The eco-digital era™

THE DUAL TRANSITION TO A SUSTAINABLE AND DIGITAL ECONOMY

#GetTheFutureYouWant

DIGITAL DATA DESIGN INSTITUTE AT HARVARD | Capgemini RESEARCH INSTITUTE

Executive Summary

In the eco-digital era™, the economy is undergoing a dual transition, delivering economic, environmental, and social value.

Our research reveals that nearly eight in ten organizations (77%) agree that we are experiencing a dual transition towards a more digital and sustainable world.

Executive Summary

The eco-digital economy is expected to double in size over the next five years, with a CAGR of 15%.

- The eco-digital economy is poised for substantial growth, projected to expand from the current $16.6 trillion to around $33 trillion by 2028.
- This shift is underlined by digital technologies playing a role in emissions reduction, more than offsetting their own carbon footprints.
- However, we are at the dawn of the eco-digital era™; the vast untapped potential of digital technologies awaits exploration.

Scaling up of mainstream digital tech, emergence of new innovations, and sustainability investments will fuel this growth.

- Digital investment as a proportion of revenue is also expected to double in the next five years.
- A majority (60%) of organizations express confidence in technology's potential to expedite the achievement of sustainability goals, leading to increased investment in digital solutions for their sustainability impact.
- Scalable adoption of data analytics and cloud solutions will unlock new revenue streams, enhancing cost efficiencies and expediting sustainability initiatives.
- Digital platforms and collaborative ecosystems are set to gain prominence.
- Nearly half of organizations are currently developing a strategy to harness the potential of emerging technologies, suggesting a widespread forward-looking approach.

Significant business benefits await those organizations that can harness digital tech.

- Scaling technologies promises significant business advantages across the entire value chain.
- As well as greater efficiency, digital technologies present substantial cost savings, paving the way for additional investment opportunities.
- Furthermore, the adoption of digital technologies will catalyze the evolution of sustainable business models.

Executive Summary

Optimal integration of digital and sustainability will yield environmental and societal benefits, in addition to economic ones.

- Integration of digital technologies has rendered organizations more sustainable across the entire value chain.
- Over the past five years, organizations have achieved a 24% reduction in energy consumption and a 21% decrease in greenhouse gas (GHG) emissions through the implementation of digital technologies, among other notable benefits.
- Beyond environmental gains, these technologies also contribute positively to society by generating job opportunities, mitigating bias and discrimination, and empowering small businesses, among other significant advantages.

How to harness the opportunities of an eco-digital era™.

- Identify efficiencies across the business to drive cost savings.
- Strive for a well-balanced blend of short-to-medium-term successes, supported by clear business objectives.
- Reinvest savings into digital transformation in order to maximize benefits.
- Embed sustainability and accessible performance metrics into the product and services lifecycle.
- Tap into the industry and supplier ecosystem to accelerate improvements.

Who should read this report and why?

This report provides digital, business, and sustainability leaders across sectors insight into the evolution of the digital economy. Among digital leaders, chief digital officers, chief data officers, heads of AI/analytics, chief information technology officers, chief technology officers, and heads of R&D, engineering, and innovation will find it useful. Additionally, given the growing importance of digital strategy for business and sustainability, the report will inform CEOs, CxOs in general management, strategy, finance, sales, and marketing, as well as sustainability executives.

This report is based on the findings of an extensive industry survey of 1,500 senior executives (director level and above) from global organizations with annual revenue above $1 billion (90% of the sample) and startups with market capitalization of over $1 billion (10% of the sample). Around 65% of surveyed executives belong to the digital category, while the remaining 35% come from the other relevant business functions listed above. See the Research Methodology at the end of the report for more details.

Introduction

The late 2000s was a time of fascinating developments in the digital world. Nokia was a dominant player in the mobile market, with over 40% market share, and sales of BlackBerry smartphones were rising. Then, Apple launched the iPhone, disrupting that dominance.[1] ImageNet, the image database that revolutionized AI research, was still in its infancy.[2] The hashtag was born in 2007;[3] Uber was founded in 2009;[4] and Instagram's first post was published only in July 2010.[5] Entire product ecosystems were created around smartphones; organizations experimented extensively with emerging technologies such as artificial intelligence (AI); new social and cultural phenomena such as social media began to blossom; and entire industries (such as transportation) experienced seismic disruption.

Fast-forward to today and there are similar developments in evidence around the world. The generative AI app ChatGPT garnered its first 100 million users within just two months of its launch in November 2022,[6] only to be surpassed by Meta's Threads app a few months later. TikTok – only launched in mid-2016 – has surpassed Instagram to become the world's most downloaded app. In addition to these commercial developments, with the adoption of the Paris Agreement in 2015, a new consciousness emerged around the urgent need to tackle the climate crisis and promote sustainability. Technology is playing a big role in sustainable development, particularly in attempts to mitigate climate change, from reducing greenhouse gas (GHG) emissions to monitoring flood levels and wildfire conditions, thereby helping to prevent damage and loss of life.[7]

Even as the digital world delivers economic, environmental, and societal benefits, there are reasons to believe what we've seen in the past decade or so is just scratching the surface. Below are a few examples that illustrate this (see also Figure 1):

1. Globally, only 6% of grocery sales happen online,[8] and e-commerce still makes up only about 20% of worldwide retail sales, even as digital leaders such as pizza specialist Domino's generate over two-thirds of their global retail sales through digital channels. The e-commerce market is set to constitute 24% of global retail sales by 2026.[9]

Introduction

2. Electric vehicles (EVs) currently constitute about 2% of the global car fleet; however, the EV market is witnessing exponential growth: 14% of all new cars sold in 2022 were electric, up from less than 5% in 2020.[10]
3. In 2020, 64.2 zettabytes of data were generated globally, indicating a 314% increase from 2015.[11] The amount of data being created is growing exponentially, and it is estimated that by 2025, the world will be generating over 180 zettabytes of data per year, nearly three times that of 2020.[12]
4. Within the last five years, advanced AI models and algorithms have become capable of comprehending written and spoken language and image recognition capable of matching or even exceeding human performance.[13]
5. 5G take-up is much faster than for its predecessors, with subscriber numbers projected to grow fivefold in 2022–28.[14]
6. Innovation is helping organizations become more sustainable. HP uses a lifecycle assessment (LCA) tool that facilitates cutting-edge and refined modelling based on HP-specific parameters to calculate GHG emissions associated with organization-specific systems. Using the tool, HP evaluated the potential to decrease GHG emissions by switching from metal parts produced using milled aluminum to lighter parts produced with HP 3D printing. The assessment demonstrated a possible reduction in carbon footprint of 60–78%.[15]

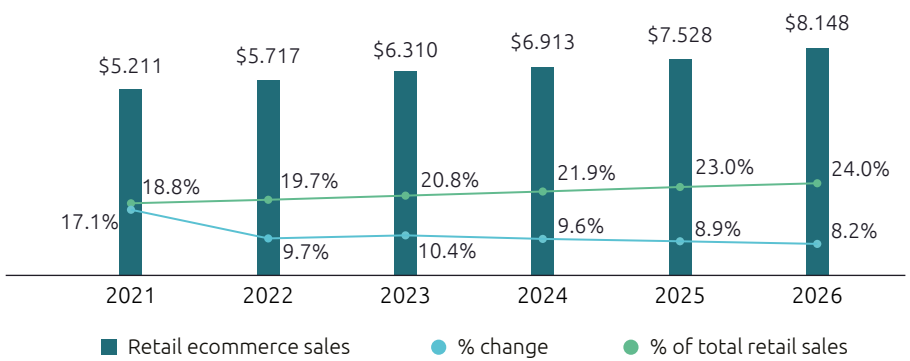
The world expects another digital wave to deliver not only economic, but also environmental and social value. But is this really a revolution in the world economy, or incremental evolution? Are we witnessing a dual transition to a more digital and sustainable world? And how much economic and social value can we expect? With this research, we attempt to answer these questions.

FIGURE 1.

Rapid technological progress is propelling digital and sustainable growth

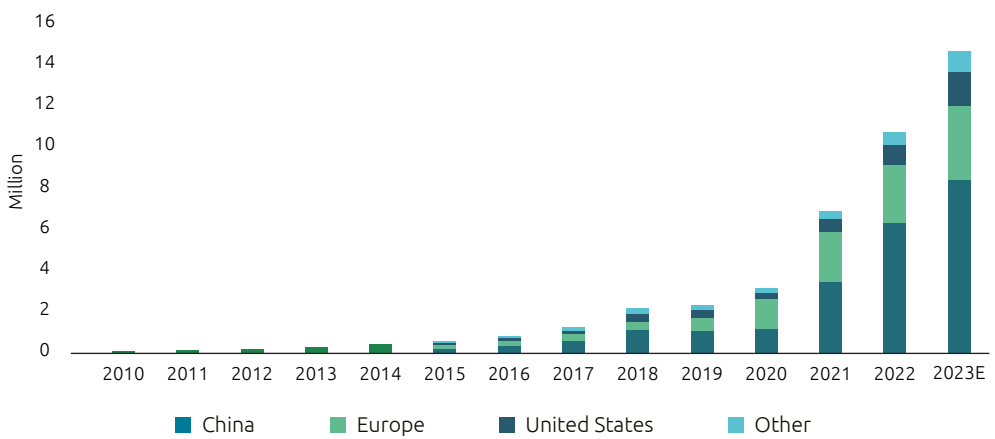
RETAIL ECOMMERCE SALES WORLDWIDE, 2021–2026

trillions, % change, and % of total retail sales



Source: eMarketer, Insider Intelligence

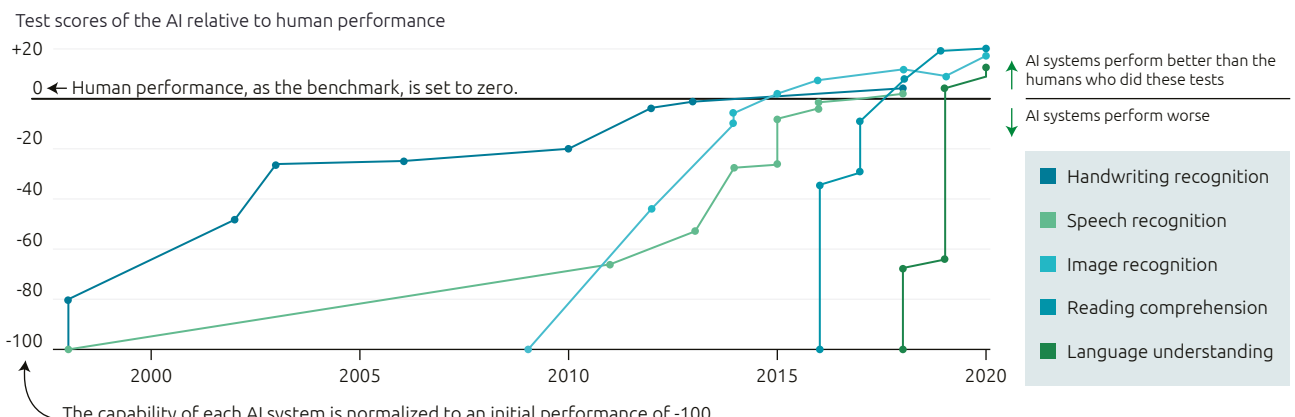
ELECTRIC CAR SALES, 2010–2023



Note: 2023 sales ("2023E") are estimated based on market trends through the first quarter of 2023.

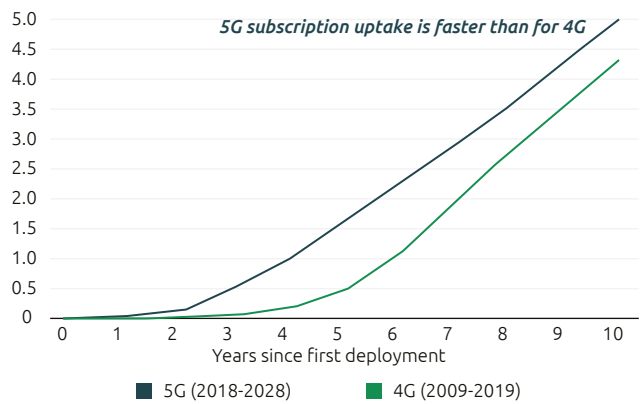
Source: IEA analysis based on EV volumes.

LANGUAGE AND IMAGE RECOGNITION CAPABILITIES OF AI SYSTEMS HAVE IMPROVED RAPIDLY



Licensed under CC-BY by the author Max Roser

COMPARISON OF 5G AND 4G SUBSCRIPTION UPTAKE IN THE FIRST YEARS OF DEPLOYMENT (BILLIONS)



Data source: Kiela et al. (2021) - Dynabench: Rethinking Benchmarking in NLP
OurWorldinData.org - Research and data to make progress against the world's largest problems.

Source: Ericsson, Mobility Report, November 2022.

THE WORLD IS EXPERIENCING A DUAL TRANSITION TOWARDS A MORE DIGITAL AND SUSTAINABLE FUTURE – WE CALL IT THE "ECO-DIGITAL ERA™"

The term "eco-digital economy" refers to the dual transition to an economy that delivers not only economic value, but also environmental and social value. In the eco-digital era™, there is greater exploration of digital technologies' value to business, in which they play a crucial role in achieving sustainable goals; fast evolution of emerging tech such as generative AI and synthetic biology; and greater collaboration, giving rise to digital ecosystems.

Our survey revealed that 79% of respondents believe they are currently witnessing the emergence of an eco-digital era™ that is more interconnected, data-driven, accessible, and sustainable, resulting in significantly greater reach, scale, and social impact (see Figure 2).

Elisabet Svensson, Head of Technology Academy at SKF Group, suggests that the evolving economy is creating transformative opportunities: ***"The economy has been evolving, yet the new, untapped possibilities stemming from the convergence of multiple technologies, collaborative innovation, and the surging prominence of digital platforms mark a new transformative era. This will reshape the way businesses operate. Organizations who are able to solve crucial customer pain points by embracing these profound changes will gain a significant competitive edge."***

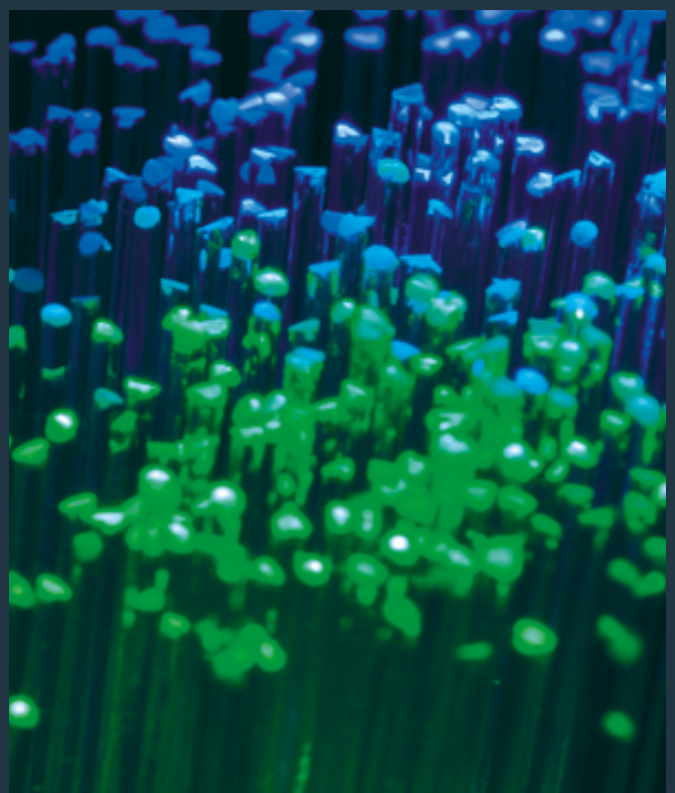


FIGURE 2.
The economy in the eco-digital era™ differs markedly from the traditional digital economy

TRADITIONAL DIGITAL ECONOMY	EMERGING ECO-DIGITAL ECONOMY	WHY IT MATTERS
Limited exploration of digital's value to business	Doubling of the size of the eco-digital economy within the next five years	The size of the emerging eco-digital economy is expected to nearly double from $16.6 trillion today to $32.9 trillion in 2028
Sustainability as a standalone, nice-to-have pursuit	Sustainability as a must-have, powered by digital technologies	Digital technologies contribute more to reducing emissions than their own carbon footprint
Limited exploration of new revenue streams	Software and digital platforms drive emergence of new revenue streams	Capgemini research found that automotive OEMs' software-based revenue could triple from $181 billion (2021) to $640 billion by 2031
Ad-hoc use of technology for driving efficiency	Emerging tech (e.g., gen AI, SynBio, quantum) boosts innovation, productivity, and decision-making	In 2023, Microsoft launched 365 Copilot, the gen AI-powered assistant, across all its apps and services
Individual organizations working in silos	Collaboration and partnerships across industries give rise to digital ecosystems	Frank Loydl, CIO at Audi AG: "The outcomes [of collaboration] are evident: significant quality improvements, enhanced speed, expanded service capabilities, and the creation of new business models."
Changes in skills demand driven by digitalization	Increased demand for a diverse mix of talent and new ways of working	The CDO at a telecom company: "Talent is a critical factor for navigating the new economy […] Without the right culture and talent, we will never be able to make progress."

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard Analysis.

"The economy has been evolving, yet the new, untapped possibilities stemming from the convergence of multiple technologies, collaborative innovation, and the surging prominence of digital platforms mark a new transformative era. This will reshape the way businesses operate. Organizations who are able to solve crucial customer pain points by embracing these profound changes will gain a significant competitive edge."

ELISABET SVENSSON
Head of Technology Academy
at SKF Group

THE ECO-DIGITAL ECONOMY WILL BE MORE DIGITAL AND SUSTAINABLE

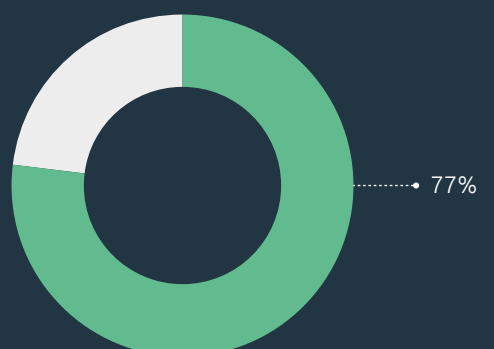
The economy is becoming more sustainable, driven by increasing awareness of environmental and social issues. Industries are embracing green technologies and renewable energy sources, while circular-economy principles, emphasizing reuse and recycling, are gaining traction and minimizing waste. Based on our research, at over half (64%) of organizations, sustainability is on the agenda of every C-suite executive.

Magdalena Gerger, formerly a Member of the Group Sustainability Council Advisory Board to the Management Board of Volkswagen, states: ***"Our group's transformation toward sustainability was initially driven by survival. If the group did not undertake this fundamental change, the company would most likely become irrelevant and disappear over time. Sustainability was expected by our customers, investors, and from society."*** [16]

Consequently, this evolution of an eco-digital era™ will involve a harmonious convergence of digital and sustainability. Our research reveals that nearly eight in ten organizations (77%) agree that they are experiencing a dual transition towards a more digital and sustainable world (see Figure 3).

FIGURE 3.
Organizations are experiencing a dual transition

SHARE OF ORGANIZATIONS EXPERIENCING A DUAL TRANSITION TOWARDS A MORE DIGITAL AND SUSTAINABLE WORLD



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N=1,505 executives.

As we will see in the following sections, utilizing digital technologies to power sustainability offers multifaceted benefits, including optimizing resource usage, lowering levels of GHG emissions to enhance energy efficiency, reducing environmental impact through data-driven decisions, and promoting transparency in supply chains. Ashley Flight, Executive Director and Head of Marketing Automation and Events Platform (EMEA) at JP Morgan Asset Management, echoes this sentiment: ***"The evolving economy will become considerably more digital and sustainable than it is presently. Moreover, the transition to digital promotes increased sustainability."***

The European Commission recognizes the interdependence of the green and digital transitions, considering them twin, mutually supportive challenges. The digital transition is seen as a critical enabler of the European Green Deal, playing a pivotal role in reducing humanity's environmental footprint.[17]

"The evolving economy will become considerably more digital and sustainable than it is presently. Moreover, the transition to digital promotes increased sustainability."

