Fujitsu Technology and Service Vision 2023

English edition

FUJITSU

Our purpose

Make the world more sustainable by building trust in society through innovation

We continue to face serious challenges, from geopolitical tensions and financial turbulence to climate change. At the same time, the world is becoming increasingly fragmented, with inequality and protectionism on the rise. In light of these pressures, how can we help to build a more sustainable world? And how can technology innovation create new value for society?

At Fujitsu, we believe we must proactively contribute to making the world more sustainable, focusing our business activities and resources for this specific purpose. In Fujitsu Technology and Service Vision 2023, we explore how we can work with you to leverage the latest technological advances and develop a better future together.

Message from the CEO

Significant challenges, from inflation, geopolitical instability and scarce natural resources to environmental problems such as climate change and global warming, are impacting society, business and our everyday lives. As a result, global financial markets have become increasingly volatile. Now, we must all work together to address these complex and interrelated systemic challenges.

In line with our purpose, we have analyzed the key issues for Fujitsu and society, prioritizing our plans and resources accordingly. As a result, we are now focused on three areas: addressing global environmental issues to ensure that people and the natural world can coexist and prosper, developing a reliable digital society that enables prosperity and stability, and improving people's well-being by establishing a human-centric approach to life and work.

Specifically, we're strengthening our technology capabilities to drive sustainable growth, and refocusing our management systems and human resources to help us work with you to address these challenges.

Fujitsu Technology and Service Vision 2023 explores how we can integrate sustainability with business and how technology can positively impact the environment, economy and people's well-being.

We hope that you will find these insights valuable on your own business transformation journey.

May 2023
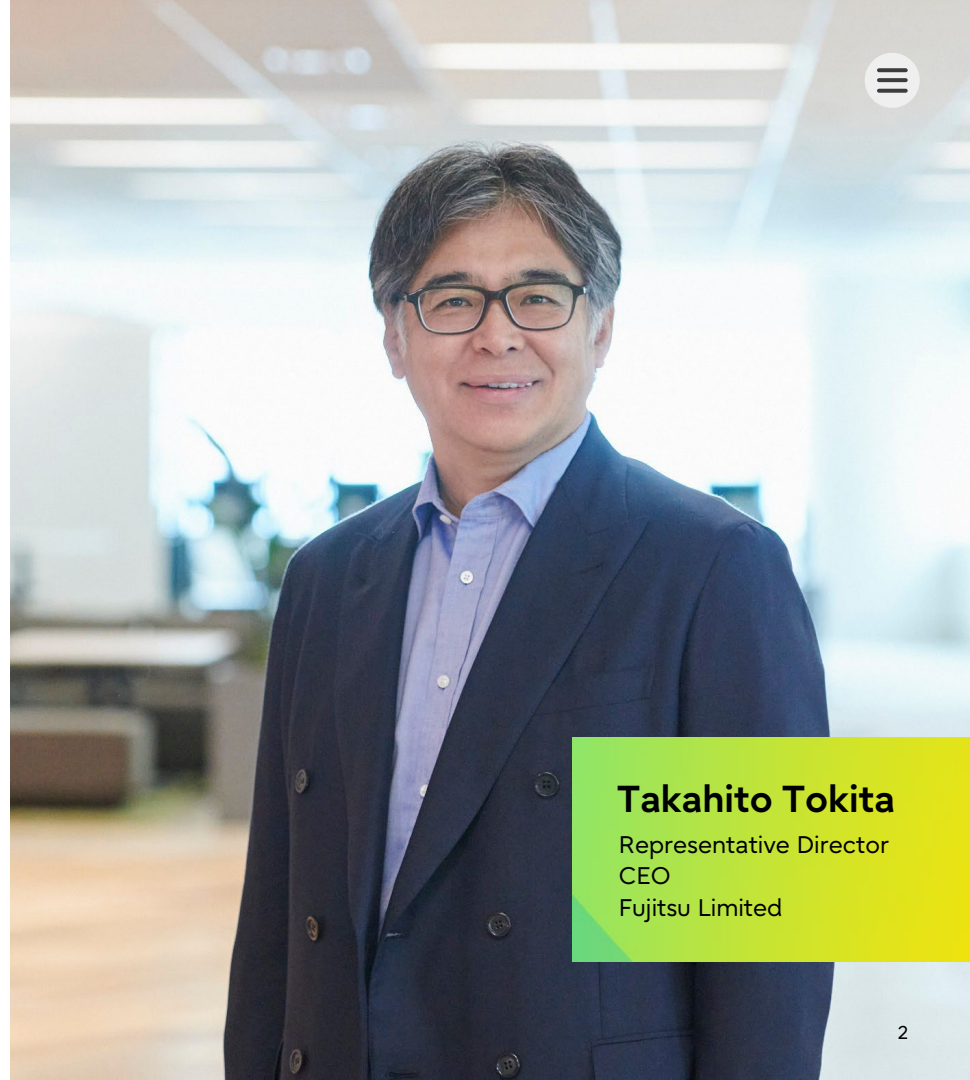
Takahito Tokita
Representative Director
CEO
Fujitsu Limited

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Module **1**   Module **2**   Module **3**

Fujitsu Technology and Service Vision (FT&SV)

Driving Sustainability Transformation through Digital Innovation

FT&SV is an evolving story, exploring the future we'd like to create with our customers and partners, how technology can help us achieve this vision and the specific actions needed to make it happen.

Since 2014, FT&SV has focused on the three key elements transforming business and society: Human-centric, using technology to empower people, Data-driven, exploiting data to generate intelligence, and Connected, addressing societal challenges by creating new ecosystems.

Last year, we emphasized that "Driving Sustainability Transformation through Digital Innovation" will be the most important theme for the next 10 years. Sustainability transformation means transforming business to bring about positive change in our environment, society and economies.

