be transformed is direct human-machine collaboration: how we use and control technology. As an example, think about how neurotech is letting us tap into our minds and connect with technology in new, potentially more natural ways.

Lastly, the "human interface" could drive the invention of new products and services. Brain-sensing, for instance, could help people "get" themselves better. L'Oréal is working with EMOTIV to help people better understand their fragrance preferences.[22]

Others are thinking about the "human interface" as a safety measure. **Eyeware Tech** develops software-only head and eye tracking technology for webcams and 3D sensors. GazeSense employs a partner's

Security Implications

If tin foil hats don't prevent mind reading, what will? More than any other trend this year, security will make or break enterprise and consumer adoption of the "human interface".

Acceptance of more perceptive and connected tools hinges on humans' ability to be the primary gatekeepers of what information gets shared, at a minimum.

This practice needs to be integrated into the design of the next generation of human-computer interface tools, letting people either opt into sharing data or telemetry relevant to the task at hand, or opt out of sharing extraneous or sensitive information.

Driver Monitoring System (DMS) to monitor driver drowsiness. The DMS adjusts assistance systems based on real-time gaze tracking, ensuring the driver's eyes are on the road. It also offers secure vehicle unlocking with 3D facial recognition and integrates with Augmented Reality (AR) to streamline the display using eye-tracking technology.[23]

Business competition is changing — and trust is more important than ever.

Businesses need to start assessing the risks posed by these technologies, and what new policies and safeguards need to be put in place. Rather than wait for regulations to ramp up, responsible enterprises need to begin now, looking to existing biometric laws and to the medical industry for guidance.

Conclusion

The human interface is a new approach to addressing one of the oldest business challenges: understanding people as humans. That's a big responsibility and an even bigger opportunity. People will have questions, and concerns about privacy will be the first and most important hurdle enterprises face. But the chance to understand people in this deeper, more human-centric way, is worth it.

Epilogue

The ongoing story:
Trend evolution

The Technology Vision trends represent some of the most impactful, exciting advancements in technology innovation. However, these are just a few trends making up a much broader technology revolution touching every business dimension.

Two years ago, we asked businesses to "Meet us in the Metaverse", and last year, we demonstrated how our digital and physical lives are converging with "When Atoms Meet Bits" — messages that are still as topical and impactful as ever. While some trends may garner more excitement or progress than others year over year (just look at the breakneck pace of AI innovation), innovation is still happening across all these areas — and it remains critical for enterprises to consider the entire scope of change taking place when planning their long-term strategy.

New this year, we present the ongoing story: major themes raised in the Technology Vision underpinning enterprise strategy, the market, and the future of technology.

2024
Technology
trends

A match made
in AI

Meet my agent

The space
we need

Our bodies
electronic

2023
Technology
trends

Digital identity

Your data, my
data, our data

Generalizing AI

Our forever
frontier

2022
Technology
trends

WebMe

Programmable
world

The unreal

Computing
the impossible

2021
Technology
trends

Stack
strategically

Mirrored world

I, technologist

Anywhere,
everywhere

From me
to we

Science Tech

The convergence of science and technology continues to influence innovation at large. Technologies such as AI are accelerating scientific advancements, which are proliferating into industry faster than ever. New domains like energy, materials, space, and biology will increasingly take a primary role in the innovation strategy of the world's most disruptive companies. This feedback loop between science and technology is expanding the horizon of what we can compute, creating tools that will allow us to solve bigger problems, and fundamentally transforming industries and marketplaces.

Sustainability

From regulatory requirements to customer pressure to the desire to be more efficient, sustainability remains top of mind among executives across industries. And technology innovation continues to play a vital part in creating truly circular economies. Emerging technologies at enterprises can build cleaner energy systems, which can offset or diminish negative environmental impacts. While the short-term costs of sustainability efforts may concern some executives, enterprises must not lose sight of the long-term gains — and how leveraging technologies can help.

Digital Ownership

The emergence of digital ownership driven by technologies like blockchain and digital ledgers continues to completely upend long-held conventions around data, identity, customer relationships, and online ecosystems. Distributed computing lets us create unique identities for an array of people and things, allowing for once impossible ownership across digital domains. But ownership itself is not the point — it is what this can support. Digital ownership can excitingly spur new forms of customer engagement, of raising capital, and of interoperability between digital environments.

The Unreal

While generative AI has seized the attention of boardrooms around the world, conversations on deepfakes, doctored images, and falsified videos have inevitably followed. Enterprises are in the middle of debates over what is real, what is not, and whether people really care. The "unreal", however, can be incredibly advantageous to enterprises under the right circumstances. Synthetic data can help us identify and prepare for edge events. Talking to a "fake" sales assistant could be a better, more judgement-free customer interaction. Yet to navigate these possibilities, enterprises will still need to monitor their "unreal" solutions' impact on people, all while bolstering security and risk practices.

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Link to the full report here:
Technology Vision 2024

Accenture's Chief Technology Officer Paul Daugherty presenting at the CES launch

About the Technology Vision

For more than 20 years, Accenture has developed the Technology Vision report as a systematic review across the enterprise landscape to identify emerging technology trends that will have the greatest impact on companies, government agencies, and other organizations in the coming years. This year, the trends look five to ten years into the future while remaining relevant across industries and actionable for businesses today.

Accenture Labs and Accenture Research collaborate on the annual research process, which this year included:

Input from the Technology Vision External Advisory Board, a group of more than two dozen experienced individuals from the public and private sectors, academia, venture capital, and entrepreneurial companies. In addition, the Technology Vision team conducts interviews with technology luminaries and industry experts, as well as many Accenture business leaders from across the organization.

Primary research, including a global survey of 20,027 consumers, to capture insights into their use of, familiarity with, and perceptions about technology in their daily lives. In addition, Accenture conducted a survey of 3,450 C-level executives across 21 industries to understand their perspectives and organizational priorities regarding emerging technologies. The surveys were fielded from October to November 2023 across 20 countries.

Research and data science to analyze technology developments and advancements; and generative AI-led interviews of 50 developers, industrial workers, and advanced users of spatial computing.

As a shortlist of themes emerges from the research process, the Technology Vision team works to validate and refine the trends.

The themes are weighed for their relevance to real-world business challenges. The Technology Vision team seeks ideas that transcend the well-known drivers of technological change, concentrating instead on the themes that will soon appear on most enterprises' C-level agendas.

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Accenture Labs incubates and prototypes new concepts through applied R&D projects that are expected to have a significant impact on business and society. Our dedicated team of technologists and researchers work with leaders across the company and external partners to imagine and invent the future. Accenture Labs is located in six key research hubs around the world: San Francisco, CA; Washington, D.C.; Dublin, Ireland; Sophia Antipolis, France; Herzliya, Israel; and Bangalore, India. For more information, visit Accenture Labs on www.accenture.com.

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