ASHLEY FLIGHT
Executive Director and Head of Marketing Automation and Events Platform (EMEA) at JP Morgan Asset Management

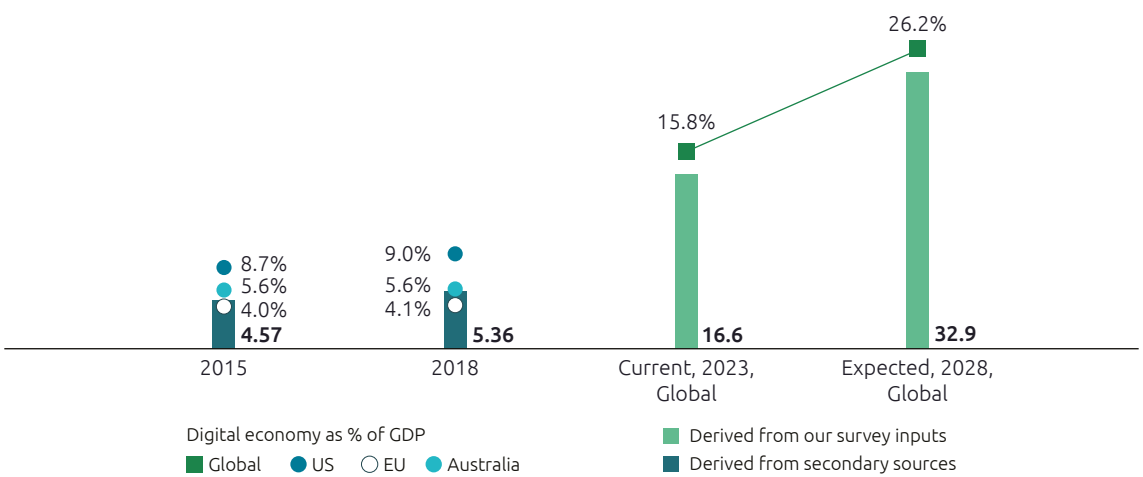
01 THE ECO-DIGITAL ECONOMY IS EXPECTED TO DOUBLE IN SIZE IN THE NEXT FIVE YEARS

Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard 2024

The eco-digital economy has grown exponentially in recent years, transforming economies and industries. Experts expect it will nearly double in size from $16.6 trillion today to $32.9 trillion in 2028, representing a 15% CAGR (see Figure 4).

FIGURE 4.

Experts expect the eco-digital economy to nearly double in size in the next five years



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 150 executives who are digital leaders in their organizations; Capgemini Research Institute analysis. Further details on the calculations and sources in the Appendix.

Despite the volatile geo-political environment, organizations believe that, in the long term, the global economy will march towards an eco-digital future. More than 7 in 10 organizations (71%) we surveyed agree that digitally driven business models will be the key to growth in the next 3–5 years. Further, 60% of organizations expect digitally driven business models to generate more revenue than traditional business models.

The World Bank[18] estimates that the digital economy currently contributes more than 15% of global GDP and that, over the past decade, it has been growing at two and a half times the pace of physical world GDP.[19]

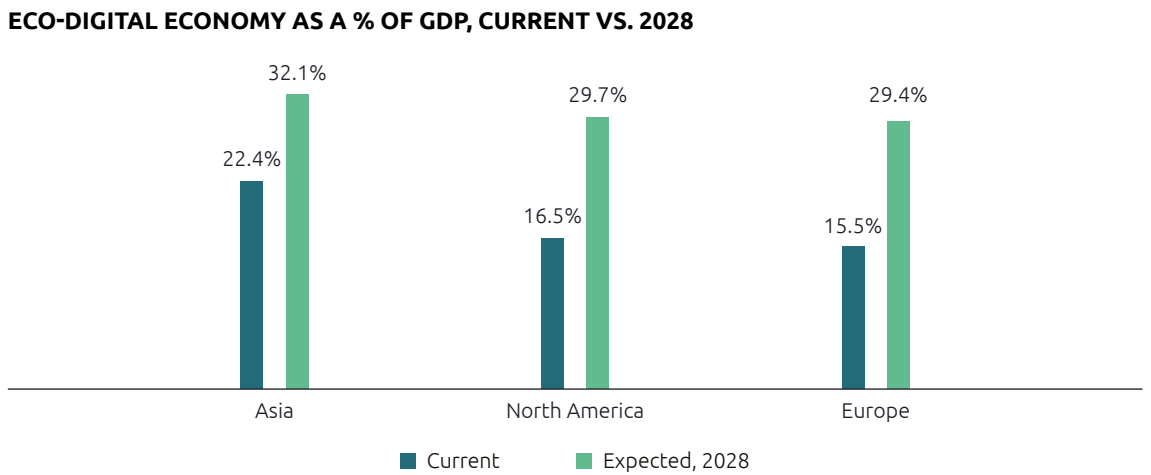
We found that the Asian eco-digital economy contributes most to regional GDP (see Figure 5).

60%

of organizations expect digitally driven business models to generate more revenue than traditional business models.

FIGURE 5.

By region, the Asian eco-digital economy contributes most relative to GDP



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 150 executives who are digital leaders in their organizations; Capgemini Research Institute analysis. *Asia, excluding China = Australia, Japan, India, Singapore; Europe = France, Germany, Italy, Norway, Netherlands, Spain, Sweden, UK; North America = Canada, USA.*

Further, we find that:

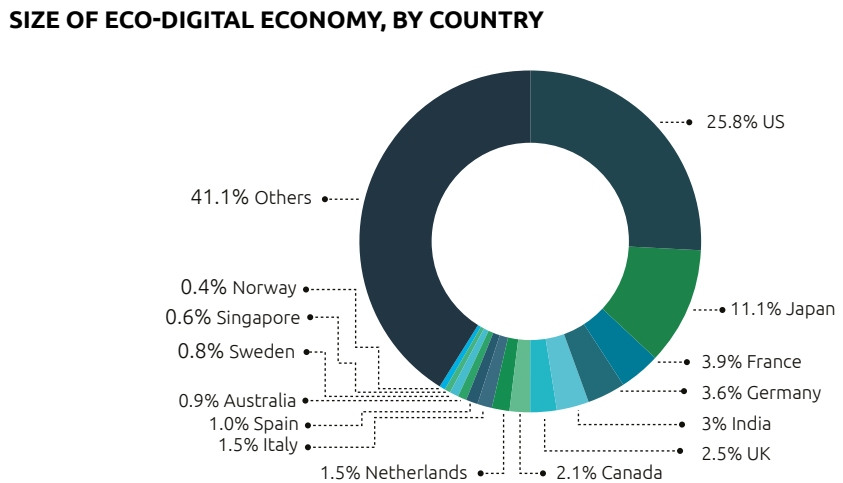
- according to recent research, South-east Asia's digital economy registered a 20% increase in size from 2021, and a recent study forecasts that it will reach $224 billion by 2025;[20] further, pre-pandemic, Asia accounted for 60% of technology patents, up from 40% two decades earlier. It also accounts for nearly 60% of global online retail sales;[21]
- the US digital economy produced $3.7 trillion of gross output in 2021 (up from $3.3 trillion in 2020), equivalent to 10.3% of GDP;[22]
- Finland, Denmark, the Netherlands, and Sweden have the most advanced digital economies in the EU.[23]

The surge can be attributed to various factors, including data utilization, cloud technology, collaborative ecosystems, and connected products/services.

We observe that the US accounts for 25% of the contribution to the eco-digital economy among surveyed countries, with Japan's eco-digital economy representing 11% of the total, followed by other countries (see Figure 6).

FIGURE 6.

The US eco-digital economy constitutes one-quarter of the global digital economy



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 150 executives who are digital leaders in their organizations; Capgemini Research Institute analysis.

Digital technologies contribute more to reducing emissions than their own carbon footprint

Digital technologies can expedite progress towards sustainability goals. The percentage of global emissions from the digital sector is 3.7% at present,[24,25] but is projected to reach 14% by 2040.[26] Assuming consistent growth from current levels to 2040, the percentage of global emissions from the digital sector will rise to 7.2% by 2028.

Organizations in our research have already realized a 20.9% reduction in GHG emissions over the last five years by adopting digital technologies in their sustainability initiatives. By scaling up digital adoption, they have the potential to achieve a reduction of over 30% in GHG emissions over the next five years. Assuming these numbers are consistent globally, we can estimate the net impact of the growth of digital on global GHG emissions through two scenarios:

- In a conservative scenario, with 50% potential reduction achieved, we can expect a 15.6% (=31.2*50%) reduction in GHG emission for surveyed organizations in 2023–28.
- In a high-performing scenario, with 70% of potential reduction achieved, we can expect a 21.9% (=31.2*70%) reduction in emissions.

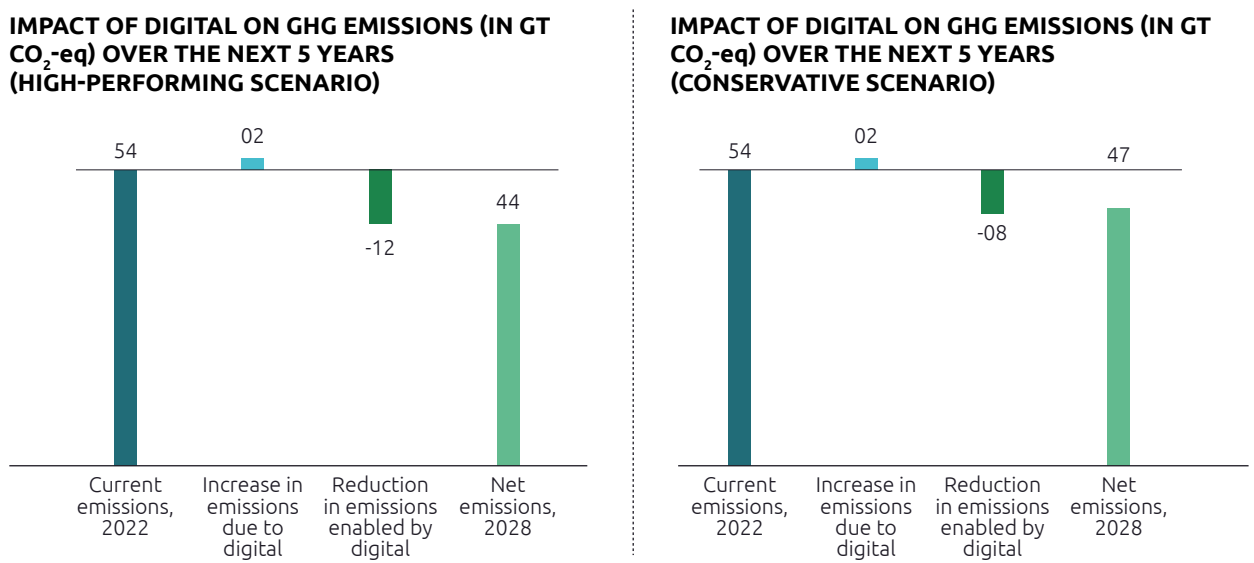
In both scenarios, emissions reduction through digital technologies outweigh the associated carbon footprint, affirming the significant environmental benefits of digital adoption (see Figure 7).[27]

In order to achieve the Paris Agreement target of a 45% reduction in emissions (from 2010 levels), emissions must fall by 8.8% annually between 2022 and 2030. In a conservative scenario, digital technologies are poised to contribute over one-fifth (21%) of this required emissions reduction, while in a high-performing scenario, their contribution is projected to be one-third (33%).

In the following sections, we discuss various environmental and social benefits of scaling digital technologies.

FIGURE 7.

Over the next five years, digital technologies are anticipated to make a net reduction in emissions



Source: Capgemini Research Institute and the Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 146 sustainability function executives; EDGAR 2023 report.

CARBON FOOTPRINT OF DIGITAL TECHNOLOGIES

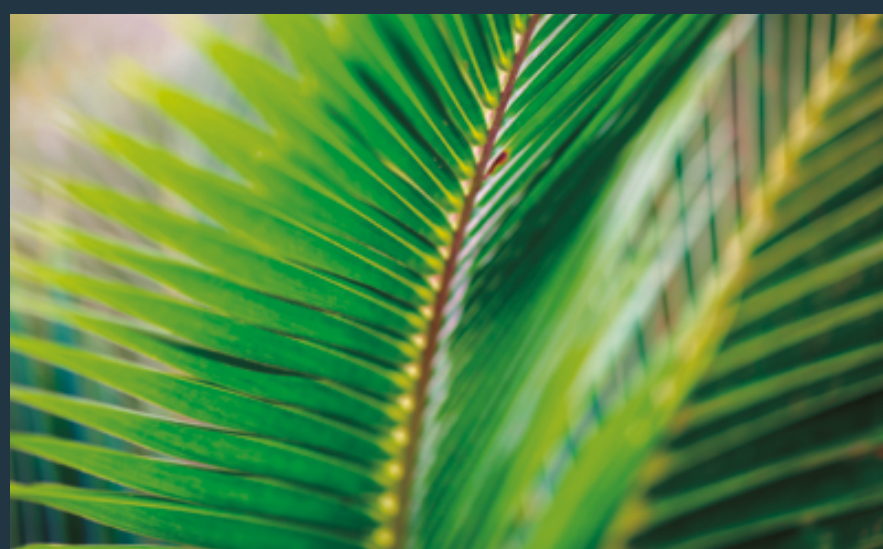
The current digital footprint represents 3–4% of global emissions,[28] and is expected to increase with emerging technologies such as generative AI, the metaverse, digital twins, and quantum computing. We anticipate the digital footprint to reach 7.2%, as discussed earlier, but the reduction in emissions facilitated by technologies should offset this.

There are several reasons for this positive impact of digital on sustainability:

a. It is projected that **digital technologies will lead to a 20% reduction in global GHG emissions.[29]** Organizations employ tools such as augmented/virtual reality (AR/VR), reducing the need for travel. They optimize energy consumption and use digital solutions for data tracking, aiding informed decision-making to mitigate environmental impact. A notable case is LG Electronics in Changwon, South Korea, achieving a 17% productivity boost, 70% higher product quality, and a 30% energy consumption reduction by converting its assembly-line simulation into a digital twin, integrated with real-time data.[30]

b. With widespread **adoption of technologies, energy efficiency is rising**. A study revealed that, while computing in data centers surged by around 550% from 2010 to 2018, energy consumption increased by a mere 6% during this period. Remarkably, despite exponential growth in cloud computing demand, data centers consumed around 1% of the world's electricity output in 2018, the same as in 2010.[31] Another example are the AI systems that Google uses to reduce the amount of energy used to cool its data centers by 40%.[32] The growing size and adoption of generative AI models has raised concerns around energy consumption and carbon footprint. However, already, there are ways to limit their carbon impact by reusing existing, trained models, and using computationally less intensive approaches, such as tiny machine learning (TinyML)[33] and small language models (SLM).[34]

In summary, digital footprints are set to expand with the adoption of established and emerging technologies. Use of technologies to reduce the carbon footprint, coupled with advances in energy efficiency within the digital landscape, suggest that benefits are expected to outweigh environmental costs, affirming the significant positive impact of digital technologies.

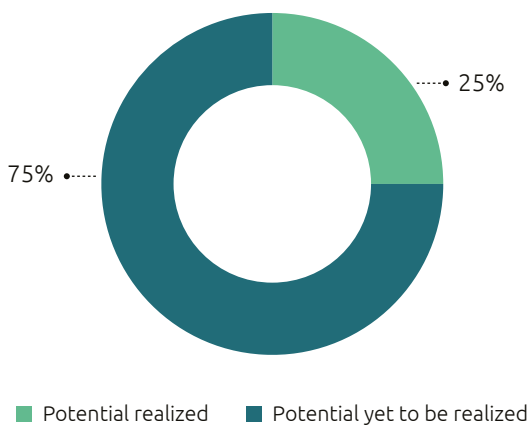


However, we're only at the beginning of the eco-digital era™, with vast untapped potential

Organizations have only scratched the surface of the current technological landscape, harnessing around 25% of the overarching potential of mainstream technologies such as AI/ML, robotics, automation, and the Internet of Things (IoT) (see Figure 8). This statistic underscores the immense untapped possibilities in digital innovation.

FIGURE 8.
There is immense untapped potential in digital technologies

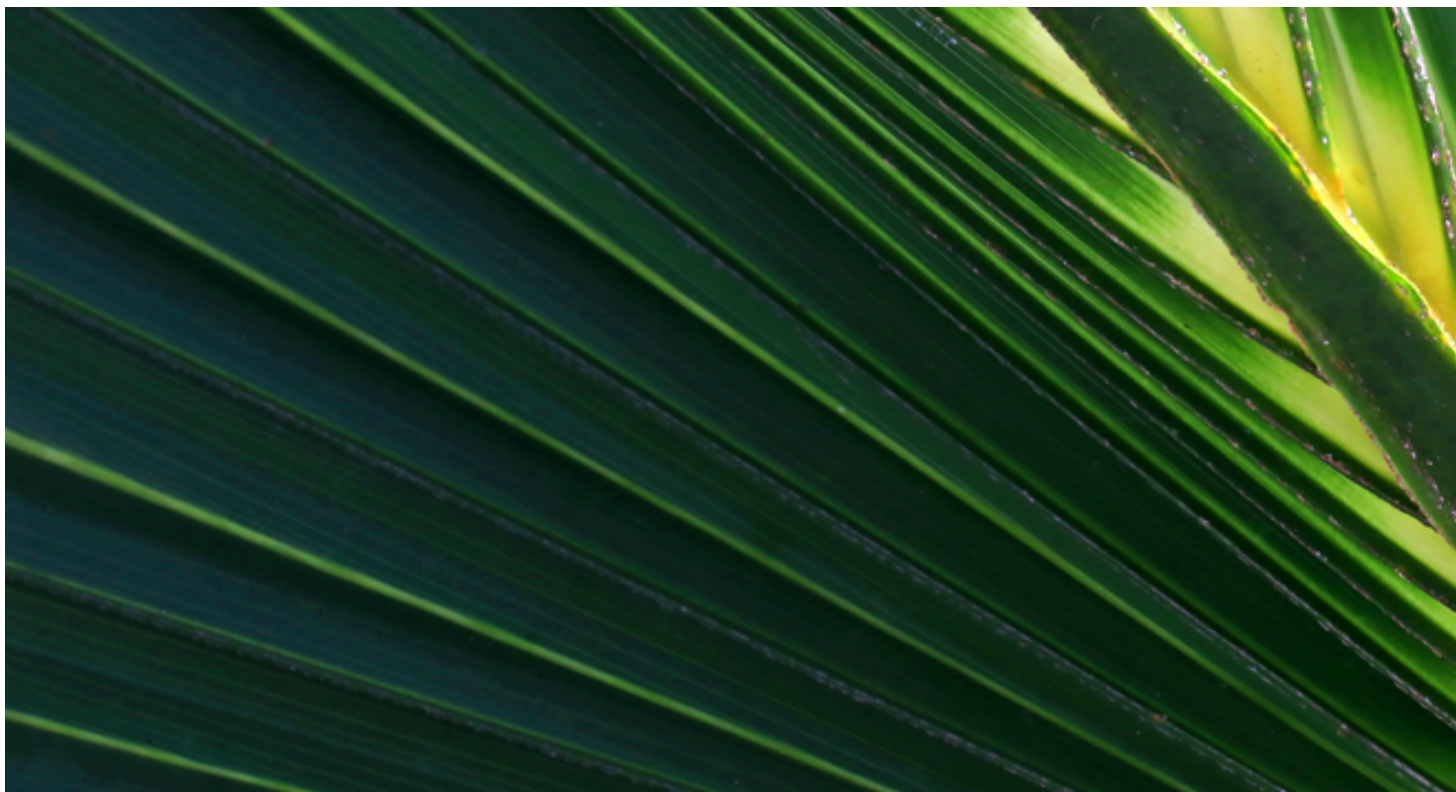
REALIZED POTENTIAL OF MAINSTREAM TECHNOLOGIES AS A % OF TOTAL PERCEIVED POTENTIAL, AS STATED BY ORGANIZATIONS