So, what is the situation now facing business and society in 2023?

Human Centric

Connected

Data Driven
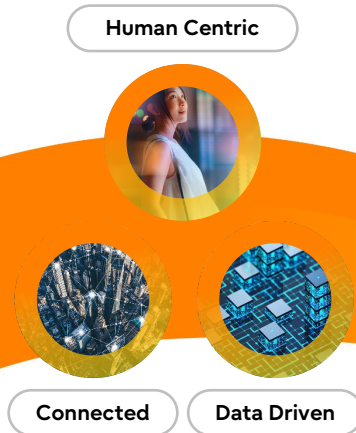
Digital Transformation

Sustainability Transformation

Systemic challenges

Climate change, pandemics and geopolitical tensions continue to have a major impact on society, business and people's lives. To make matters worse, these systemic issues are often interrelated, meaning that local events can have far-reaching global consequences.

For example, geopolitical conflicts have caused a spike in energy prices and increased demand for fossil fuels, which in turn hinders our response to climate change. Meanwhile, climate change continues to cause natural disasters across many regions. Inevitably, when these disasters occur in conflict areas, or areas with poor social infrastructure, the response can be delayed, potentially causing even greater damage and suffering.

Geopolitical conflict

Climate change
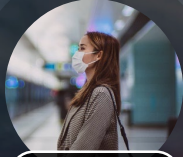
Fossil fuel

Economic growth

Inequality

Pandemic

Energy shortage

Inflation

Fragmentation

Globalization is not progressing. Indeed, protectionism is on the rise, making the world even more fragmented. While the global economy has grown, the gap between 'haves' and 'have-nots' continues to widen. The pursuit of excessive economic growth is negatively impacting attempts to improve the environment, health and human rights.

In January 2023, Fujitsu surveyed 1,800 business leaders in 9 countries to assess their current business situation and sustainability efforts. [1] In our survey, 42% of respondents observed a growing polarization between different social values, such as liberalism and protectionism, or globalism and nationalism.

It's clear that we're now at a crossroads. Can we build the global cooperation needed to overcome the systemic challenges we face?

Observing a growing polarization between different social values **42**%

1) Fujitsu's commissioned survey conducted by Oxford Economics among CxOs and decision makers in Australia, China, Japan, France, Singapore, Germany, Spain, United Kingdom, United States (an online survey with partial interviews).

Globalization

Protectionism
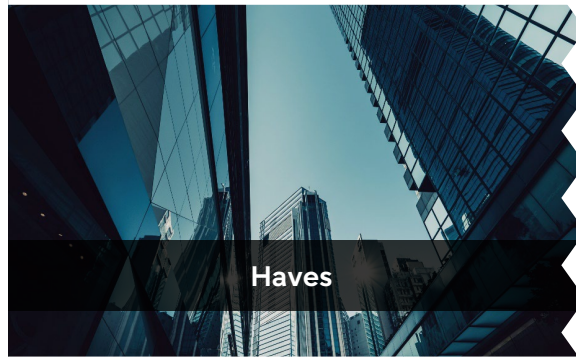
Haves

Have nots
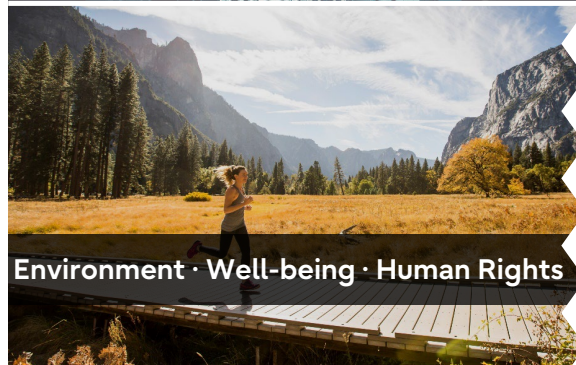
Environment · Well-being · Human Rights

Economic growth

A regenerative society

A sustainable society, where the environment, people's well-being and economy are closely interconnected within the boundaries of our planet.

We need to build a radically different society to the society we know today. By introducing a circular, regenerative economic model, the environment can be restored, people can live fuller lives, and economies can achieve sustainable growth within our planetary boundaries.

Environment
Regenerating nature and biodiversity by reducing CO_2 emissions and using natural resources more effectively.

Well-being
Regenerating people by giving access to safe water, food, education, healthcare and employment opportunities in a human centric society.

Economy
Regenerating economies by introducing circular models that positively influence the environment and people's well-being.

FT&SV 2023 outline

Integrating sustainability into business, overcoming systemic challenges

How can organizations transform their business and what can technology do to help realize a regenerative society?

FT&SV 2023 explores how sustainability can be integrated into business.

We describe the different futures that the evolution of technologies will drive, outlining how Fujitsu can help organizations to transform and pursue a collaborative journey towards a regenerative society.

Module

Sustainability = Business

1

Introducing insights into how digital can help businesses to integrate sustainability and respond to systemic challenges

Module

Technology Vision

2

Outlining a future vision of business and society, driven by five technology megatrends

Module

Business Transformation

3

Sharing how data and digital can help to regenerate the environment, well-being and economies

1

Sustainability
= Business

External factors are now on the agenda

Systemic challenges affecting business

Over a year has passed since the Russian invasion of Ukraine. Increasing geopolitical uncertainties, coupled with systemic challenges, are having a huge impact on business.

According to Fujitsu's survey, 53% of business leaders believe these external factors are now having a significant impact on their business. The intensification of cyber-attacks is cited by the greatest number of respondents, followed by high inflation and rising interest rates, energy supply problems, skills shortages, geopolitical tensions and climate change.