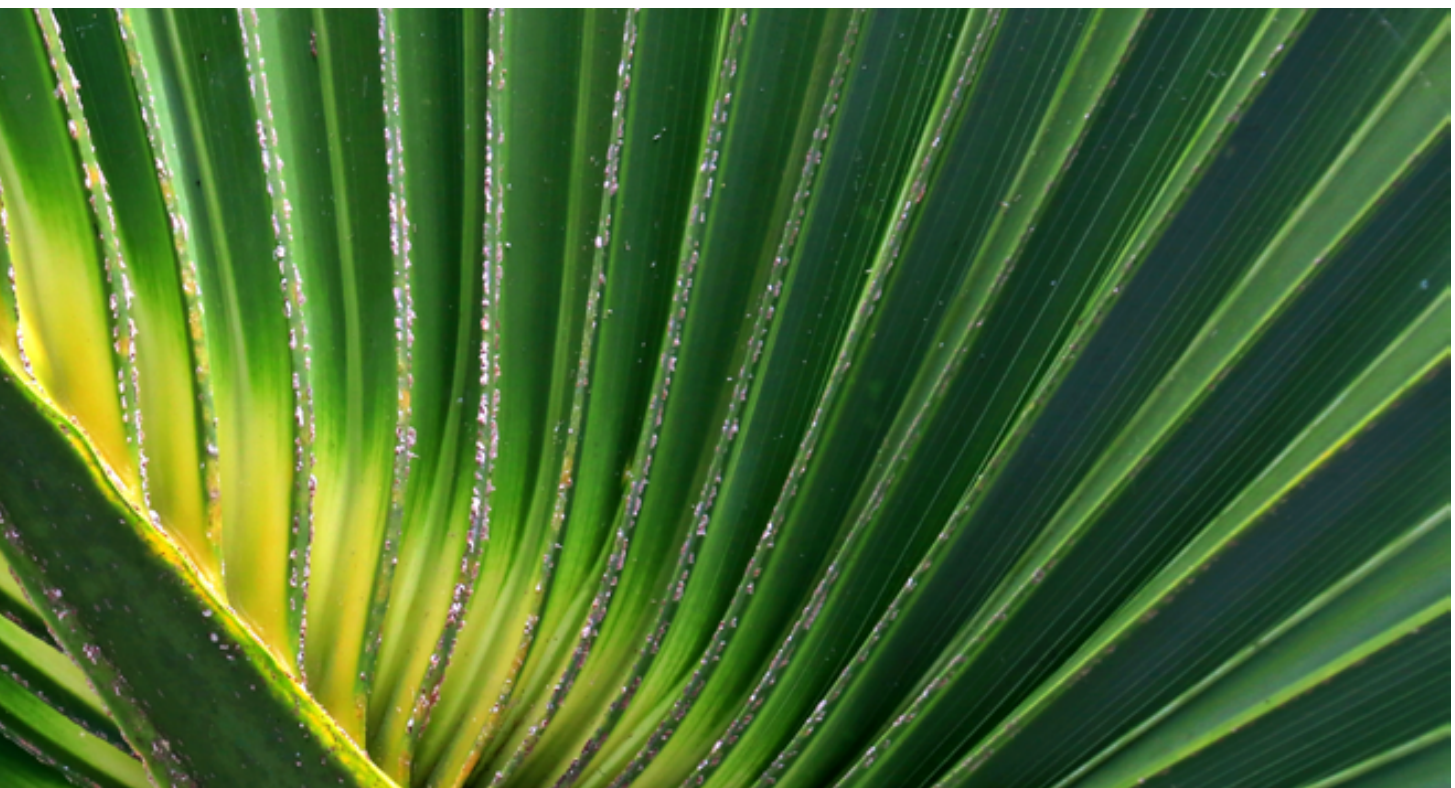


Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 972 executives who are digital and innovation leaders.
Mainstream technologies include data analytics, cloud computing, IoT, robotic process automation, industrial robotics, and AI/ML.

Oliver Buschmann, VP and Head of Strategy at Ericsson, explains: ***"In the past, innovation and productivity were challenged by working with monolithic systems that demand lengthy requirements definitions, development, and testing with overbooked IT departments. Cloud-native development and integration of services via APIs have made development more flexible with faster time to market. Low-code platforms have enriched this landscape, with users creating applications themselves by using drag-and-drop interfaces. We expect another big leap in the speed of innovation through generative AI, which takes productivity to a whole new level."***

Governments across the globe are encouraging the adoption of digital. For instance, following its Path to the Digital Decade proposal, the European Commission estimates that at least 75% of companies will take up AI, cloud, and big data technologies by 2030.[35]





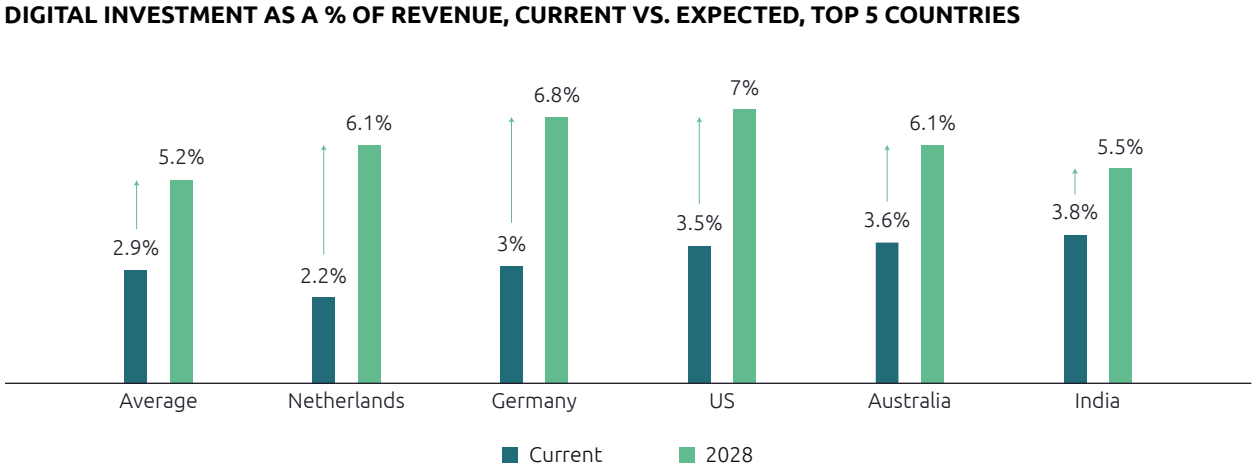
02 SCALING UP OF MAINSTREAM DIGITAL TECH, EMERGENCE OF NEW INNOVATIONS, AND SUSTAINABILITY INVESTMENTS WILL FUEL THIS GROWTH

Digital investment as a proportion of revenue is expected to double in the next five years

The landscape of business investment is transforming as the proportion of digital investment relative to revenue is projected to double within five years. As we can see in Figure 9, average investment as a share of revenue is projected to increase from 2.9% at present to 5.2% in 2028. The countries set to see the largest increase include the Netherlands, Germany, and the US.

FIGURE 9.

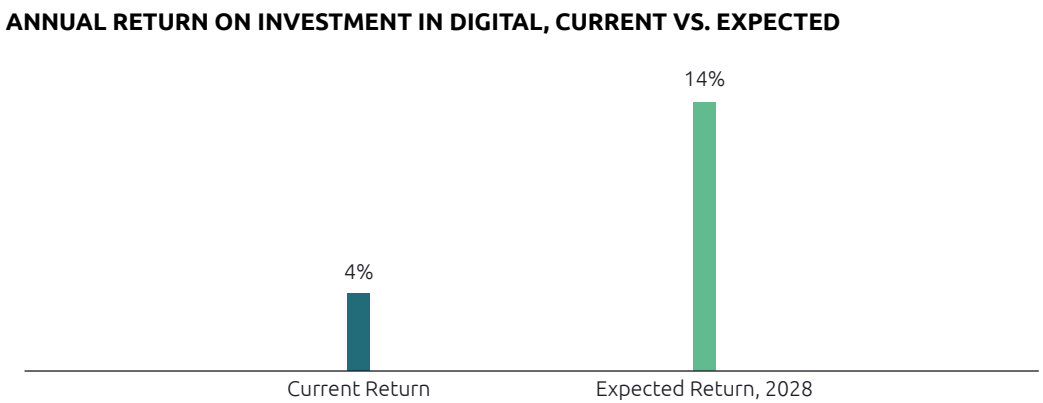
Digital investments as a share of revenue are set to double in the next five years



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 972 executives who are digital and innovation leaders.
Question asked: What percent of revenues is your organization investing altogether in at-scale implementation of data, cloud, collaborative ecosystems, digital platforms, and other emerging technologies? (Investments include systems, tools, processes, talent, R&D, etc. to create digital products and services, digital customer experience, digital business models, open innovation, digital operations, integration of digital systems and tools, etc.)

FIGURE 10.

Digital investments are expected to yield significant returns over the next five years



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 972 executives who are digital and innovation leaders.

Investments in digital assets are expected to bring significant returns over the next five years, from 4% at present to 14% in 2028 (see Figure 10).

These substantial returns can be attributed to the diversity of organizations' investment priorities, including the scaling of mainstream technologies (e.g., data, cloud); the implementation of cybersecurity and privacy measures; reskilling the existing workforce; and the automation of business processes and workflows (see Figure 11).

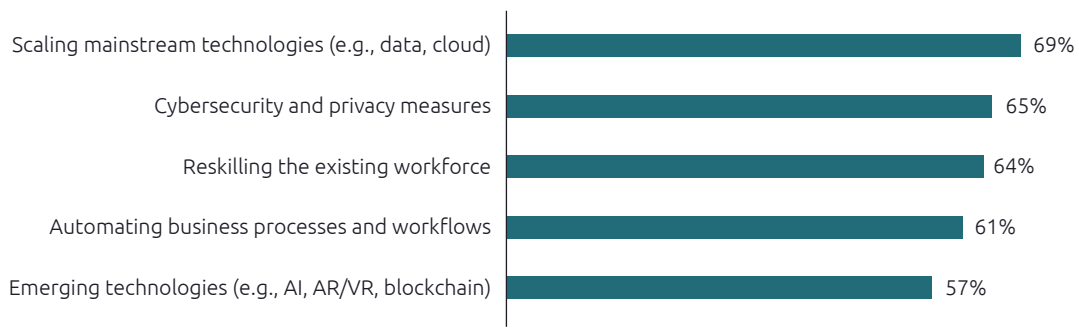
69%

of organizations prioritize investments in scaling mainstream technologies (e.g., data, cloud)

FIGURE 11.

Organizations prioritize scaling mainstream technologies, bolstering cybersecurity, and reskilling the workforce

TOP FIVE INVESTMENT PRIORITIES FOR ORGANIZATIONS



Percentages represent share of organizations

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives.
Question asked: Which of the following areas is your organization currently investing in or considering investing in as a top priority? Select the top five.

Frank Loydl, CIO at Audi AG, comments on the investment priorities: ***"Amid exponential growth in cyber-attacks, cybersecurity investments are set for major developments in the foreseeable future. As new technologies emerge, attack vectors multiply, requiring us to fortify our defenses."***

SECTOR	EXAMPLE
Automotive	Through 2025, Stellantis will invest more than $33.7 billion in software and electrification, including hiring 5,000 software engineers by 2024.[36]
Financial services	JPMorgan Chase plans to invest over $15 billion in technology during 2023 to drive cost savings and efficiency improvements worth $1.5 billion in three years across infrastructure and data initiatives.[37]
Oil and gas	The oil and gas subsector will spend more than $14 billion a year through 2030 on digital-monitoring technologies and cybersecurity.[38]
Consumer products	The fast-moving consumer goods industry will invest about $23 billion annually by 2030 towards digital transformation.[39]

With digital solutions increasingly accessible, businesses of all sizes are harnessing these powerful tools:

- The number of connected devices is expected to reach 55.7 billion by 2025, of which 75% will be connected to an IoT platform.[40] The data generated by such devices is expected to grow fourfold, from 18.3 zettabytes in 2019 to 73.1 zettabytes by 2025.[41]
- The cost of training AI models has dropped significantly, democratizing AI. MosaicML, a generative AI platform that helps businesses build their own AI models, recently launched AI training tools that can attain GPT-3-level performance at a cost of only $450,000, around one-tenth of the cost required in 2020.[42,43]
- The total volume of data stored in cloud is expected to reach 100 zettabytes by 2025, accounting for about half the world's data at that time, up from around one-quarter being stored in the cloud in 2015.[44]
- By 2023, the proportion of new enterprise IT infrastructure at the edge is expected to exceed 50% – five times the current level.[45]

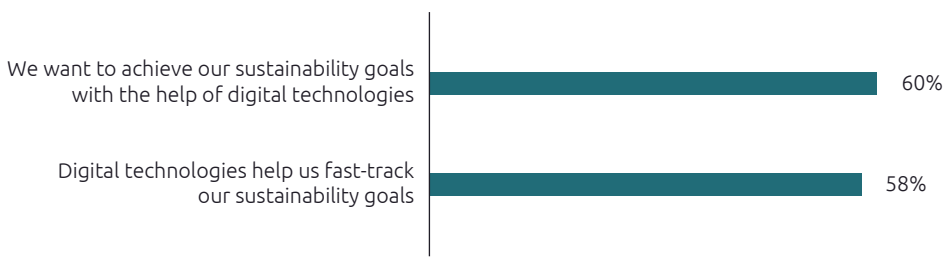
Organizations are investing in digital for its significant sustainability impact

Aligning sustainability goals with digital innovation initiatives encourages the development of eco-friendly technologies, such as energy-efficient data centers and smart grids, which not only reduce environmental impact but also drive digital advancements. A majority of organizations (60%) believe that technology can help them fast-track and achieve sustainability goals (see Figure 12).

FIGURE 12.

Organizations believe technologies can help them become more sustainable

SHARE OF ORGANIZATIONS AGREEING WITH THE FOLLOWING STATEMENTS ON SUSTAINABILITY



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 146 executives from sustainability function.

"Only digital technologies move at the speed and scale necessary to achieve the dramatic reduction in emissions that we need in the next 10 years," says Inger Andersen, UN Environment Programme (UNEP) Executive Director.[46]

Hence, organizations are actively investing in technologies to propel their sustainability agendas. Data from our previous research on sustainability confirms that nearly 60% of organizations invest in AI and automation to monitor, analyze, and optimize sustainability efforts across their entire value chains.[47] Over half (56%) of organizations globally are investing in IoT or the Industrial Internet of Things (IIoT) to monitor and reduce energy consumption.[48]

58%

of organizations believe that technology can help them fast-track and achieve sustainability goals

For instance:

- Schneider Electric's Le Vaudreuil site has implemented IIoT sensors and real-time digital twins of plant installations, resulting in a 25% reduction in energy consumption; a 17% decrease in material waste; and a 25% cut in CO2 emissions. Additionally, their smart factory incorporates a zero-reject water-recycling station connected to cloud analytics and monitored by an AI model, leading to a 64% reduction in water usage.[49]
- The automotive industry has accelerated the electrification of vehicle fleets to address sustainability concerns. General Motors has earmarked over $35 billion for electric vehicle (EV) and autonomous vehicle (AV) development in 2020-25.[50] Similarly, Honda has pledged to increase incrementally the ratio of EVs and fuel-cell vehicles (FCVs) in all major markets of electrification to 40% by 2030; 80% by 2035; and then to 100% globally by 2040.[51]

In the upcoming section, we explore how the scaled implementation of digital technologies can create both business and sustainability value for organizations.

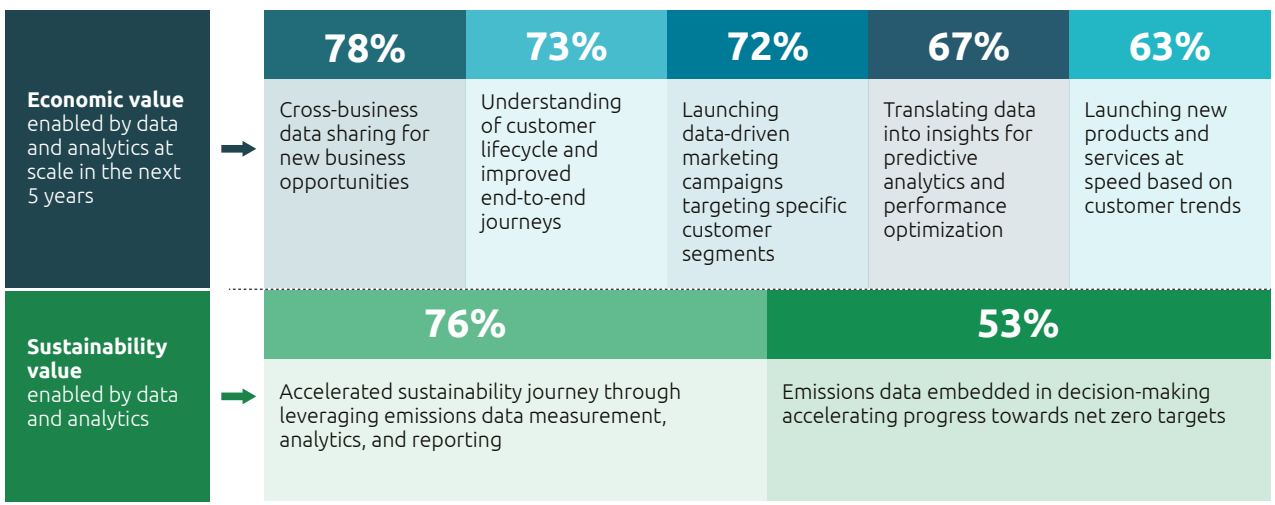
Scaling data analytics and cloud solutions will unlock new revenue streams, drive cost efficiencies, and accelerate sustainability efforts

Businesses mine real-time data for customer insights and to adapt products and services. Cloud technology optimizes resources, cuts infrastructure costs, and boosts operational flexibility. Both these technologies can also help in fulfilling sustainability goals.

In our survey, nearly six in 10 organizations (57%) see data and scalable cloud solutions as catalysts for new revenue streams, operational efficiency, and progress in sustainability goals. Extensive deployment of these technologies brings value through opportunities, predictive analytics, performance optimization, personalized offerings, quicker time to market, and accurate sustainability reporting (see Figures 13 and 14).

FIGURE 13.

Top sources of value enabled by data and analytics at scale in the next five years



Percentages represent share of organizations

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 881 executives from digital, data and analytics, technology, operations, engineering, and sales and marketing functions; Capgemini Research Institute, Data for net zero research, September 2022.

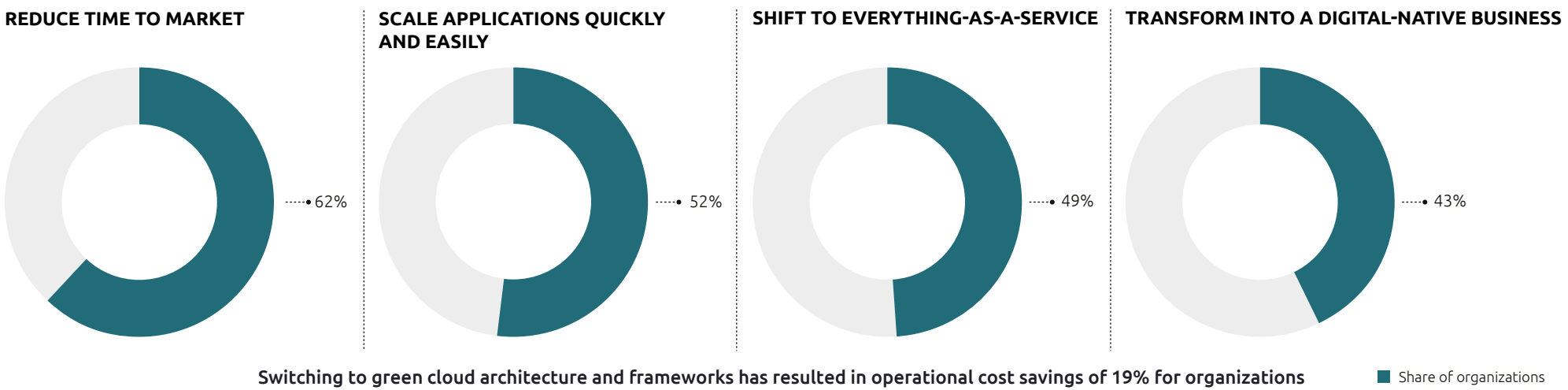
Nicolas Veauville, Senior Director and Category Leader–Kitchen Appliances at Versuni (previously, Philips Domestic Appliances), emphasizes: ***"It's crucial organizations prioritize enhancing data management and improving analysis to generate actionable insights. Data-backed insights offer clarity on global cost trends, facilitate improved supplier cost negotiations, optimize inventory management, aid in understanding customer needs, and drive innovation in product development."***

"It's crucial organizations prioritize enhancing data management and improving analysis to generate actionable insights. Data-backed insights offer clarity on global cost trends, facilitate improved supplier cost negotiations, optimize inventory management, aid in understanding customer needs, and drive innovation in product development."

NICOLAS VEAUVILLE
Senior Director and Category Leader–Kitchen Appliances at Versuni (previously, Philips Domestic Appliances)

FIGURE 14.