It should be noted that all these external factors are environmental, social and economic sustainability issues.

External factors are having a significant impact on business **53%**

External factors affecting business

Number of samples: 1,800

1	Intensifying cyber-attacks	**80%**
2	High inflation and rising interest rates	**77%**
3	Energy supply problems	**76%**
4	Increased scarcity of talent	**69%**
5	Geopolitical tensions	**65%**
6	Climate change (global warming)	**63%**
7	Pandemics	**61%**
8	Loss of biodiversity, waste and environmental pollution	**54%**

10
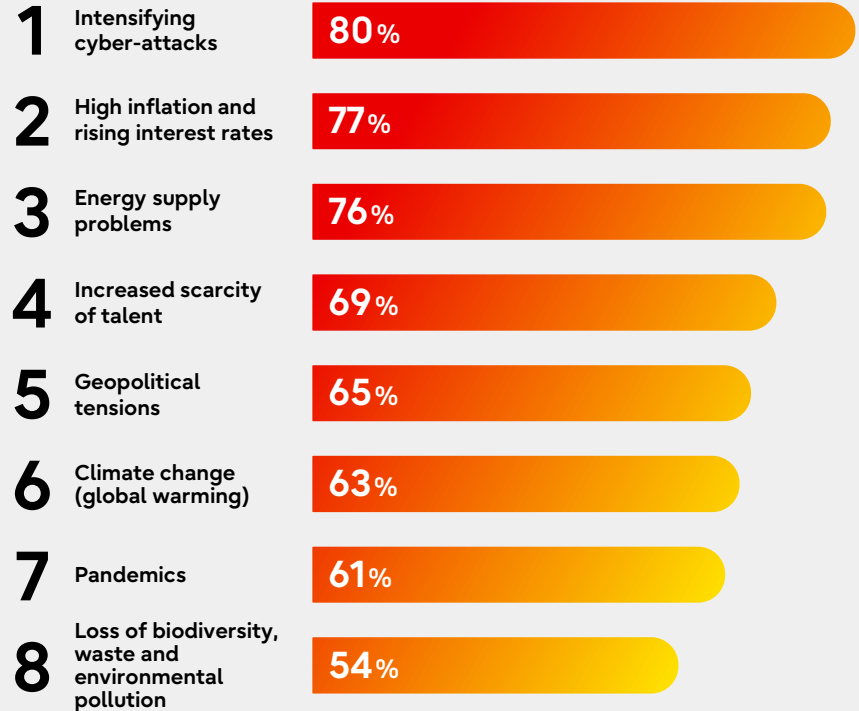
Sustainability brings business opportunities

Business leaders now recognize external challenges as opportunities

Despite an uncertain business environment, organizations are finding business opportunities in their efforts to deal with external sustainability factors. 49% of business leaders said that they are already contributing to sustainable energy consumption, followed by waste reduction, recycling, disaster prevention and safety and response to climate change.

Indeed, organizations are increasingly seeing sustainability as an important way to drive value for customers and consumers. They have shifted their approach from CSR, regarding sustainability as a business rather than cost.

> **We are now engaged in sustainability as a business, for example exploring exciting new opportunities around the use of ammonia and hydrogen.**
>   Chief Environment and Sustainability Officer, Transport, Japan
>
> **We have increased our efforts in pollution control, while promoting ecological environment management systems and capabilities.**
>   Environmental & Social Superintendent, Public Sector, China

Business opportunities in sustainability

Number of samples: 1,769
(excluding public sector)

1 Contribution to sustainable energy consumption — **49%**

2 Reduce waste and promote recycling — **41%**

3 Disaster prevention and safety — **28%**

4 Response to climate change — **27%**

5 Contribution to smart and sustainable cities — **25%**

6 Contribution to sustainable development of economy and industry — **25%**

7 Improved well-being — **25%**

8 Conservation of natural resources and biodiversity — **23%**
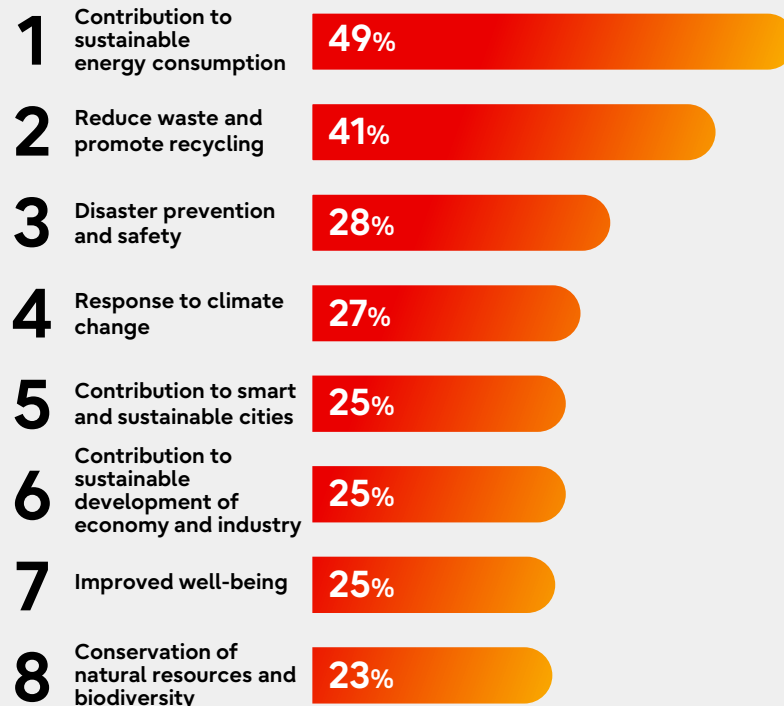
Digital + Sustainability

External challenges have increased the importance of digitalization and sustainability

Priorities are changing as external factors are starting to have a greater impact on business. Business leaders are shifting their management priorities.

According to Fujitsu's survey, about 80% of these leaders have increased their focus on digitalization. Almost 70% are also setting a higher priority around sustainability.

> " **Our board members are heavily involved in sustainability. Their mindsets have changed, especially in the past two years. We have been participating in the Davos agenda, focusing on de-carbonization, economic growth and resilience.**
>
> Chief Environment and Sustainability Officer, Transport, Japan
>
> **Our company promotes sustainability and accelerates the transition to a low-carbon economy using data and digital technologies.**
>
> Chief Sustainability Officer, Public Sector, Australia

Priorities of digital and sustainability

Number of samples: 1,800

Increased priority of digitization

77%

Increased priority of sustainability

68%
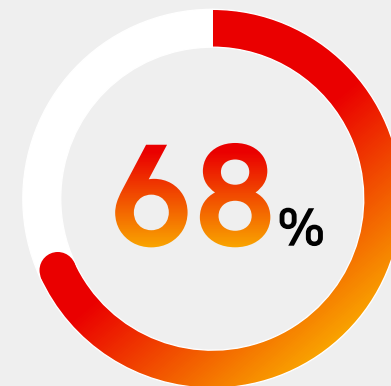
The progress of sustainability transformation

Many organizations still have a long way to go

Despite the business opportunities in sustainability, the maturity of sustainability transformation initiatives varies significantly between organizations.

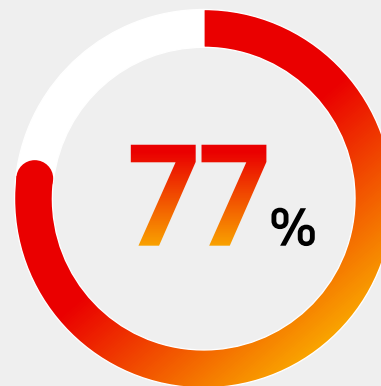Fujitsu's survey finds that 43% of all organizations remain inactive, limiting their activities to specific CSR initiatives and high-level vision statements. 8% of organizations are true sustainability leaders, demonstrating mature practices with implemented strategies and delivered outcomes.

In contrast, digital transformation has progressed far more significantly, with most organizations already moving into the implementation phase. While only 12% of organizations are still inactive, 21% have already delivered outcomes as successful digital leaders. While digital transformation practices are relatively mature, sustainability transformation is just starting to take off. Many organizations are not yet fully implementing sustainability transformation.

	Non-Active	Followers	Next leaders	Leaders
Status of Sustainability Transformation	**43%** Sustainability is part of CSR activities / Set out a sustainability vision	**27%** Set out a sustainability strategy and started implementation	**22%** Implemented strategies, and increased sustainability maturity	**8%** Implemented strategies with high sustainability maturity and delivered outcomes
Status of Digital Transformation	**12%** Set out a digital vision / **22%** Set out a digital strategy and started implementation	**45%** Implemented strategies, and increased digital maturity		**21%** Implemented strategies with high digital maturity and delivered outcomes

Number of samples: 1,800

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How are leaders different?

Sustainability leaders are highly purpose-driven, integrating sustainability into their business operations. Our survey reveals that sustainability leaders have successfully aligned sustainability transformation with delivering benefits to multiple stakeholders.

Sustainability leaders deliver significantly higher value to all stakeholders, including the environment, society, customers, employees and investors.

Actively transforming business

Purpose-driven management
- Consistently communicating a sustainability story to stakeholders.
- Rebuilding portfolio based on purpose oriented around sustainability.

Human empowerment
- Actively promoting the diversity and inclusion of employees.
- Helping employees have the right skills for sustainability transformation.

Integrating sustainability into business
- Creating sustainability business opportunities, integrated into business strategies.
- Understanding the relationship between sustainability and business KPIs, managing both across the organization.

Using digital
- Using data and digital technologies to transform the process of creating products and services to increase sustainability.
- Building a digital ecosystem to co-create sustainability innovation.

Creating value for all

Respondents who answered delivering value to each stakeholder to a moderate or significant extent

Number of samples	
Leaders	152
Next leaders	399
Followers	477
Non-active	772

14
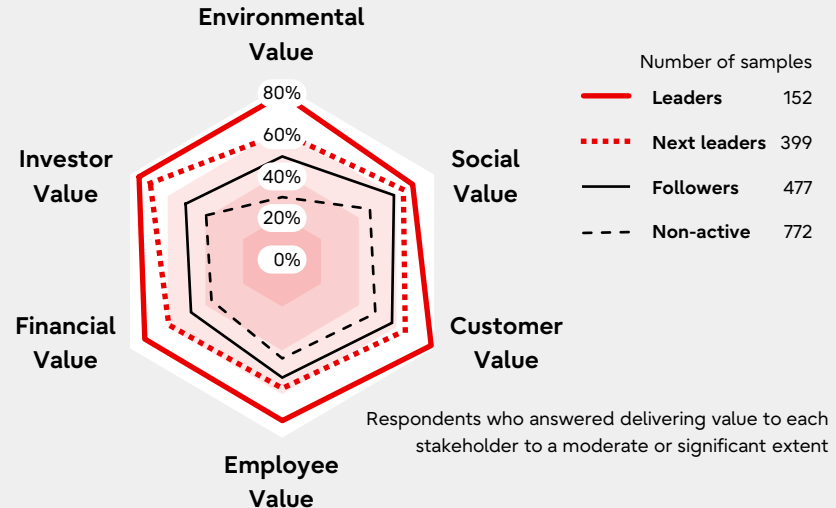
Sustainability = Business

Value creation cycle driven by empathy

Sustainability leaders have established a value creation cycle by integrating sustainability into their business. This cycle is driven by people's empathy towards their sustainability purpose.