Top value-creating actions that will be enabled by cloud at scale in the next five years



Percentages represent share of organizations

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 874 executives from digital, data and analytics, innovation, technology, and product development functions; Capgemini Research Institute, Sustainable IT, May 2021.

Bijoy Sagar, Chief Information Technology and Digital Transformation Officer at Bayer, asserts: ***"Cloud technology enables scalability, which was previously unattainable. In innovation-driven fields like drug discovery and crop science, where early development demands substantial investment, the cloud empowers us to use in silico [i.e., on the computer] instead of in vivo [within living organisms] or in vitro [in glass lab containers]. This is a complete game-changer, as we can explore a multitude of scenarios, overcoming physical lab or field constraints."***

Arvid Swartsenburg, Head of Digital Strategy & Transformation at United Overseas Bank, emphasizes: ***"Clean, relevant, and shareable data, coupled with cloud technology, is vital for banks' modernization efforts. Digitalizing end-to-end processes demands collaborative data sharing across the organization. Cloud can enable and empower banks to share and access information seamlessly; efficiently manage end-to-end processes; and drive greater overall efficiency."***

SECTOR	EXAMPLE
Consumer products and retail	Using analytics and ML, PepsiCo's Sales Intelligence Platform reconciles supply chain and retailer data to predict when certain items will go out of stock and prompts retailers to re-order.[52]
Telecom	Nokia used its MX Industrial Edge platform, a cloud-native Industry 4.0 edge solution to generate 12.8% year-on-year growth in 2021, driven by double-digit growth in core network sales and enterprise solutions.[53]
Pharmaceutical	Eli Lilly built an ecosystem called MagnolAI, a full-stack capable sensor cloud that can collect and process large amounts of data from sensors associated with Lilly's trials. This saved nearly $3 million per year for their in-house investigational drug service.[54]

"Clean, relevant, and shareable data, coupled with cloud technology, is vital for banks' modernization efforts. Digitalizing end-to-end processes demands collaborative data sharing across the organization. Cloud can enable and empower banks to share and access information seamlessly; efficiently manage end-to-end processes; and drive greater overall efficiency."

ARVID SWARTSENBURG
Head of Digital Strategy & Transformation
at United Overseas Bank

Digital platforms and collaborative ecosystems to gain prominence

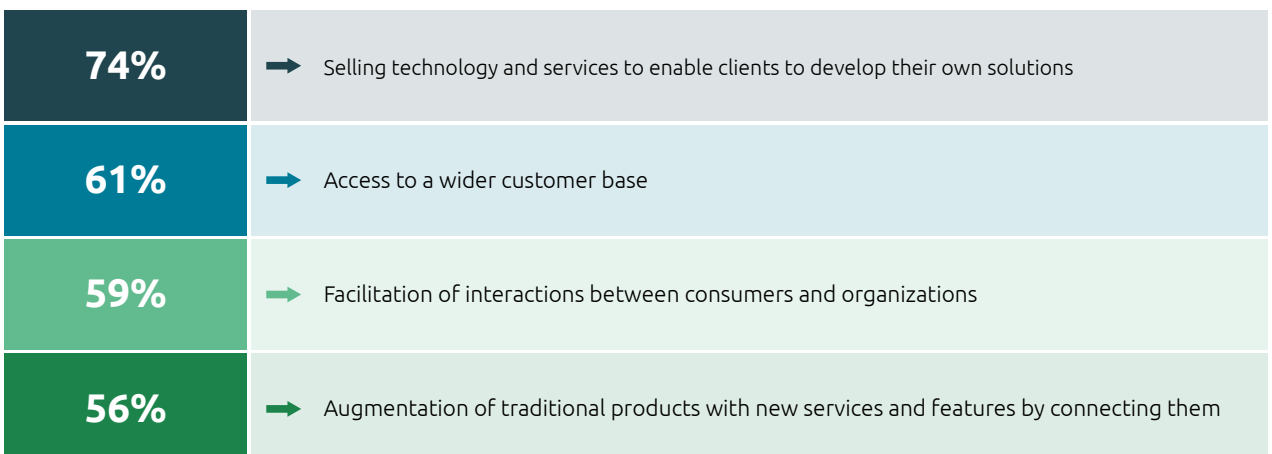
Digital platforms empower businesses to access diverse services and experiences via a single interface, expanding market reach, reducing entry barriers, and fostering innovation. Further, as industries intertwine, ecosystems become hubs for cross-disciplinary collaboration, pooling resources, expertise, and perspectives, transcending geographical limitations for seamless co-creation.

Software plays a paramount role in cutting across organizational boundaries and silos; constructing digital channels for communication and data sharing; and fostering collaborative, productive ecosystems. ChatGPT's creator OpenAI recently launched a platform for creating customized versions of ChatGPT, essentially turning it into a platform.[55]

The majority of surveyed organizations (59%) recognize the rising prominence of platform-based models and collaborative ecosystems due to network effects, fostering co-creation and co-innovation (see Figures 15 and 16).

FIGURE 15.

Top sources of value enabled by a platform-based model at scale in the next five years



Percentages represent share of organizations

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 903 executives from digital, data and analytics, innovation, technology, sales, and marketing functions.

Oliver Buschmann, VP and Head of Strategy at Ericsson, highlights: ***"The prevailing trend is a strategic shift towards the platform business model. Platforms such as 5G enable a whole ecosystem to build on top of it, so businesses and developers can, for example, build on better quality of service or location information. The fundamental benefit is a networking or 'flywheel' effect, as the value of the platform increases the more partners join and vice versa. This shift also drives the adoption of as-a-service and consumption-based models, prioritizing outcomes over mere features or functions."***

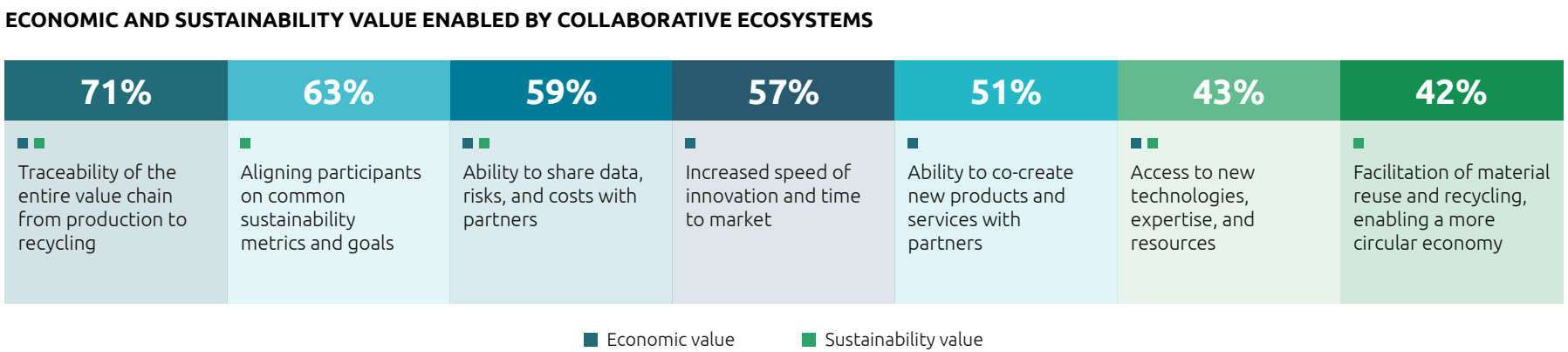
A senior government official in charge of digital health shares: ***"Digital health platforms offer the convenience of anytime, anywhere access to patient and provider information, consolidating medical history and notes in one accessible place. This not only saves time and reduces costs but also eliminates the need for patients to carry physical records and enables quicker decision-making."***

"The prevailing trend is a strategic shift towards the platform business model. Platforms such as 5G enable a whole ecosystem to build on top of it, so businesses and developers can, for example, build on better quality of service or location information. The fundamental benefit is a networking or 'flywheel' effect, as the value of the platform increases the more partners join and vice versa. This shift also drives the adoption of as-a-service and consumption-based models, prioritizing outcomes over mere features or functions."

OLIVER BUSCHMANN
VP and Head of Strategy at Ericsson

FIGURE 16.

Top sources of value enabled by collaborative ecosystems at scale in the next five years



Percentages represent share of organizations

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 1,043 executives from digital, data and analytics, innovation, technology, operations, and sustainability functions.

"Public-sector entities have to streamline workflows and establish unified infrastructures, so that individuals only need to provide information once, and not to multiple entities. Regulation propels this transformation by incentivizing organizations to participate in collaborative data ecosystems," says the CDO at a government agency responsible for financial regulation.

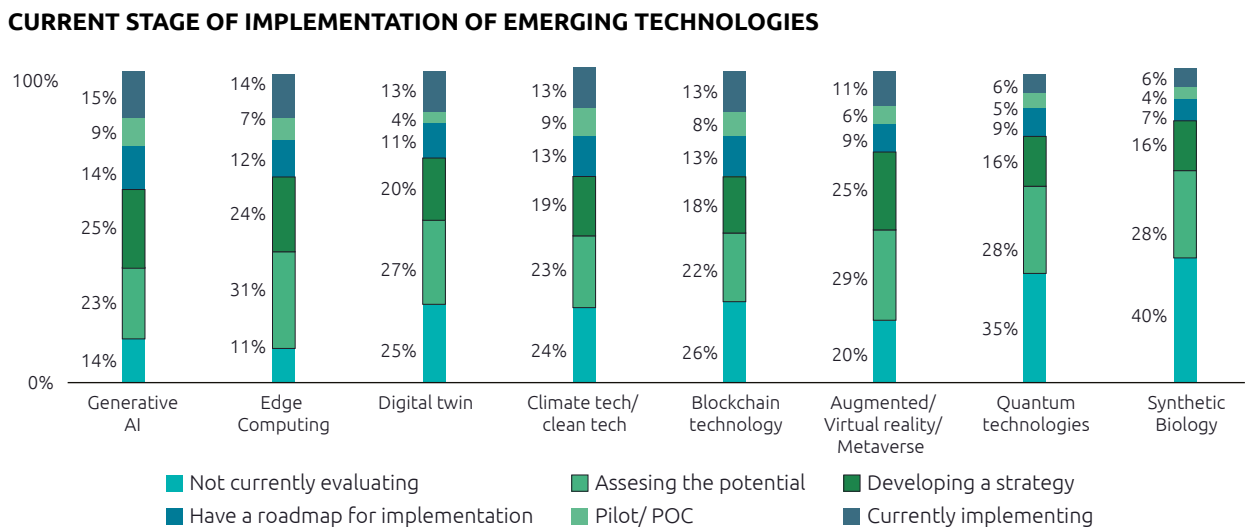
SECTOR	EXAMPLE
Automotive	AUTOSAR (AUTomotive Open System ARchitecture) is a global partnership of key players in the automotive and software industries, dedicated to developing and implementing a standardized software framework and open electrical/electronic (E/E) system architecture for intelligent mobility.[56] The Connected Vehicle Systems Alliance (COVESA) is a global alliance that is open, collaborative, and member-driven, with a specific focus on developing open standards and technologies. Its goal is to expedite innovation for connected vehicle systems, fostering a more diverse, sustainable, and integrated mobility ecosystem.[57]
Healthcare	The OPTIMA consortium, comprising around 40 partners across the pharmaceutical value chain, aims to establish a GDPR-compliant real-world oncology data and evidence-generation platform in Europe for the treatment of specific cancers. The interoperable platform will host datasets, data-analysis tools, AI models, and electronic decision-support tools to enhance cancer care.[58,59]
Energy and utilities	Ericsson developed the Global Ericsson Utilities Innovation Center, which enables utilities, device manufacturers, wireless-network experts, etc. to design and test use cases in a live operating context. Device manufacturers and utility companies are able to view the entire smart grid and experiment with each component of it.[60]
Telecom	Swisscom, Switzerland's largest telecom provider, utilized collaborative ecosystems featuring a network of startup partners to enable expansion of its IT services and digital portfolio. It also launched the DACH InsurTech Map, a virtual interactive platform to showcase innovative solutions and startups throughout the insurance value chain. This facilitates discovery of relevant partners as well as potential investments for corporates.[61]

Nearly half of organizations are developing a strategy to harness the potential of emerging technologies

It's notable that around 50% of organizations are currently either planning or actively developing strategies to capitalize on the value generated by emerging technologies such as edge computing, immersive technologies, and generative AI (see Figure 17).

FIGURE 17.

Organizations are looking to tap into emerging technologies



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 972 executives who are digital and innovation leaders.

Many organizations already see generative AI as bringing numerous transformative benefits, including enhanced decision-making, improved efficiency, personalized experiences, cost reduction, augmented innovation capacity, better risk management, and predictive analytics. Executives expect to see improvements of 7–9% in operational efficiency, customer engagement, and sales within three years.[62]

Bijoy Sagar from Bayer reveals: ***"We're currently exploring generative AI, primarily within the realm of research, driven by our belief in its potential to expedite research and development. At the same time, we're actively preparing for its extensive deployment, foreseeing the transformative impact it can bring. The entire process of large-scale agriculture encompassing crop planning, protection, planting, etc. is already highly digital. We will continue to invest in it and expect to achieve greater yields in this area."***

Cicero Hennemann Machado, Head of Digital Hub at Reckitt Benckiser, remarks: ***"Today, with people consuming ever-more varied and customizable digital media, brands must focus on delivering top-quality, engaging content to cut through. By harnessing the capabilities of a large language model (LLM) tailored to their product portfolio, brands can provide personalized content and address consumer queries about their products thoroughly."***

"Today, with people consuming evermore varied and customizable digital media, brands must focus on delivering top-quality, engaging content to cut through. By harnessing the capabilities of a large language model (LLM) tailored to their product portfolio, brands can provide personalized content and address consumer queries about their products thoroughly."

CICERO HENNEMANN MACHADO
Head of Digital Hub at Reckitt Benckiser

IMMENSE VALUE CREATION IS ON THE HORIZON WITH EMERGING TECHNOLOGIES

Generative AI:

Our research reveals that generative AI is on the boardroom agenda at 96% of organizations. Nearly 60% say their leadership is a strong advocate for this technology and only 39% are taking a "wait-and watch" approach to adoption. Generative AI has applications across different functions and sectors, and use cases are wide-ranging, from creating unique content and automating and accelerating tasks, to creating personalized experiences and generating synthetic data. It brings numerous transformative benefits to organizations, including enhanced decision-making, improved efficiency, personalized experiences, cost reductions, augmented innovation capacity, better risk management, and predictive analytics.[63]

Valérie Legat, Chief Digital Factory Officer at Carrefour, shares: ***"As part of our ongoing pilot initiatives, we are exploring the potential of generative AI across various applications. This includes creating product content on our website, automating design tasks like web-page generation, streamlining supplier negotiations, crafting marketing content for social media platforms, composing emails, and generating code or translating between different programming languages."***

Digital twins:

Cost reduction, along with technological advancement and reduced time to market, are the top drivers of digital twin investments. Our previous research reveals that organizations using digital twins have already seen, on average, a 15% improvement in metrics such as sales, turnaround time, and operational efficiency, as well as an improvement of upwards of 25% in system performance. Organizations have realized an average improvement of 16% in sustainability owing to the use of digital twins. Further, digital twins will provide flexible ways of working to mitigate risks and extend collaboration, allowing operations to be virtual before they become physical, and enabling closed-loop feedback. As a result, organizations are set to increase the deployment of digital twins by 36% on average over the next five years.

Organizations have realized an average improvement of 16% in sustainability owing to the use of digital twins. The automotive industry has been using digital twins, not necessarily under that name, in their design (such as the design of assembly lines) and engineering departments for more than a decade. Over the years, the applicability of digital twins has expanded and, today, digital twins can help automotive manufacturers achieve end-to-end digital continuity and thereby provide additional value to customers.

Edge computing:

Edge computing frameworks bring enterprise applications closer to data sources such as IoT devices or local edge servers. Edge computing provides greater control over the location of stored data than that provided by the public cloud. By 2023, over 50% of new enterprise IT infrastructure will be at the edge, rather than in corporate data centers, up from less than 10% in 2020.[64] Further, edge-computing

techniques lead to reduction in data transfer, saving crucial bandwidth, and improved latency due to local processing, leading to lower energy consumption.

Immersive technologies (AR/VR/metaverse):

Our research on immersive technologies reveals that consumers are interested in immersive experiences: 58% feel that such experiences could be both impactful and valuable in their buying journeys. Interest in the metaverse primarily revolves around social interactions and gamification, with a focus on engaging with family, friends, colleagues, metaverse commerce, and virtual try-ons. Retail and manufacturing organizations (particularly of high-engagement products such as cars, furniture, and household electronics) have seen the highest degree of consumer interest. Organizations also recognize the opportunity for their internal operations. The benefits gained from these use cases range from improved performance to more effective collaboration.

Martijn Hagman, CEO of Tommy Hilfiger Global, says: ***"While launching a new collection, we try to bring our Tommy Hilfiger ambience to the location. We successfully created this brand experience in the metaverse, and it saved us on cost of travel and building physical branding." He further states: "So far, consumers are showing an appetite for these interactions, and we are committed to being relevant to their journey."*** [65]

Quantum computing:

Quantum technologies manipulate electrons, photons, and atoms to solve problems previously thought insoluble – and to open up exciting new opportunities. Quantum computing promises exponential speed-up vis-à-vis the best available supercomputers, tap-proof communications, and ultra-precise and fast measurements – a phenomenon commonly referred to as the "quantum advantage" over classical systems. Companies moving early on quantum will benefit from greater process efficiencies and enhanced security. Seven in ten organizations in our survey agree that, owing to long product-development cycles, they need to integrate quantum technologies into their processes. Early-mover industries and sectors include energy, chemicals, automotive, aerospace, life sciences, and banking.[66]

André König, CEO of Global Quantum Intelligence, a premier market and business intelligence provider in quantum tech, and Managing Partner at Entanglement Capital, a venture capital firm focused on quantum technologies, states: ***"Any company that does not start this [quantum tech] journey today is at severe risk of losing any sort of meaningful position within its industry in the next 5–10 years."*** [67]

Synthetic biology:

Synthetic biology (SynBio) is a multidisciplinary field that combines biology, engineering, and computer science to design, construct, and manipulate biological systems, genes, or organisms for specific functions or applications. It involves creating artificial DNA sequences, genetic circuits, and biological components to re-engineer living organisms or create new ones. SynBio has several applications across sectors such as healthcare and life sciences, manufacturing and consumer goods, and food and agriculture. Diverse technologies such as metabolic engineering, protein engineering, bioreactor engineering, and biosensing can be harnessed to drive business impacts such as operational expenditure (OPEX) reduction, new product development, improved consumer demand, reduced emissions, and reduced supply chain shocks.

"As part of our ongoing pilot initiatives, we are exploring the potential of generative AI across various applications. This includes creating product content on our website, automating design tasks like web-page generation, streamlining supplier negotiations, crafting marketing content for social media platforms, composing emails, and generating code or translating between different programming languages."

VALÉRIE LEGAT
Chief Digital Factory Officer
at Carrefour

TYPE OF BENEFIT	EXAMPLE
Improved operational efficiency using AI and metaverse	Mercedes-Benz is digitizing its production process using AI and metaverse technology to design manufacturing and assembly facilities. The automaker will use this new system to create feedback loops to reduce waste, decrease energy consumption, and enhance quality.[68]
Increased sales using metaverse	Nike's metaverse space, Nikeland, allows its fans to socialize, participate in promotions, enjoy various brand experiences, personalize their virtual avatars with Nike products, gamify real-world movements, and access exclusive virtual products. Nike capitalized on the popularity of non-fungible tokens (NFTs, a virtual phenomenon whose value lies principally in ownership) in April 2022, when they sold 600 pairs of NFT sneakers worth $3.1 million in just 6 minutes.[69]
Improved customer engagement and increased sales using metaverse	For the Metaverse Fashion Week in March 2023, Tommy Hilfiger introduced both digital and real-life clothing to the metaverse fashion event with pieces available for sale in both forms. Attendees could either purchase clothing pieces to be shipped to their door or wear the exact same piece in online game environments.[70]
Improved operational efficiency using generative AI	Wealth-management advisors at US financial services organization Morgan Stanley found its vast library of investment strategies, market research, and analyst insights time-consuming and cumbersome to sift through. To address this, the organization uses GPT-4 to power an internal chatbot that provides instant access to any area of the archive.[71]
Improved sustainability using synthetic biology	Repsol and Aramco have commissioned a new synthetic fuel plant in Spain, which will produce a sustainable synthetic drop-in fuel that can be blended for existing road vehicle engines, planes, and ships. It is due to be commissioned in 2024, with a starting capacity of more than 2,100 tonnes per year.[72]
Improved sustainability using generative AI	Airbus uses AI algorithms in its generative design process to develop lighter-weight parts for its aircraft, resulting in lower fuel consumption and lessened environmental impact. The initial design was 45% lighter than the traditional part and is projected to reduce Airbus's annual CO2 emissions by nearly 500,000 metric tonnes (mt) if rolled out across its A320 fleet.[73]

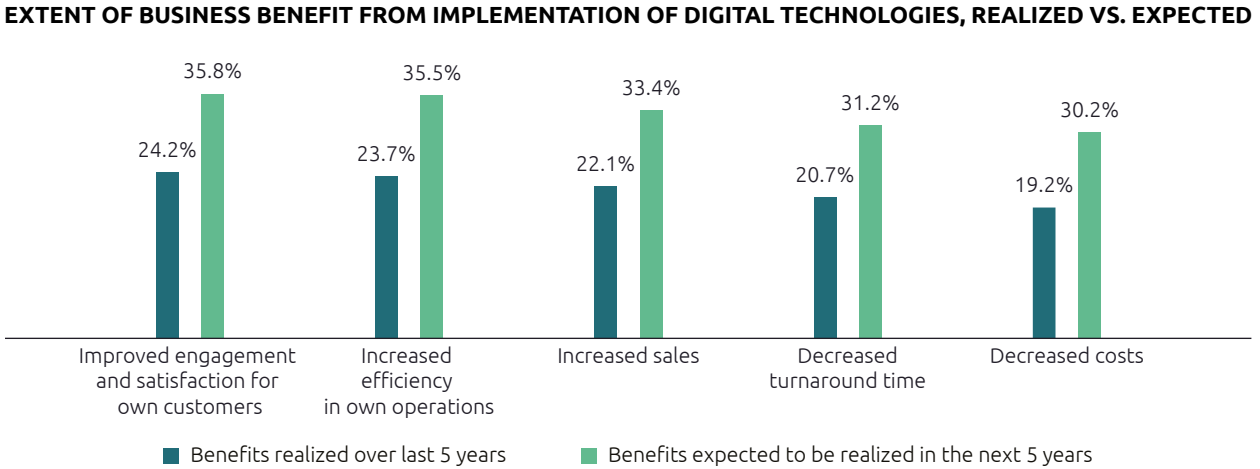
03 SIGNIFICANT BUSINESS BENEFITS ARE IN STORE FOR ORGANIZATIONS HARNESSING DIGITAL TECH

Technology will bring substantial business benefits throughout the value chain

From the inception of a product or service to delivery and aftercare, technology integration promises to streamline processes, enhance efficiency, and drive value creation. As we can see from Figure 18, organizations have already realized significant benefits, which they expect to increase in the next five years. In the next section, we explore the sustainability of digital technologies.

Describing the benefits anticipated by the use of digital, Dr. Gunter Beitinger, Senior Vice-President, Manufacturing and Head of Factory Digitalization at Siemens, states: ***"We anticipate 6–7% increased productivity annually through digitalization and automation. There aren't any clear limits yet, as advancements such as new robotic solutions expand possibilities and enhance the economic attractiveness of automation and digitalization."***

FIGURE 18.
Organizations have realized notable business benefits from digital technologies



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 520 executives who are business leaders.

Similarly, emphasizing the increase in revenue due to digital, a senior executive from the banking industry comments: ***"With the proliferation of digital products, new revenue streams are emerging. As these avenues mature over the next five years, we anticipate a 30% increase in digital sales."*** Giovanna Questioni, Omnichannel Director (Auchan Retail International, Ralph Lauren, PVH, ESPRIT), comments: ***"Digital is projected to contribute one-third of revenue for retail organizations."***

Organizations across sectors have already realized significant benefits from the implementation of digital technologies:

- **Increased sales:** Domino's generates over two-thirds of its global retail sales, and more than 80% of US retail sales, from digital channels.[74]
- **Increased revenue:**
  - Mercedes-Benz generates more than €1 billion ($1.1 billion) in software-enabled revenue, and projects €1 billion in operating profit from digital services by 2025.[75]
  - Stellantis will use Amazon to bring connected products and services to its vehicles by 2024 as part of its plan to generate $22.5 billion annually from software. It will use the technology to develop vehicles, build connected in-vehicle experiences, and train the next generation of automotive software engineers.[76] To put this into perspective, Stellantis's targeted software revenue represents a substantial addition to its overall net revenue, which stood at ~$190 billion in 2022.[77]
- **Increased customer base:** In 2021, Citibank acquired 94% of new customers digitally (for its branded cards segment) and generated ~65% higher average annual revenue per digital customer compared with non-digital customers.[78]
- **Decreased costs:** CADDi, a B2B manufacturing marketplace, offers the CADDi Manufacturing platform, which removes some procurement work and aggregates purchase orders to enable discovery of similar materials, processes, and suitable delivery schedules. This will lead to a fall in procurement costs of nearly 20%.[79]
- **Improved efficiency:** US-based medical-devices company Propeller Health's connected inhaler can record information on when and where patients experience asthma symptoms and provide insights into local aggravating environmental factors, which it sends directly to doctors, enabling more informed symptom management.[80]
- **Improved customer engagement and satisfaction:** UK insurance major Bupa has used ServiceNow to revamp its internal collaboration and communication systems, resulting in a 10-point boost to customer satisfaction and a 50% reduction in absences (equating to more than $300,000).

"Digital is projected to contribute one-third of revenue for retail organizations."

GIOVANNA QUESTIONI
Omnichannel Director (Auchan Retail International, Ralph Lauren, PVH, ESPRIT)

Digital technologies offer substantial cost savings, creating opportunities for additional investment

The implementation of digital technologies not only strengthens financial positions but also provides the flexibility to channel funds into innovative initiatives, technological advancements, and sustainability, thereby serving as a catalyst for a transition towards an eco-digital era™.

For instance, by "cloudifying" their networks, telcos expect to optimize network Total Cost of Ownership (TCO) by 13%, resulting in cost savings of $260 million – $380 million per year.[81] Rakuten Mobile's network operating costs are now 30% lower than those of other mobile network operators.[82] Chunghwa Telecom, Taiwan's largest integrated service provider, has been able to reduce CAPEX by 16% per year by moving to a microservices-based network automation enabled by cloud.[83]

Germany-based Claudius Peters, which produces processing equipment for cement, coal, alumina, and gypsum plants, uses generative design to produce components with a remarkable 20–60% weight reduction. This served as a re-engineering template for conventional manufacturing, resulting in a 30% lighter final design, lowering component costs.[84] Rolls-Royce's Intelligent Borescope[85] can reduce by up to 75% of the time required to inspect an aircraft engine, potentially saving £100m in inspection costs over five years.[86]

Arvid Swartsenburg from United Overseas Bank points out the cost-saving benefits from digital technologies: ***"Through digitalization and automation, most conventional banks can conservatively expect cost reductions up to 20% in the near term. As the business and operating models of banks pivot towards digital, cost structures will evolve, with some savings being replaced by investments in technology capabilities, infrastructure, personnel, testing, and other digital-related expenses."***

Chad Aronson, Global Head of Intelligent Automation COE at Uber, says: ***"Our automation efforts have resulted in savings of 1.6 million hours annually, translating to more than $35 million in cost reductions."***

"Our automation efforts have resulted in savings of 1.6 million hours annually, translating to more than $35 million in cost reductions."

CHAD ARONSON
Global Head of
Intelligent Automation COE
at Uber

Digital technologies will catalyze the emergence of sustainable business models

Digital tools also assist in transforming current business models towards sustainability, creating value for all stakeholders. Organizations have started to implement sustainable leadership practices and business models:

37%

of organizations aim to shift to circular business models and design products and services for longevity, reuse, and recycling in the next five years

Circular business models

Businesses are urgently embracing circular principles, reducing waste and decoupling economic activities from the depletion of finite resources. Strategies such as dematerialization and designing for product durability, repairability, modularity, recyclability, and recoverability ensure that material usage is reduced, and products and materials can be kept in use for longer. Technologies such as radio frequency identification (RFID), blockchain, and IoT can enhance such strategies. Recycling aluminum, for instance, eliminates 97% of the GHG emissions produced in the primary production process.[87]

Our research highlights that, in the next five years, nearly four in ten (37%) organizations aim to shift to circular business models and design products and services for longevity, reuse, and recycling.

Adidas's UltraBoost DNA Loop shoes employ recycled materials, while biodegradable packaging, modular products, and sharing platforms further contribute to resource conservation.[88] Philips Lighting use future-proof components that are easily upgradable and serviceable to prolong the shelf life of their units.[89] Fairphone manufactures mobile phones with a body crafted from recycled aluminum and a back cover composed entirely of recycled plastic, and also has various reuse and recycle programs to ensure the sustainability of its devices.[90]

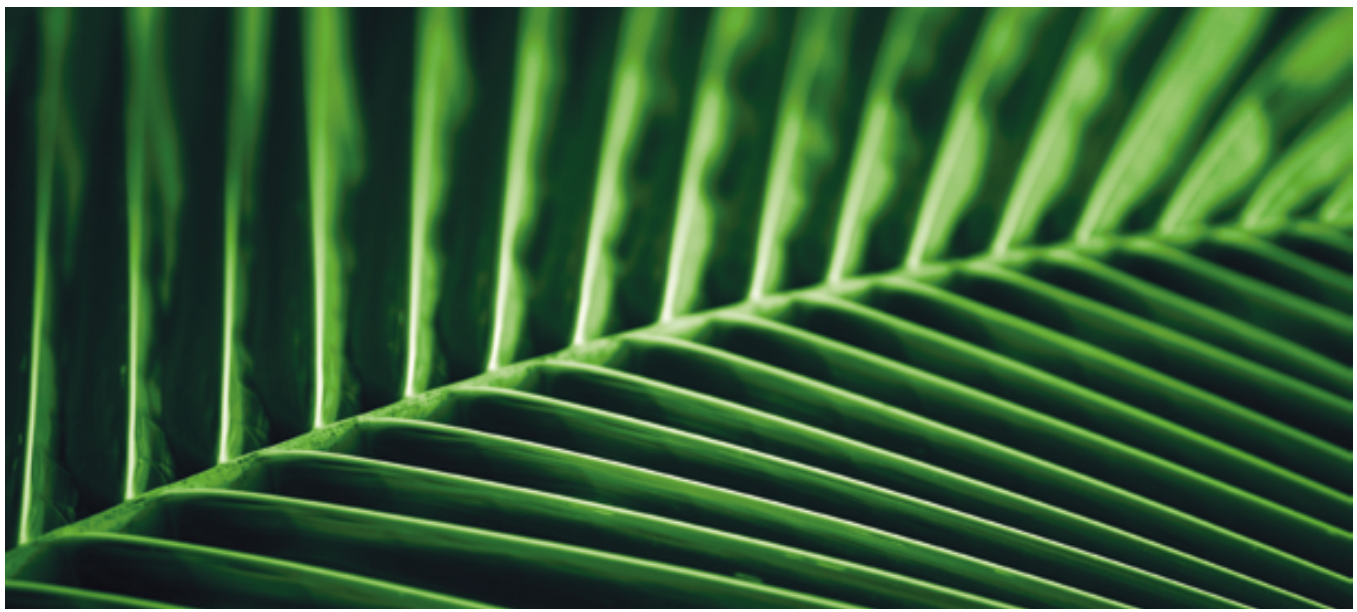
Pay-as-you-go and usage-based model:

Such models represent a consumption approach where costs align with actual usage, fostering resource optimization and minimizing overprovisioning. Using digital tools, such as “as-a-service” models, allows users to extract value from products before returning them for renewal. Owners can also facilitate broader access to idle products, promoting both environmental sustainability and cost-effectiveness.

This approach enhances efficiency and sustainability, with technology playing a pivotal role in real-time monitoring and reporting of usage for more effective management.

Schneider Electric, for instance, offers membership in a program that provides access to tools and resources to help clients boost efficiency of their machines throughout their lifecycles, support and expert advice in targeted original equipment manufacturer (OEM) applications, and information regarding industrial market trends and events.[91]

As part of its transition to a circular economy by 2030, IKEA has been testing a circular furniture subscription model since 2019. The company introduced a limited roll-out of a B2B edition called IKEA Rental in six markets during 2021: Finland, Sweden, Denmark, Norway, Spain, and Poland.[92]

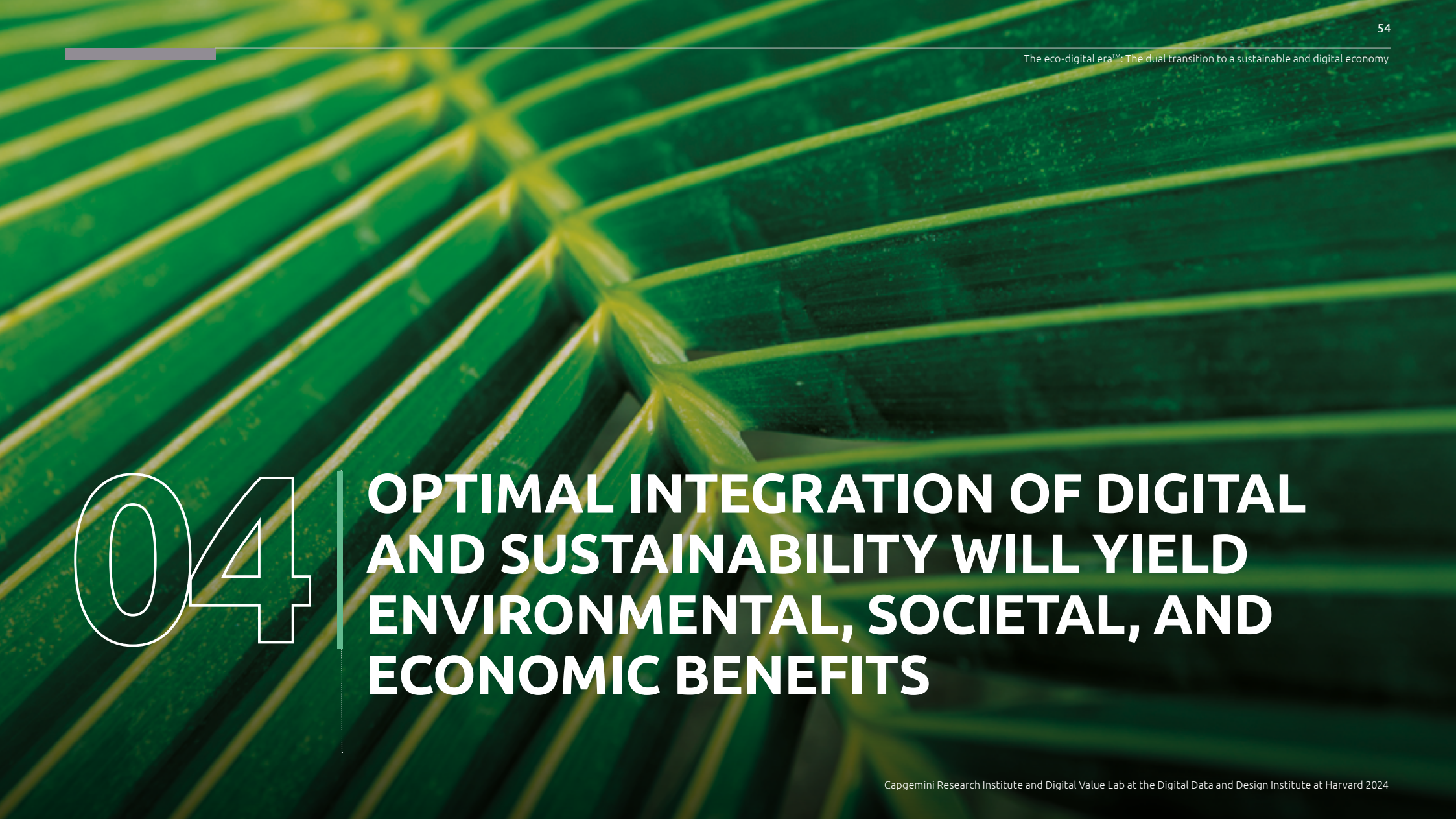


Sharing economy

Community-based online platforms facilitating the sharing economy streamline the process of acquiring, providing, or sharing access to goods and services. This collaborative model emphasizes the efficient use of resources by encouraging sharing or refurbishing assets, such as textiles, accommodations, or cars, to optimize resource utilization and actively contribute to the reduction of carbon emissions.

US car-sharing company Zipcar enables users to rent cars on demand, promoting resource efficiency and reducing the need for individual car ownership. ReSuit, a fit-based peer-to-peer clothing-sharing app for buying, renting, or selling wardrobe items, reduces carbon emissions by 500 pounds per person annually, resulting in a more than 80% reduction in carbon, waste, and water footprint.[93]

In February 2023, Orange and Vodafone partnered for Open RAN network sharing in rural areas across Europe, enabling them to reduce costs and minimize energy consumption by sharing networks, while also creating unique offerings.[94]

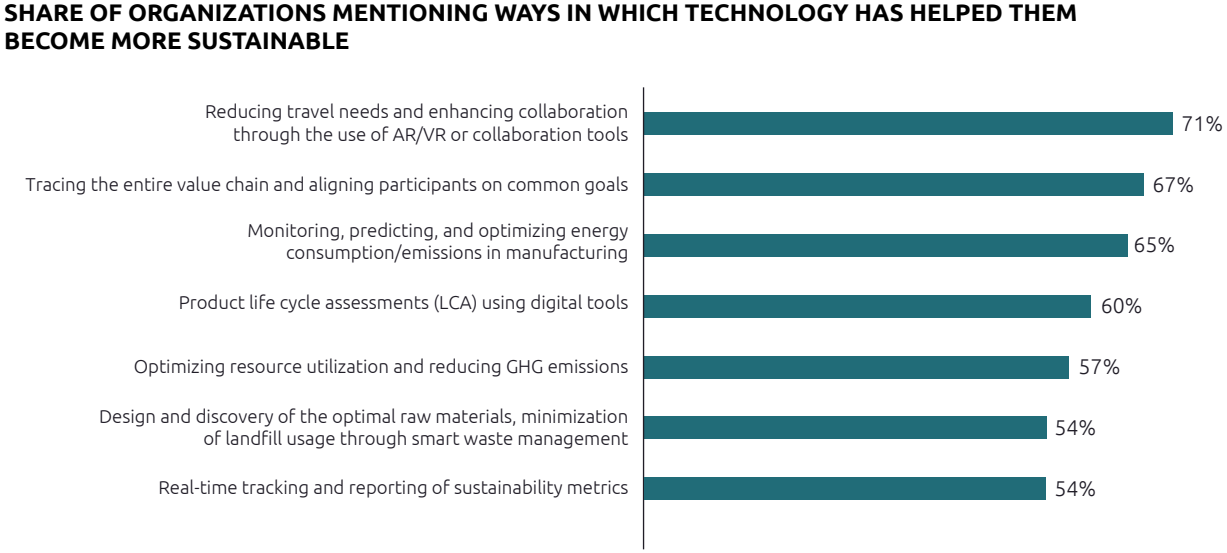


04 OPTIMAL INTEGRATION OF DIGITAL AND SUSTAINABILITY WILL YIELD ENVIRONMENTAL, SOCIETAL, AND ECONOMIC BENEFITS

Technology has made organizations more sustainable throughout the value chain

Organizations are using technology and data to further their sustainability initiatives in several ways. For instance, some use technology to facilitate virtual collaboration, thereby reducing the need for travel. Furthermore, it also helps in optimizing energy and resource allocation, tracking data, enabling organizations to make informed decisions to reduce environmental impact, and so on (see Figure 19).

FIGURE 19.
Organizations harness technology extensively to become more sustainable



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 146 executives from sustainability function.