- In our survey, nearly all sustainability leaders said their sustainability transformation initiatives resonated with their customers, with 82% agreeing that this resonance has increased customer preference for their products and brands.

- Similarly, 90% of sustainability leaders said that their sustainability activities resonated strongly with their employees, with 88% of them reporting improved engagement and productivity.

This value creation cycle is important. Environmental and social transformation fuels empathy, in turn creating new financial value in terms of revenue and profit.

Sustainability transformation initiatives resonate

With customers **98**%   With employees **90**%

Value creation cycle of Sustainability = Business model

- Environmental and social value
- Purpose
- Financial value
- Customer and employee value

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Harnessing digital capability

Digital is key to successful sustainability transformation

Digital technology plays a major role in realizing the sustainability = business model. In digital transformation, organizations have connected people, things and processes, using the generated data to transform their businesses. More importantly, organizations have mastered completely new ways to deliver innovation with agility, by developing skills and empowering individual employees.

The new technology platforms and organizational capabilities that these organizations have built through their digital journeys are extremely effective for generating sustainability outcomes. To make this happen, it is essential to motivate their employees and partners to own their shared purpose, creating environmental and social values.

Digital transformation skills and techniques will lead to a successful sustainability transformation. In the Fujitsu survey, 74% of sustainability leaders indicated that digital transformation is key to promoting sustainability transformation. Similarly, 74% of sustainability leaders are also digital transformation leaders.

> " Sustainability is built on digital transformation. We've been looking at the internet of things, getting digital connected, real-time data on energy use, water use, all this kind of stuff. Getting all this data means that you can now measure, you can control it, you can optimize it. Once you become digital, it means you became more sustainable. They are definitely connected.
>
> VP, Government Affairs, Manufacturing, France

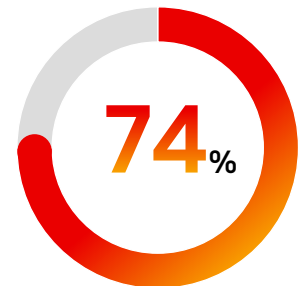## Use of digital by sustainability leaders

Number of samples: 152

Digital transformation helps organizations to succeed in sustainability transformation

Strongly agree
37%

74%

Agree
37%
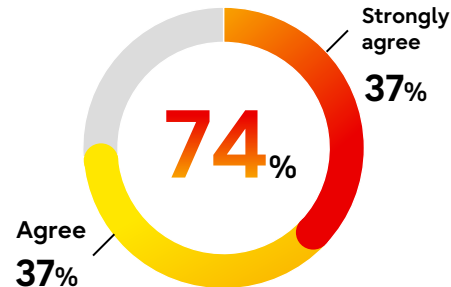
The ratio of digital leaders in sustainability leaders

74%

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The five key dimensions of digital-led sustainability

Digital helps create value for the environment, well-being and economies

How can we leverage digital technology to create sustainable value for the environment, well-being and economies? We believe that it's important to apply digital excellence across the following five key dimensions of digital-led sustainability. Our survey revealed that around 80% of sustainability leaders believe these five dimensions are crucial to their sustainability transformation.

Automation and augmentation
Using AI to help people solve problems and improve productivity.

Experience transformation
Converging physical and digital to provide inclusive experiences.

Innovation for environment and society
Using High Performance Computing (HPC) and AI to help create innovations that solve complex systemic challenges.

Resilience of business and society
Exploiting data to enable real-time visualization and agile responses in the face of uncertainty.

Trust across society
Using trust technologies to increase data reliability and visualize environmental and social value.

Sustainability leaders that have agreed the five key dimensions are important[1)]

80%

1) An average of the 5 dimensions

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Transformation is already underway

Organizations are pursuing digital-led sustainability transformation

Sustainability is a matter of survival for all of us. Every organization is expected to take immediate action.

While many organizations are still in the early stages of their sustainability journeys, leaders have already begun their digital sustainability practices in the five key dimensions.

Digital technology continues to evolve, with a major impact on business and society.

In the next module, we introduce our technology vision, exploring the future made possible by technology evolution.

Examples of sustainability transformation initiatives

Automation

Increasing productivity in a decreasing-population society through AI-enabled automation

Experience
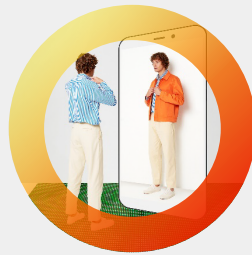
Enabling inclusive shopping experiences through physical and digital convergence

Innovation

Increasing well-being through HPC and AI-enabled drug discovery and genomic medicine

Resilience

Reducing congestion and CO_2 emissions with mobility digital twins

Trust

Improving traceability of materials and products to increase recycling and reduce waste

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2

Technology Vision

Technology innovation enabling a regenerative society

A physical-digital converged borderless world

How can digital technologies help us realize a regenerative society?

We expect the evolution of digital technology to shape a borderless world, by seamlessly converging physical and digital spaces. In this borderless world, new value for our environment, well-being and economies will be created in the five key dimensions we introduced in module 1: Automation, Experience, Innovation, Resilience and Trust.

In module 2, we explore the technology megatrends impacting these key dimensions as well as leading-edge Fujitsu technologies that are enabling us to realize our technology vision.

A borderless world

Future

The convergence of the three worlds

Past

The creation of the digital world

Digital world

Physical world

Now

The emergence of virtual and mirror worlds

Virtual world (Metaverse)

Mirror world (Digital Twin)

Physical world

Environment

Virtual world (Metaverse)

Mirror world (Digital Twin)

Shared purpose

Economy

Physical world

Well-being
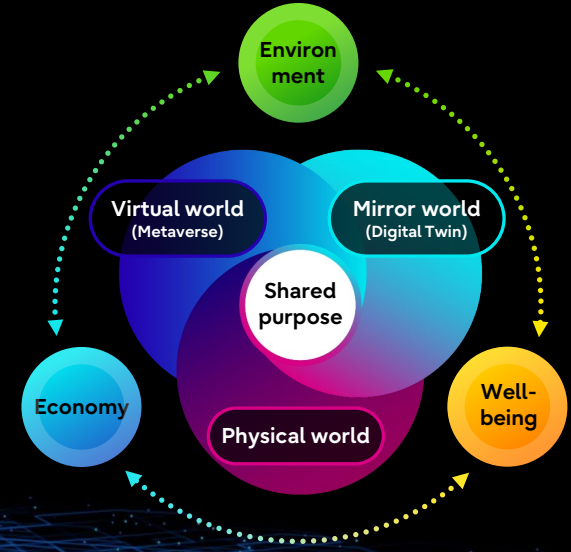
We are now seeing the emergence of a virtual world (the metaverse) and a mirror world (the digital twin of the physical world). The virtual world can enable more inclusive experiences for everyone, while the mirror world has the potential to enhance the resilience of our physical world.

We expect these three worlds will gradually merge, creating a seamless, borderless world. We believe that a regenerative society can be built collaboratively by various stakeholders with a shared societal purpose in this borderless world.

The five technology megatrends

1 | Amplifying creativity

People and AI will collaborate creatively, sharing common knowledge to boost performance.

2 | Being connected and inclusive

Network evolution will allow people to connect with empathy, maximizing their potential.
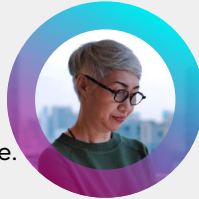
5 | Evolving Web

Distributed trust will help people to connect everything in a borderless world, with confidence.

3 | Developing at quantum speed

The integration of computing and AI will enable the entire innovation process to be completed ultra-fast, in the digital space.

4 | Redesigning the future

Federated digital twins will enable digital rehearsals across multiple domains, helping to redesign the future.

Automation
Experience
Trust
Innovation
Resilience

Virtual world (Metaverse)
Mirror world (Digital twin)
Shared Purpose
Physical world
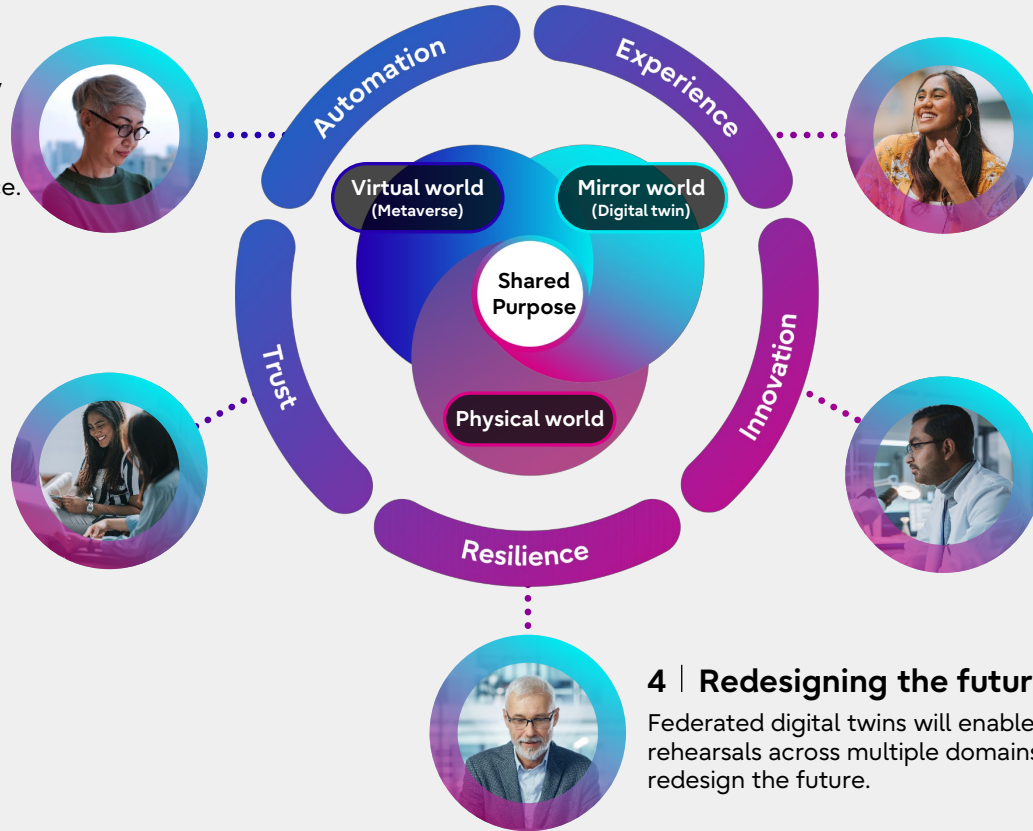
Amplifying creativity

AI technologies have automated various routine tasks to improve efficiency. Now, very large-scale generative AI models such as GPT4 can even automate creative work, like high-quality writing and software programming. In Fujitsu's global survey, over 40% of organizations said they expect more than half of their business tasks to be conducted through the collaboration of people and AI by 2030. Collaboration with AI can now improve both efficiency and creativity. Increasingly, AI is becoming our buddy.

So, what will be needed to realize this vision? Firstly, AI needs to be trusted, operating within strict disciplines and ethical codes. There needs to be a transparent understanding of what AI does, with the assurance that AI can accurately interpret people's intentions. The evolution of AI technologies will dramatically change the way we work in many domains, changing the rules of the game.