Valérie Legat at Carrefour underscores the pivotal role of data and technology in her organization's sustainability efforts: ***"During e-commerce checkout, customers can view the carbon footprints of their chosen items and receive suggestions for alternative, environmentally friendly baskets. Additionally, as customers pick their preferred delivery slots, the system recommends ecologically favorable ('green') slots. For instance, opting for slots coinciding with existing deliveries in the vicinity reduces overall emissions."***

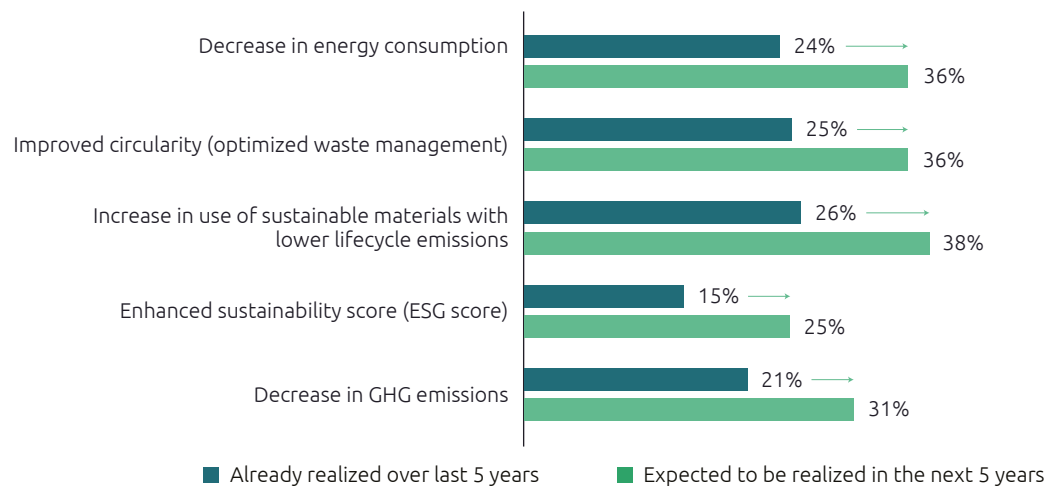
SECTOR	EXAMPLE
Financial services	BBVA, a Spanish financial services organization, has adopted a carbon-management system anchored in the cloud. Data entry and calculations are automated; BBVA can analyze its global energy consumption at granular level; and alerts are provided based on key indicators.
Automotive	Rolls-Royce is using digital twin technology and ML to extend maintenance time for some airplane engines by up to 50%, improving efficiency. This has saved around 22 million tonnes of carbon to date.[95] Renault's partnership with Envision AESC and Verkor in Douai aids in reducing the carbon footprint of their batteries. Further, the Scenic Vision concept car is made of new low-carbon materials, with over 70% recycled components, ensuring longevity.[96] Japanese auto manufacturer Subaru has used AI to identify alternative uses for its entire catalog of manufacturing materials. It was able to identify patterns that enabled the implementation of closed-system circular processes intended to eliminate waste and encourage recycling.[97]
Consumer products and retail	L'Oréal has partnered with Schrödinger to harness the power of the latter's digital chemistry platform and simulation tools. This aims to explore and assess sustainable alternatives to shampoos. Through virtual exploration, L'Oréal can evaluate a diverse range of ingredients, including those currently more problematic to source.[98]

Organizations are reaping tangible benefits in sustainability by scaling digital technologies

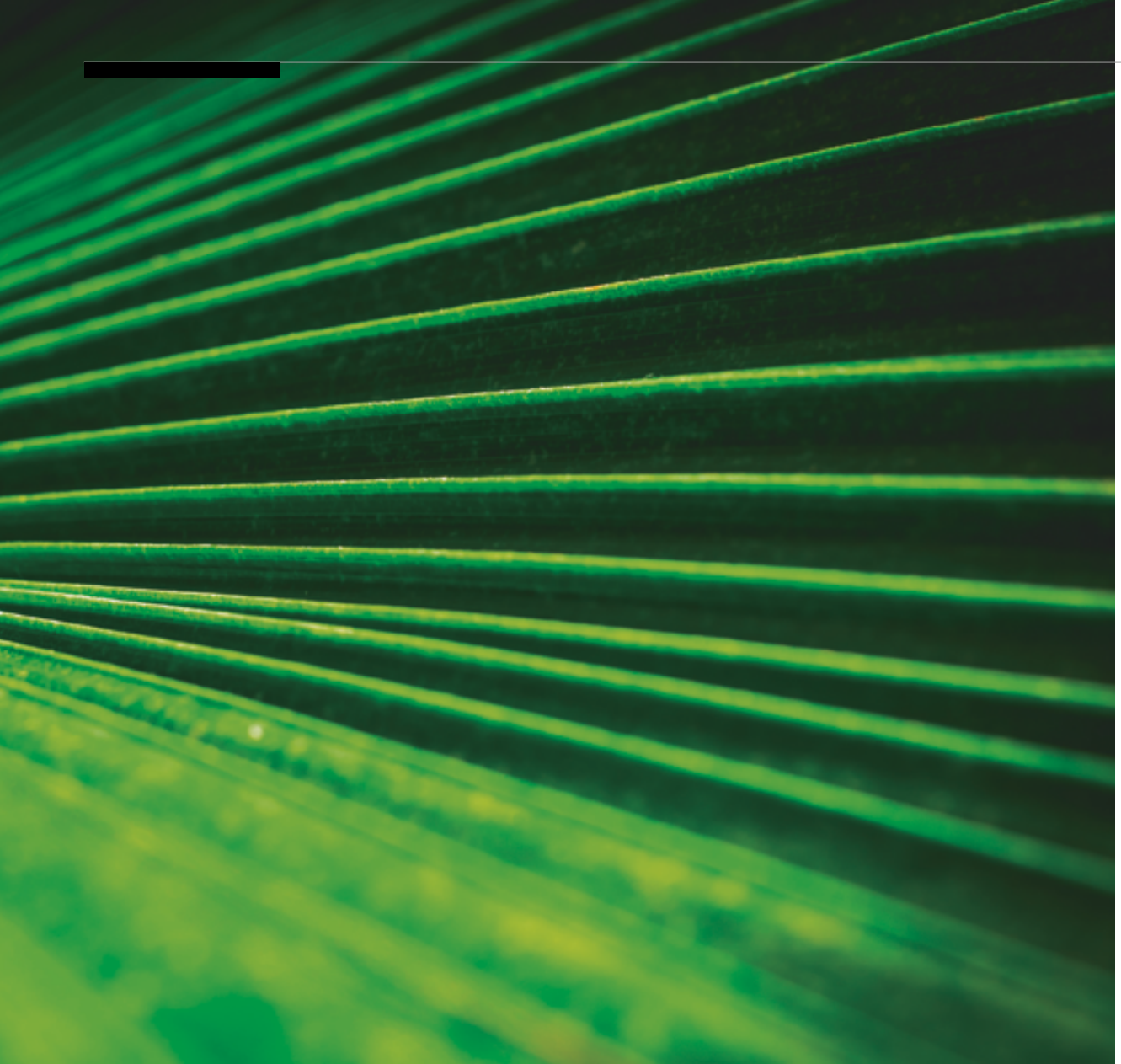
By embracing digital innovations, businesses have efficiently managed energy consumption, minimizing waste production and reducing emissions (see Figure 20).

FIGURE 20.
Organizations have reaped sustainability benefits by using technology

EXTENT OF SUSTAINABILITY BENEFITS REALIZED BY IMPLEMENTING DIGITAL TECHNOLOGIES, CURRENT VS. 2028



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 146 executives from sustainability function.



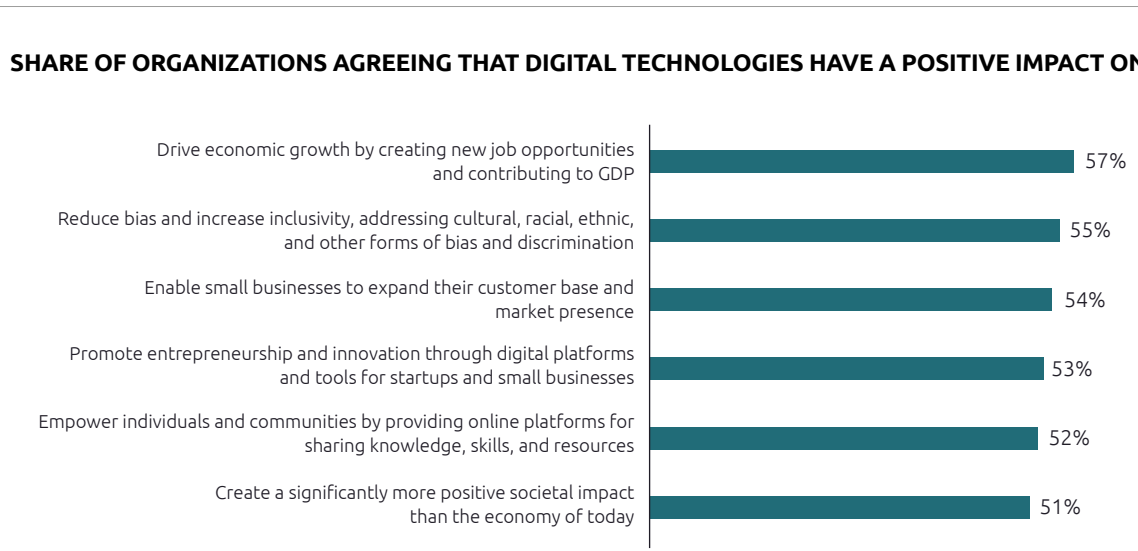
The CSO at a large software services firm highlights the significance of data and generative models: ***"Eighty percent of a product's carbon footprint is decided right at the beginning, during the engineering phase. With access to data about raw materials and their composition, coupled with generative design technology, sustainable products can be built at an efficient cost."***

Digital technologies can transform society

Digital technologies have democratized access to information, education, and services, fostering greater inclusivity and equity. Figure 21 illustrates organizational agreement that technology plays a significant role in creating new job opportunities, addressing bias and discrimination, promoting entrepreneurship, and enabling learning.

Laura Messineo, Vice-President of Virtual Health at Highmark Health, an American non-profit healthcare company, sums it up: ***"Data helps us pinpoint gaps, particularly in rural areas, where basic healthcare services may be lacking. And in addressing social determinants of health, data and analytics play a crucial role in guiding our actions. They also enable us to track total cost of care and identify the underlying drivers, which we can then focus on mitigating."***

FIGURE 21.
Digital technologies impact society positively



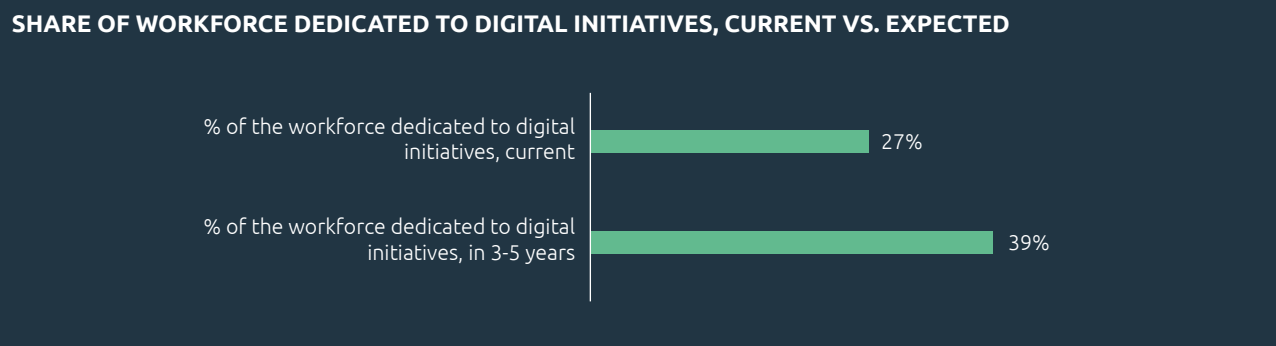
Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives.

DIGITAL EXPECTED TO HAVE A GROWING INFLUENCE ON THE EVOLUTION OF THE WORKFORCE

Organizations expect the digital workforce to constitute a substantial 40% of the overall workforce within the next 3–5 years.

The CDO at a telecom company sums it up: ***"Talent stands out as a critical factor for navigating the new economy. As the pace of change accelerates, attracting fresh perspectives from external sources and investing in our existing talent to embrace evolving business models is paramount."***

FIGURE 22.
Digital workforce expected to make up nearly 40% of the total workforce in the next 3–5 years



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N=150 executives from digital and finance functions.

- In the US, online job postings for digital roles increased by 24% between 2018 and 2021, led by a 116% increase in postings for data engineers.[99]
- Online postings for data scientist roles in Canada, the UK, and the US increased more than fortyfold by volume between 2012 and 2021.[100]

Recognizing the rapid pace of technological advancement, businesses are acknowledging the need for flexible, adaptive frameworks.

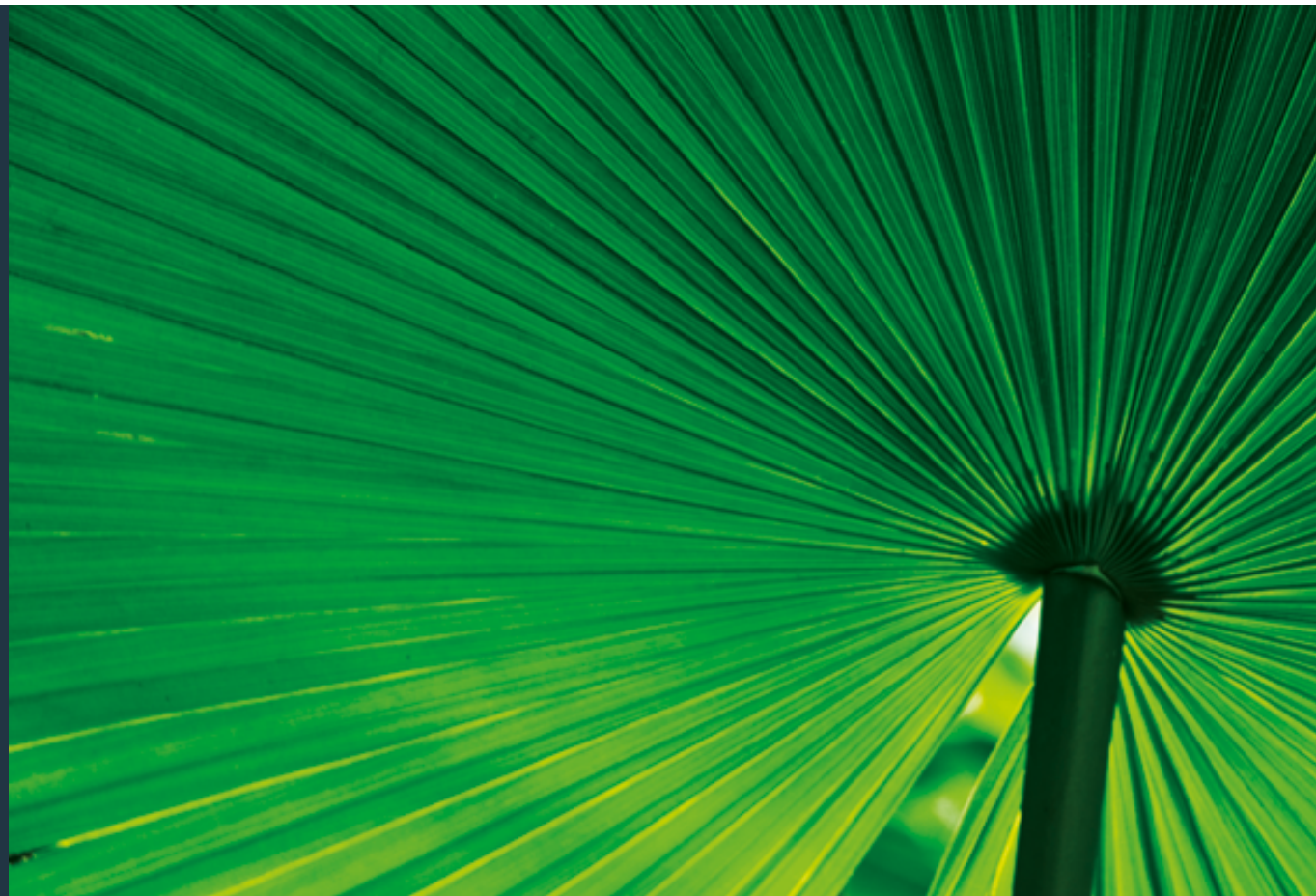
FIGURE 23.
Organizations are acquiring digital skills and becoming more agile

64%	53%	53%	47%	47%
say they are investing in reskilling their existing workforces	are creating dedicated software teams for driving software-defined transformation	of incumbent organizations are partnering with technology startups for their expertise	are investing in scaling agile methodologies across the organization	of incumbent organizations are re-evaluating their business models and transforming operations to be more agile

Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives, N = 1,355 incumbent organizations.

- To transition from a traditional telco provider into a genuine technology company, Vodafone is adding 7,000 software engineers to its European workforce by 2025.[101]
- Daimler plans to recruit 3,000 programmers worldwide to strengthen its software hubs in India, Germany, the US, China, and Israel.[102]

Bijoy Sagar from Bayer comments: ***"Every senior leader in the company has undergone standardized digital training, ensuring a shared vocabulary and a unified understanding of concepts like platform business. This consistency was pivotal in raising initial awareness across the company. Digital business is seamlessly integrated into our strategic processes, guiding resource allocation. Subsequently, extensive training initiatives have been implemented to reinforce these principles."***



"Data helps us pinpoint gaps, particularly in rural areas, where basic healthcare services may be lacking. And in addressing social determinants of health, data and analytics play a crucial role in guiding our actions. They also enable us to track total cost of care and identify the underlying drivers, which we can then focus on mitigating."

LAURA MESSINEO
Vice-President of Virtual Health at Highmark Health,
an American non-profit healthcare company

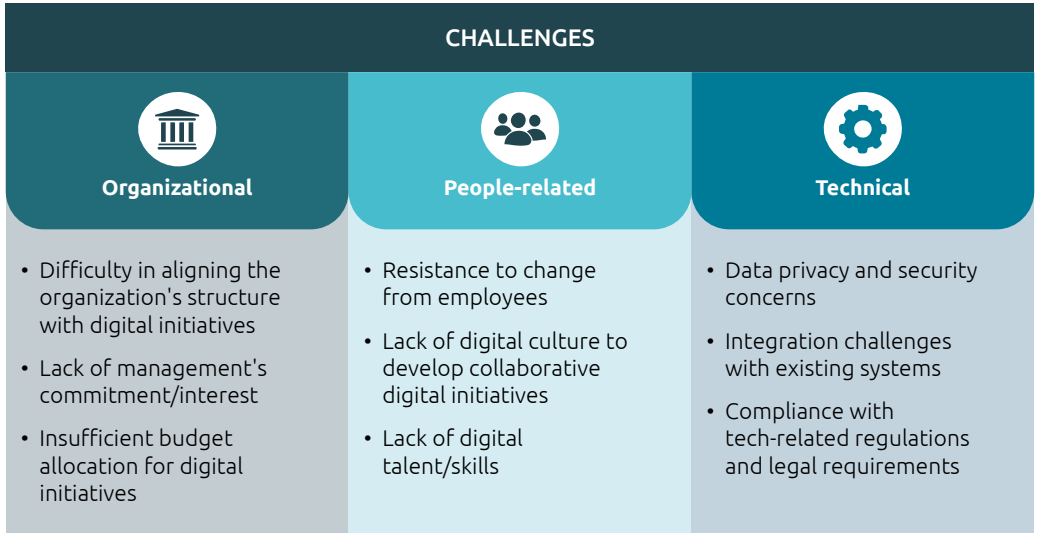
05 HOW TO HARNESS THE OPPORTUNITIES OF AN ECO-DIGITAL ERA™

Figure 24 illustrates a comprehensive overview of the challenges faced by organizations in their transition to an eco-digital era™ (see Figure 24).

At organizational level, challenges arise in aligning the structure with digital initiatives, hindering seamless integration. Lack of management commitment, compounded by insufficient budget allocations, can impede prioritization and execution of digital projects. People-related hurdles include employee resistance to change, lack of a collaborative digital culture, and a dearth of digital talent. The technical dimension introduces concerns about data privacy, security, and integration challenges, necessitating careful navigation for a smooth transition.

FIGURE 24.

Organizations face several challenges in their transitions towards an eco-digital era™



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives.

Failure to address these challenges adequately poses the risk being left in the wake of disruption. The volatile geo-political environment is a challenge but also an opportunity to reimagine long-established norms and practices. As recent multi-crises, ranging from the COVID-19 disruption of 2020 to the supply chain issues of 2022, have shown, organizations exhibiting agility and responsiveness have not only survived but thrived once the economy normalized.

Even as examples of startups upending traditional businesses are widely recounted, large organizations often underestimate the risk of disruption. In our survey, as many as three in five (60%) organizations consider digital startups to pose only a moderate threat or none.