Automation

1

Now	Future
Improving efficiency through task automation	**Amplifying creativity through knowledge sharing**

Task
Output

People   AI

Knowledge sharing

People   AI
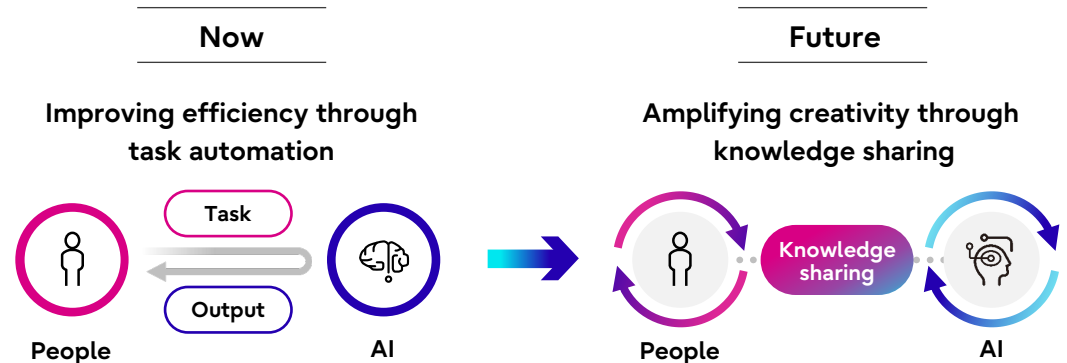
Supporting Community Health with AI

Kumiko is a doctor in her 70s in a small town in Japan. Here she is explaining a treatment plan for a disease with very few reference cases. Previously, it was difficult for doctors in small towns to handle such cases.

Kumiko is now able to offer effective treatment by collaborating with a medical AI system. By analyzing vast data resources, from clinical studies to case reports, the AI system can infer the causal relationships between medical records, genomic information and medication, using these to suggest treatment plan options. Kumiko can quickly decide on the best approach by discussing this analysis with expert doctors in a metaverse meeting.

This type of collaboration lets people and AI learn together in order to improve both decision-making speed and healthcare quality. As a result, even small, local clinics can provide cutting-edge medical care, such as personalized genomic medicine. With the help of AI, Kumiko can access the very latest medical information, helping her achieve her goal of improving regional healthcare.

Semantic graph AI

Enabling people and AI to work together

Fast-growing AI models can already analyze input texts and images, identifying correlations between a large volume of data and generating outputs. But we cannot always be sure that these outputs are trustworthy, based on facts and reasoning. Inferring causal relationships and carrying out hypothesis testing remain major challenges. There is still much to do to create AI that can be relied upon to help people make critical decisions like those described in Kumiko's future story.

A transparent knowledge base is essential to fill this gap, allowing people and AI to work together effectively. Now, new technology is being developed to enable the autonomous inference of causal relationships between vast amounts of data and to discover new knowledge, for example by using AI to analyze relationships of data to create graph-structured data. This graph-structured data provides a knowledge base that people can understand transparently. This approach is already being used in genomic medicine.

We refer to this graph-structured AI as 'semantic graph AI'. We expect to see semantic graph AI being developed to address challenges in environmental and social sectors as well as industrial and business domains. Indeed, as we approach 2030, we expect multiple semantic graph AIs will be connected organically, helping us to discover new knowledge and to solve our most complex challenges.

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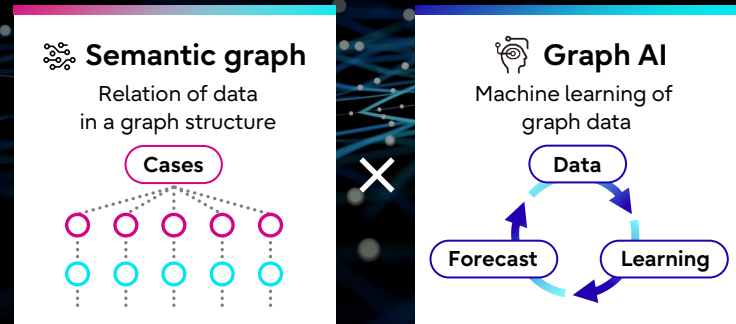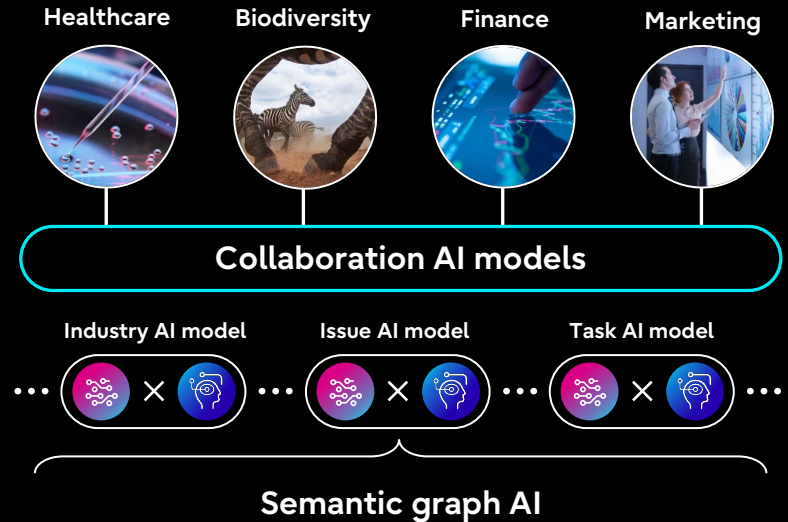
Creating the future of people and AI

Fujitsu enhances AI technologies to help people make advanced decisions

We are working to further develop semantic graph AI technologies to realize the future visions of people and AI collaborating creatively. By using key components of semantic graph AI such as semantic graph and graph AI, we are already offering 'Explainable AI' that explains AI decisions and 'Discovery AI' that can infer causal relationships.