We aimed to conduct a more in-depth analysis of the surveyed organizations, focusing on their digital maturity to assess whether the mature organizations perform better than the rest. Consequently, we categorized organizations with advanced digital strategies, governance, and implementation as "Leaders," distinguishing them from "Followers," representing those without such advanced practices. Additional information regarding this analysis can be found in the appendix.

With insights based on this analysis, our discussions with industry experts, and our experience of driving digital and sustainable transformations at global organizations, we have clarified the following key steps for organizations to fully harness the opportunities of the eco-digital era™.

Identify efficiencies across business to drive cost savings

Organizations should adopt a strategic approach, pinpointing critical areas in the value chain for enhanced efficiencies and cost savings. Digital technologies are the key to this process:

- Analyze cost structures using **digital tech for streamlined expenses and improved financial health**
- Prioritize **process efficiencies via workflow reassessment and digital tech adoption** for operational effectiveness
- Empower employees with **digital skills training**, reducing errors, enhancing adaptability, and minimizing the need for external hires and associated costs

Over **70% of Leaders in our study strongly believe that widespread technology integration will yield significant cost advantages**, in contrast with only 55% of Followers.

Furthermore, organizations should not only prioritize business objectives but should also consider adopting a **True Cost Accounting (TCA) approach that assesses product costs holistically – including environmental and social costs.**[103] The incorporation of technology into sustainability initiatives can indeed yield simultaneous cost reductions. For instance:

- Transitioning to renewable energy sources provides long-term savings
- The adoption of technology platforms that contribute to a circular economy brings about cost-saving benefits
- Embracing localized supply chains can enhance sustainability and decrease logistics costs[104]

Our recent research indicates that most respondents acknowledge reduced or similar costs with the adoption of sustainable design strategies. IKEA, for instance, utilizes flat packing, allowing twice as many products to be packed in a single lorry, lowering transportation costs and emissions.[105] Low-cost airline easyJet has invested in the latest aircraft software from Airbus, designed to cut costs on jet fuel as a part of a flight-management system upgrade to be undertaken by end-2023. Airbus estimates that this upgrade will help easyJet save more than 98,000 kg of fuel per year per aircraft across its European network.[106]

Therefore, embedding sustainability into the lifecycle of products and services would be beneficial for organizations; we explore this in more detail in the subsequent sections.

Strive for a blend of short- and medium-term successes, supported by clear business objectives

Striking a careful **balance between short-term wins and medium-term goals is pivotal** for organizations. While the focus remains on reaping quick and visible benefits from digital implementations, equal importance should be placed on harnessing technology for medium-term objectives, thereby building a more substantial and enduring digital capability.

- **Short-term wins**, achieved through swift, targeted digital initiatives, deliver instant benefits to organizations, and create positive momentum that sets the stage for long-term digital adoption.
- **Medium-term goals** involve innovative application development and holistic platform integration. These objectives empower organizations to explore not only established technologies but also emerging ones, cultivating continuous innovation and adaptability.

Further, organizations must **align their digital goals with well-defined business cases** serving as strategic blueprints. A robust business case outlines objectives, potential benefits, and costs, ensuring stakeholders grasp the project's value proposition. This clarity sets realistic expectations, establishes measurable outcomes, and enables data-driven decisions for future digital initiatives.

Reinvest savings into digital transformation for maximum benefits

As observed, digital technologies drive enhanced operational efficiencies and substantial cost savings. Strategically **harnessing these cost reductions within the core business opens avenues for continuous reinvention and facilitates a dual transition to an eco-digital era™**. Reinvesting these savings in initiatives promoting sustainability and digital transformation is paramount.

Highlighting the importance of agility and adaptability for continuous reinvention, Bijoy Sagar from Bayer comments: ***"To transform an organization into a digital business is the work of more than one function. This requires a lot of training, new ways of working: agile as a methodology is now consistently implemented across all the digital functions. But it's also a very challenging process because, going forward, every function is going to become a digital function."***

However, the digital journey for organizations is not one-size-fits-all; it is contingent upon their existing digital maturity level.

For leaders who have already made significant strides in their digital transformations, the short-term focus should be on investing in scaling mainstream technologies across the organization. This approach would ensure that economies of scale kick in, spreading benefits from early successes across the organization, at relatively lower additional investment. To scale technologies successfully, organizations should:

- **Continuously invest** in the necessary digital infrastructure, **including cloud solutions, data storage, and networking solutions**, in order to accommodate future growth.

In the medium term, they should:

- **Evaluate and invest in emerging technologies** such as generative AI, quantum technology, blockchain, and digital twins, which are relevant to their specific business; they should select these by understanding market trends and identifying innovative solutions that can address existing challenges or create new opportunities.
  - **Generative AI:** Formulate clear guidelines for usage, seamlessly integrate generative AI into the organization's strategy and operations, and prioritize sustainable development.[107]
  - **Digital twins:** Ensure comprehensive integration of the digital twin architecture, implementing robust security measures to safeguard sensitive information.[108]
  - **Quantum technologies:** Evaluate the viability of quantum technologies for your business (in relevant use cases), assemble a proficient team, pinpoint the most promising use cases, and establish enduring partnerships with technology providers.[109]
- Develop a **structured roadmap that outlines a systematic approach for the gradual and eco-conscious scaling** of these emerging technologies, aligning technological advancements with environmental preservation.

Nearly **8 in 10 (79%) Leaders believe that convergence of new technologies will create new opportunities for innovation**, bringing about a paradigm shift in the business and economic landscape in the next 3–5 years, whereas only 51% of Followers believe so.

Conversely, for organizations in the initial stages of their digital journey, the emphasis should be on starting small:

- **Test and pilot select digital technologies on a smaller scale**, especially mainstream ones such as data analytics, AI/ML, robotics, automation, etc. This will mitigate risks, assess feasibility of different technologies, and enable learning from initial successes and failures.

In the medium term, such organizations should:

- **Gradually expand digital initiatives and scale them**, aligning them with business objectives
- Develop a **clear roadmap for implementing and scaling digital technologies** over time
- Outline the **sequence of initiatives, milestones, and resource allocation** necessary to achieve these objectives

"To transform an organization into a digital business is the work of more than one function. This requires a lot of training, new ways of working: agile as a methodology is now consistently implemented across all the digital functions. But it's also a very challenging process because, going forward, every function is going to become a digital function."

BIJOY SAGAR
Chief Information Technology and
Digital Transformation Officer at Bayer

Embed sustainability and progress metrics in product and services lifecycle

Embedding **end-to-end sustainability** and the capability to measure it within the lifecycle of products and services is imperative. This will help in reducing their carbon footprint and meet eco-conscious consumer demands. Our findings show that **nearly eight in 10 (81%) Leaders believe that digital technologies help them in achieving their sustainability goals**, compared to 57% of Followers.

"What we do, and where most companies can improve, is taking a holistic approach: looking at the entire supply chain, from material extraction to how the customer uses the phone and how it is discarded. We keep questioning how we can make sure everything is as good as possible for people and the planet." Ronald van Harten, Head of Marketing for Fairphone, a Dutch electronics manufacturer.[110]

"Smart meters, sensors, and holistic energy-management systems offer insight into energy consumption and production processes. This helps us make informed decisions, optimizing our operations, addressing inefficiencies, and reducing our carbon footprint.

DR. GUNTER BEITINGER
Senior Vice-President, Manufacturing and Head of Factory Digitalization at Siemens

Beyond merely adopting ad-hoc eco-friendly practices, organizations should:

- **Holistically integrate sustainability** using technologies across operations, from supply chain optimization to customer engagement. Employing technology to measure environmental and social impacts aids in identifying high-impact areas.

Dr. Gunter Beitinger from Siemens reveals: ***"Smart meters, sensors, and holistic energy-management systems offer insight into energy consumption and production processes. This helps us make informed decisions, optimizing our operations, addressing inefficiencies, and reducing our carbon footprint. For instance, identifying inefficient machine usage or worn-out components that contribute to excessive energy consumption. Moreover, with data-driven precision, we synchronize energy-intensive processes with renewable energy availability, driving sustainability while also optimizing costs."***

- Embed **sustainability as a core design priority** and set clear goals for design teams. According to our recent research, design decisions impact emissions, with **67% of organizations reducing carbon emissions through sustainable design**. Despite product emissions mainly arising from the customer use phase, design decisions can impact and reduce emissions. Technologies like life cycle assessment (LCA) tools, AI/ML, additive manufacturing, bio innovation, and digital twins significantly aid sustainable product design. Unilever is reformulating products such as liquid laundry detergents with plant-based stain removers, lowering use-phase emissions through features such as suitability for low-temperature washing, resulting in lower GHG impact compared with laundry powders.[111]
- **Prioritize services for a transition to a circular economy**, aiming for sustainable product and material flows. Additionally, investment in infrastructure and services supporting product-life extension and end-of-life management is crucial. Developing digital product passports (DPPs) is essential for driving circularity, providing stakeholders with valuable product-related data including material details, carbon footprint, repairability, and disposal instructions.[112]

81%

of Leaders believe that digital technologies help them in achieving their sustainability goals

The European Commission's proposed Ecodesign for Sustainable Products Regulation also makes DPPs a priority. Cisco has set a target to ensure that 100% of its new products and packaging will incorporate circular design principles by 2025. Oliver Zipse, Chair of the Board of Management of BMW AG, comments: ***"We must design our vehicles for sustainability from the very first day of development: reducing the amount of material used to manufacture them and, above all, planning for reuse and recycling from the very beginning. In the face of rising raw-materials prices, this is not just an environmental, but also a business imperative."*** [113]

- **Encourage a culture of sustainability as a fundamental organizational principle**, rather than a peripheral initiative. Upskill employees for a mindset shift towards systems thinking and circular design. Currently, less than a third (28%) of organizations are upskilling design teams with sustainable design skillsets.[114]

Although digital technologies do have a carbon footprint, their positive impact on sustainability (as described in the previous section) often outweighs this negative aspect.

Tap into industry and supplier ecosystems to accelerate benefits

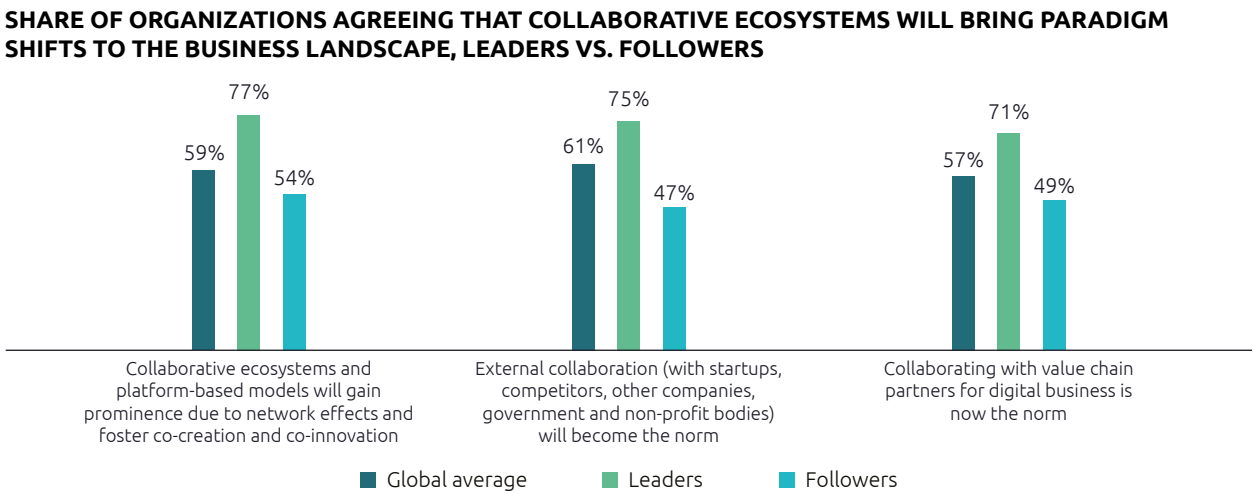
Collaborative ecosystems bring together diverse players, including businesses, suppliers, startups, research institutions, and government bodies, to pool their expertise and capabilities. Our previous research on collaborative data ecosystems revealed that they can drive financial advantage to the extent of 2–9% of annual revenue over five years for an organization with $10 billion in annual revenue.[115]

Such data sharing and partnerships should be harnessed to:

- **Foster innovation**, allowing organizations to tap into new technologies, markets, and ideas they might not have access to independently;
- **Optimize resources** and **enhance agility**, enabling organizations to respond more effectively to changing customer demands and market dynamics, and helping them **work collectively towards a sustainable world**.

Leaders have already recognized the potential of such partnerships and believe that they will gain more prominence in the near future (see Figure 25).

FIGURE 25.
Leaders recognize the potential of collaborative ecosystems



Source: Capgemini Research Institute and Digital Value Lab at the Digital Data and Design Institute at Harvard, Eco-Digital Survey, May–June 2023; N = 1,505 executives; N=874 executives from digital and innovation function, out of which N=168 Leaders, N=261 Followers.

Frank Loydl from Audi AG asserts: ***"Collaboration helps us bridge knowledge gaps, not just in products and services but also with regards to cultural exchange. The outcomes are evident: significant quality improvements, enhanced speed, expanded service capabilities, and the creation of new business models."***

Dr. Gunter Beitinger explains how Siemens uses collaborative ecosystems for sustainability: ***"We have developed Estanium, an open, cross-industry network that operates on an ecosystem-driven approach, allowing manufacturers, suppliers, customers, and partners to exchange reliable product carbon footprint (PCF) data seamlessly. Operating as a pre-competitive association, Estanium aims at tackling supply chain decarbonization."***

"Collaboration helps us bridge knowledge gaps, not just in products and services but also with regards to cultural exchange. The outcomes are evident: significant quality improvements, enhanced speed, expanded service capabilities, and the creation of new business models."

FRANK LOYDL
CIO at Audi AG

Conclusion

The world is witnessing an eco-digital revolution. Value is now measured not only in economic terms, but in relation to the environment and wider society. Tools and processes developed over the past decade generate value more efficiently. Scaling of digital technologies – data and analytics, cloud, software, and platforms – is now mainstream and promises to multiply benefits exponentially. Effective harnessing and inclusive distribution of these benefits will require a conscious and agile approach to experimentation, implementation, and collaboration across organizational and industrial boundaries.

Appendix

I. Calculating the size of the eco-digital economy

To arrive at the size of the global eco-digital economy, we used the following calculations:

1. Estimated the current size of digital for our surveyed organizations by using the share of digital revenue (as a % of total revenue)
2. Scaled up this value using the total revenue of listed organizations globally to arrive at the global size of the digital economy
3. Used the forecasted GDP growth rate to arrive at the expected size of the eco-digital economy by 2028

MODEL INPUTS	
Digital revenue as a % of total revenue, current, survey data	23.1%
Digital revenue as a % of total revenue, expected 2027, survey data	34.4%
Current GDP, global (in $ bn), IMF	100,500
Expected GDP, 2028, global (in $ bn), IMF	125,740

II. Digital maturity analysis of organizations

MODEL INPUTS

ELEMENTS ON WHICH THE CATEGORIZATION AS LEADERS VS. FOLLOWERS WAS BASED	
Strategy	Presence of a comprehensive digital strategy with well-defined goals and target timelines
Governance	Presence of a governing body in place to oversee digital initiatives; presence of processes in place for identifying, prioritizing, and investing in digital technologies
Implementation	Organizations' state of implementation of mainstream digital technologies – pilot/PoC, partially scaled, or fully scaled
Assessment	Regular assessment, updates, and communication of digital strategy
Sustainability	Use of technology and data at scale for sustainability initiatives

We assessed the surveyed organizations using the aforementioned criteria:

- Those in the top 33% were categorized as Leaders
- Those in the bottom 33% were categorized as Followers

III. Definitions of digital economy by region

REGION	ORGANIZATION/ INSTITUTE	DEFINITION
Asia	Asian Development Bank	The digital economy is defined as a contribution to the gross domestic product (GDP) of any exchange or flow of economic value involving digital products and/or industries
Australia	Government of Australia – Department of Broadband, Telecommunications and Digital Economy	The digital economy is the global network of economic and social activities that are enabled by platforms such as the Internet, mobile, and sensor networks
India	Invest India	The term 'digital economy' first appeared during the 1990s and has evolved since with the simultaneous evolution of the technology, and its usage by businesses and consumers. In recent years, this particular definition has centered on the diffusion of technology, products, techniques and services across economies
Various (primarily in North America and Western Europe)	OECD	The digital economy incorporates all economic activity reliant on, or significantly enhanced by, the use of digital inputs, including digital technologies, digital infrastructure, digital services, and data. It refers to all producers and consumers, including government, that are utilizing these digital inputs in their economic activities
Singapore	Infocomm Media Development Authority (IMDA) and Lee Kuan Yew School of Public Policy, National University of Singapore (LKYSPP)	The digital economy is defined as comprising both the value-added (VA) of the Information & Communications (I&C) sector and the VA from digitalization in the rest of the economy
Spain	Santander	'Digital economy' refers to the use of information technology (IT) to create or adapt, market or consume goods and services.
UK	British Computer Society	The digital economy refers to an economy based on digital technologies, although we increasingly perceive this as conducting business through online markets based on the internet and the World Wide Web
US	Census Bureau	It is useful to think of the digital economy as having three primary components: supporting infrastructure, electronic business processes (how business is conducted), and electronic commerce transactions (online sale of goods and services). It is important to note that a common feature of both electronic business processes and electronic commerce transactions is reliance on the use of computer-mediated networks. This is the 'bottom-line' difference between electronic and other kinds of business

Research Methodology

This research seeks to understand the nature of the new eco-digital economy, including:

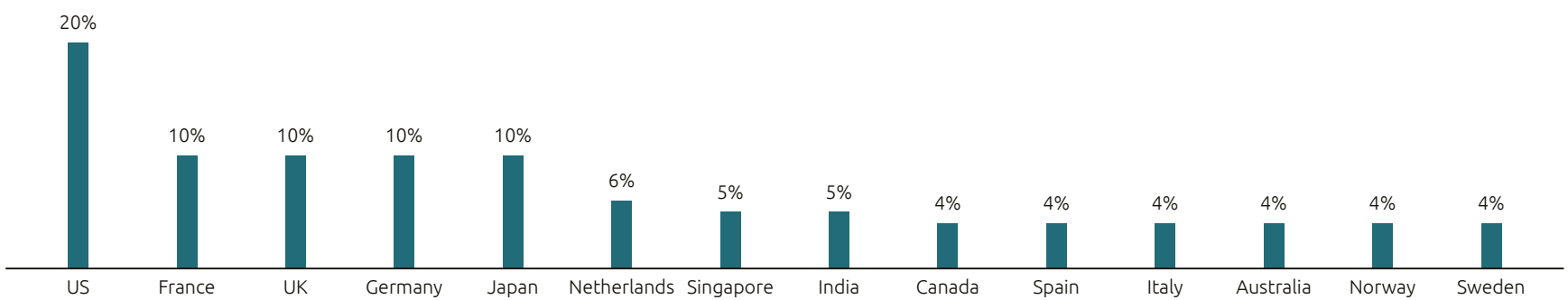
- what sets it apart from the traditional digital economy it is replacing;
- its drivers of growth;
- its contribution to global GDP;
- how businesses experiment with and scale new models to create economies of scale and new revenue streams;
- how digital and sustainability work symbiotically.

Survey of executives from large organizations and startups

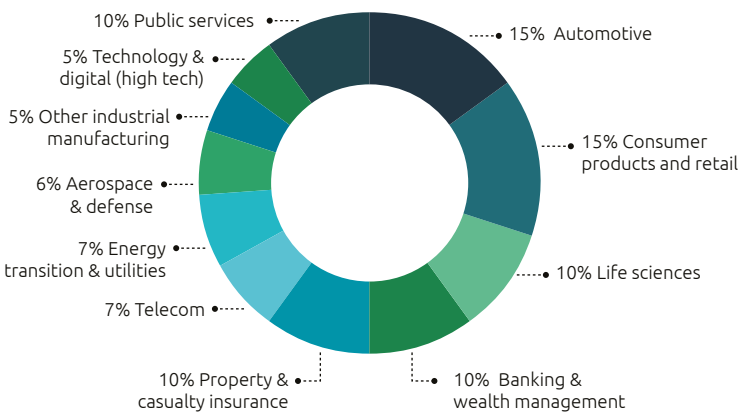
We surveyed 1,500 senior executives (director level and above) from 1,350 large organizations with annual revenue of over $1 billion (or annual budgets of over $50 million for public-sector entities) and 150 startups valued at over $1 billion each, all of which are actively pursuing multiple digital initiatives and/or have a comprehensive digital strategy in place. The organizations came from a range of sectors, including automotive, consumer products, retail, life sciences, banking and wealth management, property and casualty insurance, telecommunications, energy and utilities, aerospace and defense, technology, industrial manufacturing, high tech, and public services. They are based in 14 countries across North America, Western Europe, and APAC.

The distribution of respondents and their organizations is provided below.

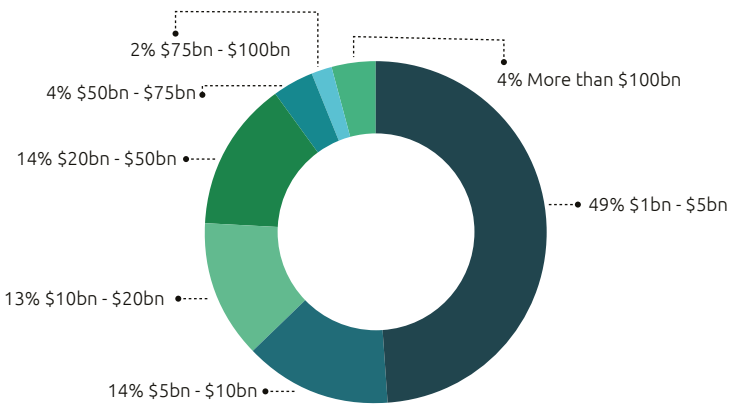
ORGANIZATIONS BY COUNTRY



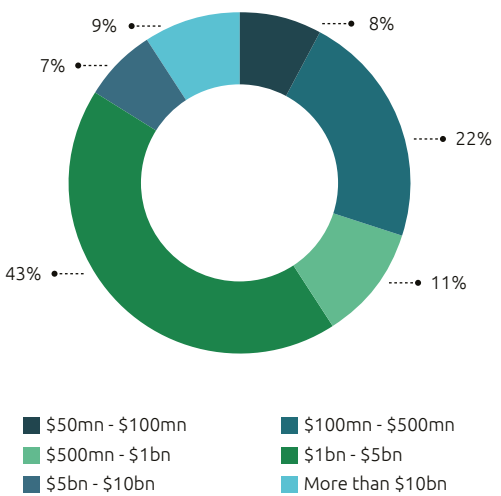
ORGANIZATIONS BY SECTOR/INDUSTRY



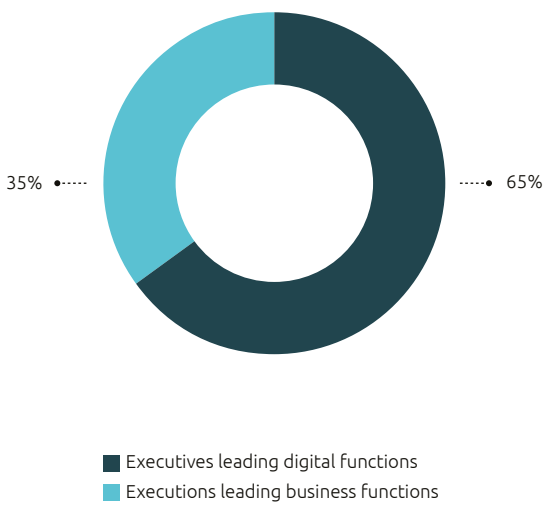
ORGANIZATIONS BY ANNUAL REVENUE



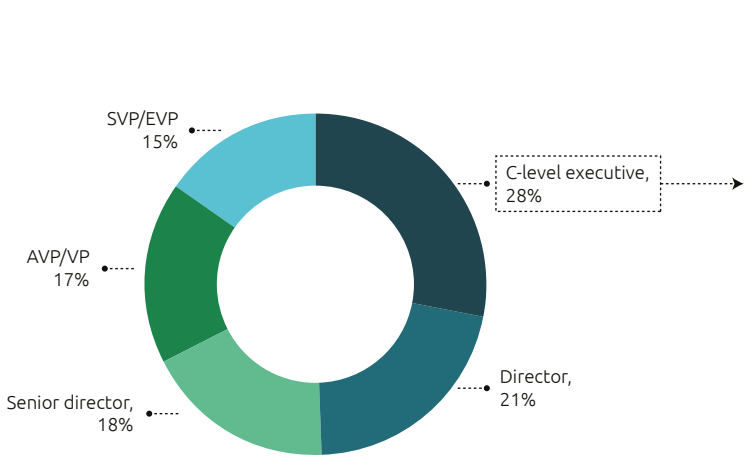
PUBLIC-SECTOR ENTITIES BY ANNUAL BUDGET

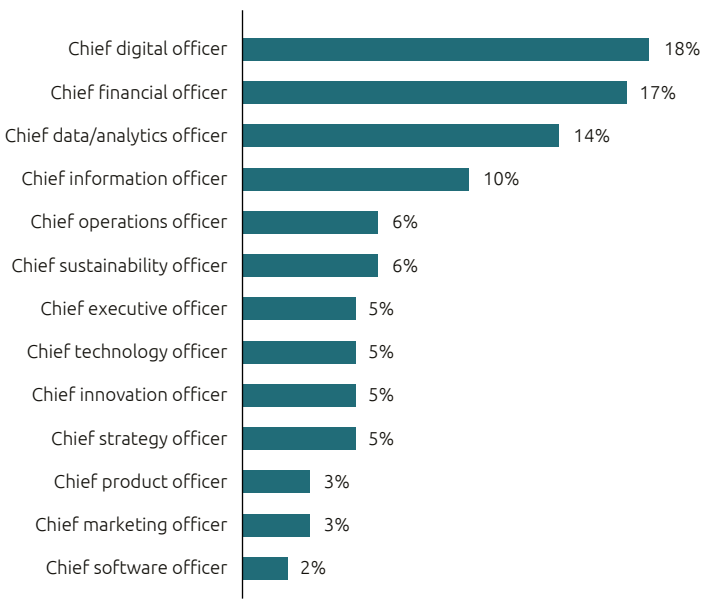


RESPONDENTS BY JOB ROLE



RESPONDENTS BY JOB TITLE





In-depth interviews

We complemented the surveys with in-depth interviews with 26 senior industry executives and experts.

The study findings reflect the views of the respondents to our online questionnaire for this research and are aimed at providing directional guidance. Please contact one of the Capgemini experts listed at the end of the report to discuss specific implications.

References

1. The Guardian, “Apple jumps to third place in smartphone market as Nokia declines,” December 2008.
2. Quartz, “The data that transformed AI research—and possibly the world,” July 2017.
3. Wired, “An oral history of the #hashtag,” May 2017.
4. Investopedia, “The history of Uber,” April 2023.
5. Time, “Here's the first Instagram photo ever,” July 2014.
6. Reuters, “ChatGPT sets record for fastest-growing user base,” analyst note, February 2023.
7. World Economic Forum, “3 ways technology is helping the world adapt to climate change,” February 2023.
8. ARK Investment Management LLC, “Big Ideas,” 2023.
9. Insider Intelligence, “Worldwide ecommerce growth drops to single digits, while overall retail muddles through,” August 2022.
10. International Energy Agency, Global EV Outlook 2023, April 2023.
11. United Nations, “Big Data for Sustainable Development,” accessed September 2023.
12. Statista, “Amount of data created, consumed, stored 2010-2025,” May 2022.
13. Github blog, “Research: quantifying GitHub Copilot’s impact on developer productivity and happiness,” September 2022.
14. Ericsson, Mobility Report, November 2022.
15. HP, “HP sustainable impact report,” 2021.
16. Capgemini Research Institute, *A world in balance: Why sustainability ambition is not translating to action,* November 2022.
17. European Commission, “Green digital sector,” accessed September 2023.
18. The World Bank defines digitalization as a transformative opportunity that is characterized by the increasing importance of digital technologies and platforms in terms of tackling global issues and creating new job opportunities and markets, along with an increased access to finance, while enhancing transparency and efficiency. World Bank, “Digital Development: Overview.” Accessed October 27, 2023.
19. WEF, “Digital trust: How to unleash the trillion-dollar opportunity for our global economy,” August 2022.
20. IMDA, “Asia spurs transparency and digital economy growth,” April 2023.
21. IMF, “Asia's productivity needs a boost that digitalization can provide,” January 2023.
22. U.S. Bureau of Economic Analysis (BEA).
23. European Commission, The Digital Economy and Society Index (DESI) 2022.
24. Enel, “Digital Carbon Footprint: measuring for more improvement,” May 2023.
25. Science Direct, “Disentangling the worldwide web of e-waste and climate change co-benefits,” December 2022.

26. Nature, “Breaking through ingrained beliefs: revisiting the impact of the digital economy on carbon emissions,” September 2023.
27. Ibid.
28. Science Direct, “Disentangling the worldwide web of e-waste and climate change co-benefits,” December 2022.
29. Enel, “Digital Carbon Footprint: measuring for more improvement,” May 2023.
30. WEF, “Why manufacturers should use digital twins for sustainability not just productivity,” May 2023.
31. Science, “Recalibrating global data center energy-use estimates,” February 2020.
32. Forbes, “Google Trusts DeepMind AI To Manage Data Centre Cooling,” August 2018.
33. tinyML foundation webpage.
34. Microsoft, “Phi-2: The surprising power of small language models,” December 2023.
35. European Commission, The Digital Economy and Society Index (DESI) 2022.
36. TechCrunch, “Amazon’s tech is headed to millions of Stellantis vehicles in 2024,” January 2022.
37. JP Morgan Chase & Co. Investor Day, 2023.
38. Forbes, “Auto industry leads in digital-transformation investments,” November 2022.
39. Ibid.
40. IDC, “IoT Growth Demands Rethink of Long-Term Storage Strategies, says IDC,” July 27, 2020.
41. Ibid.
42. MosaicML, “Mosaic LLMs (Part 2): GPT-3 quality for <$500k,” September 2022.
43. ARK Investment Management LLC, “Big Ideas,” 2023.
44. Cybersecurity Ventures, “The world will store 200 zettabytes of data by 2025,” June 2020.
45. Forbes, “Computing on the edge can be transformative – but look before you leap,” March 2021.
46. UNEP, “With new pact, tech companies take on climate change,” March 2021.
47. Capgemini Research Institute, *A world in balance: Why sustainability ambition is not translating to action*, November 2022.
48. Ibid.
49. WEF, “The “No-Excuse” Framework to accelerate the path to net-zero manufacturing and value chains,” January 2023.
50. GM Website; Tech Crunch, “GM increases EV and AV investments to $35B through 2025,” June 2021.
51. Honda, Sustainability Report 2021.
52. CIO, “Supply chain analytics: 3 success stories,” February 2022.

53. Capgemini Research Institute, *Networks on cloud: a clear advantage,* February 2023.

54. CIO, "Lilly revolutionizes clinical trials with intelligent sensor cloud," August 2023.

55. The Verge, "OpenAI wants to be the App Store of AI," November 2023.

56. AUTOSAR website.

57. COVESA website.

58. European Respiratory Society, "IMI project OPTIMA aims to improve treatment for patients with prostate, breast and lung cancer through artificial intelligence," accessed August 2023.

59. OPTIMA website.

60. Ericsson, "How utilities ecosystem collaboration is helping the industry accelerate problem solving and capture long-term value," accessed August 2023.

61. FinTech News, "Launch of the first interactive Insurtech DACH Map," March 2021.

62. Capgemini Research Institute, *Harnessing the value of generative AI: Top use cases across industries,* July 2023.

63. Ibid.

64. Capgemini Research Institute, *The journey to cloud sovereignty: Assessing cloud potential to drive transformation and build trust,* July 2022.

65. Capgemini Research Institute, *Total immersion: How immersive experiences and the metaverse benefit customer experience and operations,* December 2022.

66. Capgemini Research Institute, *Quantum technologies: How to prepare your organization for a quantum advantage now,* March 2022.

67. Ibid.

68. Nvidia, "Manufactured in the Metaverse: Mercedes-Benz assembles next-gen factories with NVIDIA Omniverse," January 2023.

69. Wired, "Nike will let people design and sell sneakers for the Metaverse," November 2022.

70. Vogue Business, "Tommy Hilfiger to launch first of its kind multi-metaverse hub," March 2023.

71. OpenAI, "Morgan Stanley wealth management deploys GPT-4 to organize its vast knowledge base," March 2023.

72. PR Newswire, "HyCOgen and FT CANS, innovative technologies to enable sustainable fuel production selected for Repsol and Aramco's synthetic fuel plant in Bilbao," May 2022.

73. Autodesk, "Autodesk and Airbus demonstrate the impact of generative design on making and building," November 2019.

74. Domino's Pizza, Financial Results 2022.

75. Mercedes-Benz Group website, accessed on August 2023.

76. TechCrunch, "Amazon's tech is headed to millions of Stellantis vehicles in 2024," January 2022.

77. Stellantis Annual Report, July 2023.

78. Citi Investor Day, 2022.

79. Platform Industrie 4.0, "Digital platforms in manufacturing industries," March 2021.

80. Synapse, "Propeller Health: Inhaler Sensor," accessed August 2023.

81. Capgemini Research Institute, *Networks on cloud: a clear advantage,* February 2023.

82. TM Forum, "Rakuten Mobile: No ordinary telco," June 2020.

83. Capgemini Research Institute, *Networks on cloud: a clear advantage,* February 2023.

84. Capgemini Research Institute, *Harnessing the value of generative AI: Top use cases across industries,* July 2023.

85. Borescope is an optical device used to inspect narrow, inaccessible spaces (such as the interior of an engine cylinder).

86. Rolls-Royce, "Harnessing the power of AI to deliver more intelligent engine inspections," 2021.

87. Capgemini Research Institute, *Rethink: Why sustainable product design is the need of the hour,* September 2022.

88. GQ, "Runners, rejoice! Adidas Ultraboosts have been given a super-sustainable makeover," April 2021.

89. Philips website, accessed on December 2023.

90. Telekom, "Fairphone 5 – Sustainability and innovation going hand in hand," August 2023.

91. Schneider Electric, "Original Equipment Manufacturers."

92. CNBC, "Why you might be leasing not buying your next couch," January 2022.

93. Forbes, "ReSuit Helps Reduce Carbon Emissions Through A Peer-To-Peer Clothing Rental Platform," September 2023.

94. Mobileworldlive, "Orange, Vodafone partner on open RAN sharing," February 23, 2023

95. CIO, "Rolls-Royce turns to digital twins to improve jet-engine efficiency," June 2021.

96. Renault, 2021-22 Integrated Report.

97. 21st Century Tech, "AI is empowering the new Industrial Revolution for manufacturing," October 2021.

98. Extrapolations powered by Schrödinger, "How L'Oréal uses digital simulation to explore sustainable product ingredients," May 2023.

99. Randstad and the OECD, "Digital Skills, unlock opportunities for all," 2022.
100. Ibid.
101. Eightfold.ai, "Vodafone is revamping hiring and talent management as it shifts from telecom to tech company," March 2022.
102. Reuters, "Daimler to hire 1,000 programmers in Germany – Automobilwoche," April 2021.
103. Capgemini Research Institute, *Rethink: Why sustainable product design is the need of the hour,* September 2022.
104. Ibid.
105. Ibid.
106. Aerotime hub, "easyJet to invest in software to cut fuel costs, noise levels across A320 fleet," September 2022.
107. Capgemini Research Institute, *Harnessing the value of generative AI: Top use cases across industries,* July 2023.
108. Capgemini Research Institute, *Digital twins: Adding intelligence to the real world,* May 2022.
109. Capgemini Research Institute, *Quantum technologies: How to prepare your organization for a quantum advantage now,* March 2022.
110. Ibid.
111. Capgemini Research Institute, *Rethink: Why sustainable product design is the need of the hour,* September 2022.
112. Ibid.
113. Ibid.
114. Ibid.
115. Capgemini Research Institute, *Data-sharing masters: How smart organizations use data ecosystems to gain an unbeatable competitive edge,* July 2021.

Key contributors

Dr. Suraj Srinivasan
Philip J. Stomberg Professor of Business Administration at Harvard Business School and Head of the Digital Value Lab at Digital Data and Design (D^3) Institute at Harvard
ssrinivasan@hbs.edu

Jiani Zhang
Executive Vice President, Chief Software Officer, Capgemini Engineering
jiani.zhang@capgemini.com

Sally Epstein
Innovation Director, Cambridge Consultants, Capgemini
sally.epstein@capgemini.com

Andy Feinstein
Executive Vice President, Strategy, Capgemini
andrew.feinstein@capgemini.com

Noémie Lauer
Global Head of Sustainability, Capgemini Invent
noemie.lauer@capgemini.com

Jerome Buvat
Head of the Capgemini Research Institute
jerome.buvat@capgemini.com

Amol Khadikar
Research Program Lead, Capgemini Research Institute
amol.khadikar@capgemini.com

Hiral Shah
Manager, Capgemini Research Institute
hiral.shah@capgemini.com

Vaishnavee Ananth
Senior Consultant, Capgemini Research Institute
vaishnavee.a@capgemini.com

The contributors would like to thank all industry experts and executives who participated in this research.

The contributors would like to especially thank Subrahmanyam Kanakadandi and Marisa Slatter from the Capgemini Research Institute for their contributions to the research.

The contributors would also like to thank Paul Gittins, Gagandeep Gadri, Moïse Tignon, Richard Traherne, Emmanuelle Bischoffe-Cluzel, Pallav Srivastava, Amalachukwu Okafor, Punam Chavan, Abhishek Ogale, and Varsha Joshi for their contributions to the research.

About the Capgemini Research Institute

The Capgemini Research Institute is Capgemini's in-house think tank on all things digital. The Institute publishes research on the impact of digital technologies on large traditional businesses. The team draws on the worldwide network of Capgemini experts and works closely with academic and technology partners. The Institute has dedicated research centers in India, Singapore, the UK, and the US. It was recently ranked number one in the world by independent analysts for the quality of its research.

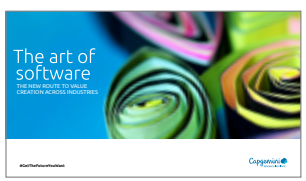
Visit us at www.capgemini.com/researchinstitute/

About the Digital Value Lab at the Digital Data and Design Institute at Harvard

The Digital Value Lab is part of the Digital Data and Design Institute at Harvard. The mission of the Digital Value Lab is to understand the impact of AI, big data, and digital transformation on performance and value creation in organizations. The Digital Value Lab addresses such questions as how can companies get the best return on their digital investments? What are the implications of AI on the way companies make decisions? How does performance change when data-driven decisions are made? Lab researchers adopt a variety of methods in their research from large sample empirical analysis, surveys and interviews, and in-depth case studies.

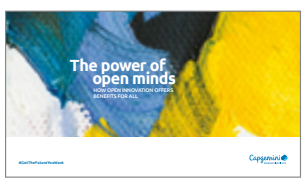
Visit us at https://d3.harvard.edu/labs/digital-value-lab/

More Capgemini Research Institute Publications

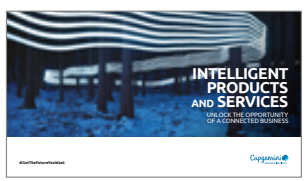


The art of software: The new route to value creation across industries

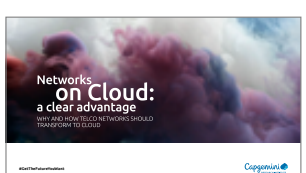
Harnessing the value of generative AI: Top use cases across industries



The power of open minds: How open innovation offers benefits for all

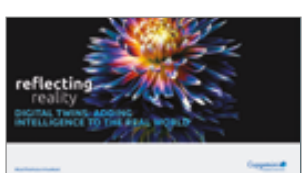


Intelligent products and services: Unlock the opportunity of a connected business



Networks on cloud: A clear advantage

Data for Net Zero:Why data is key to bridging the gap between net zero ambition and action



Digital twins: adding intelligence to the real world

Generative AI and the evolving role of marketing: A CMO's PLAYBOOK

Subscribe to latest research from The Capgemini Research Institute

Receive copies of our reports by scanning the QR code or visiting https://www.capgemini.com/insights/research-institute/subscribe/

Notes

About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided every day by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of nearly 350,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering, and platforms. The Group reported in 2022 global revenues of €22 billion.

Get the Future You Want | **www.capgemini.com**

Copyright © 2024 Capgemini. All rights reserved.