In the field of genomic medicine, we are helping clinicians create personalized treatment plans for cancers. Similar technology is being used to automatically detect fraudulent financial operations, including circular transactions. We plan to enhance AI technologies to autonomously generate semantic graphs and broaden the application of semantic graph AI by connecting multiple semantic graph AIs across different industries and sectors.

We also offer Fujitsu Kozuchi (code name) - Fujitsu AI Platform, delivering Explainable AI, Discovery AI, Actlyzer[1], Human Reasoning[2] as well as AI fairness and ethics verification through the cloud. We are also working with partners to build a foundation for large-scale language models utilizing the supercomputer Fugaku. We continue to enhance AI technologies to help a broad range of businesses and research institutions.

1) Technology for sensing various human actions and facial expressions, as well as the relationship between people, goods and the atmosphere
2) Extended technology for understanding, predicting and guiding human behavior by utilizing knowledge of behavioral science and psychology
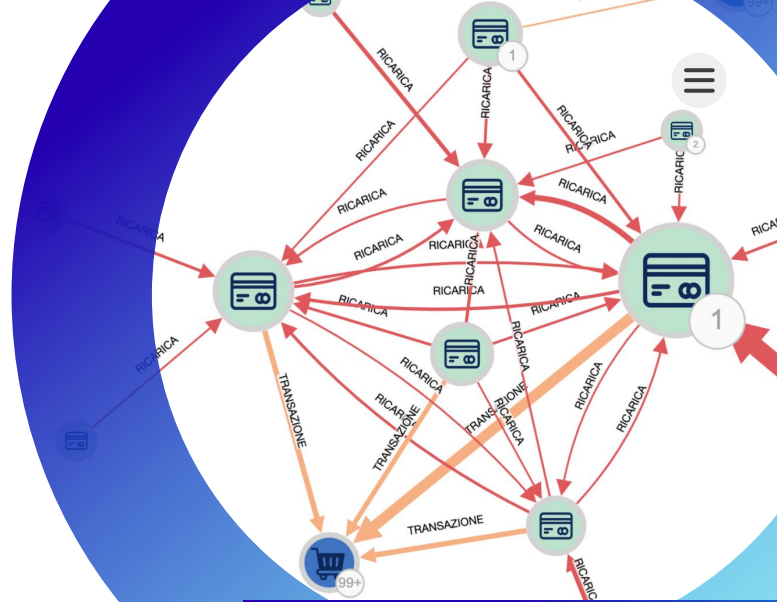
Large-scale semantic graph
Accurate fraud detection in credit card payment services

2023   **2030**

AI

- Semantic graph AI (Explainable AI, Discovery AI)
- Actlyzer
- Ethical AI

- Fujitsu Kozuchi (code name) - Fujitsu AI Platform

- Semantic graph AI (specific domain)
- Foundation model
- Synthetic data/Generative AI

- Semantic graph AI(multi-domains)
- Composite AI

- Semantic graph AI (autonomous)
- Human reasoning

The impact of people-AI collaboration

Environment ## Responding to environmental challenges

We're facing extremely difficult environmental challenges, from climate change to loss of biodiversity. Semantic graph AI technology can help us shape creative solutions. By developing large-scale semantic graphs for target domains, we can infer critical causal relationships of complex data, helping to discover new solutions. During such processes, we can control and verify the AI reasoning through a shared knowledge base.
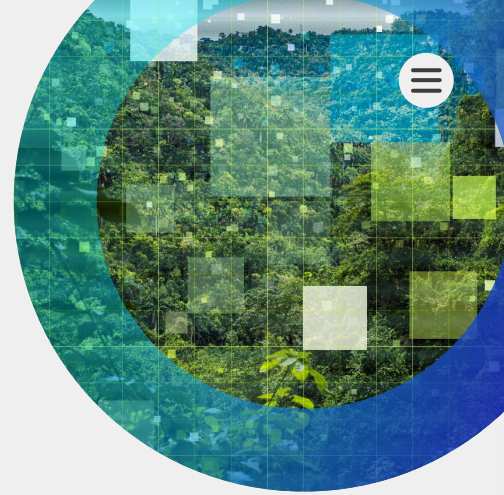
Well-being ## Helping people live long, creatively

It's now commonplace for people to live for 100 years. In light of this, how can we help older people to work creatively, even in their 70s and 80s? As we explained in the regional healthcare scenario, the power of AI can complement human knowledge to help people remain creative and productive in their professional lives. How might this affect your future career plans?

Economy ## The next wave of business transformation

The next wave of business transformation will impact creative business processes, including research, development and design. In areas such as these, people will increasingly work together with advanced AI models, enhancing learning, productivity and even employee satisfaction. Today, many countries like Japan are facing the serious challenge of an aging and decreasing population. Collaboration between people and AI will help these countries to boost their productivity and effectively address this significant societal challenge.

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Experience

2

Being connected and inclusive

Basic human rights, as well as educational and employment opportunities, can often be restricted by physical attributes such as living environment, age and physical conditions. How can technology help solve these challenges?

We believe that a borderless world can help people to maximize their potential, overcoming physical constraints and enabling inclusive experiences that ensure no one is left behind. People who share the same purpose will connect with each other across the three worlds.

Now

Experiences constrained by physical attributes

Environment

Location

Back ground

Gender

Physical conditions

Age

Physical world

Future

Inclusive experiences in a borderless world

Virtual world

Mirror world

Physical world
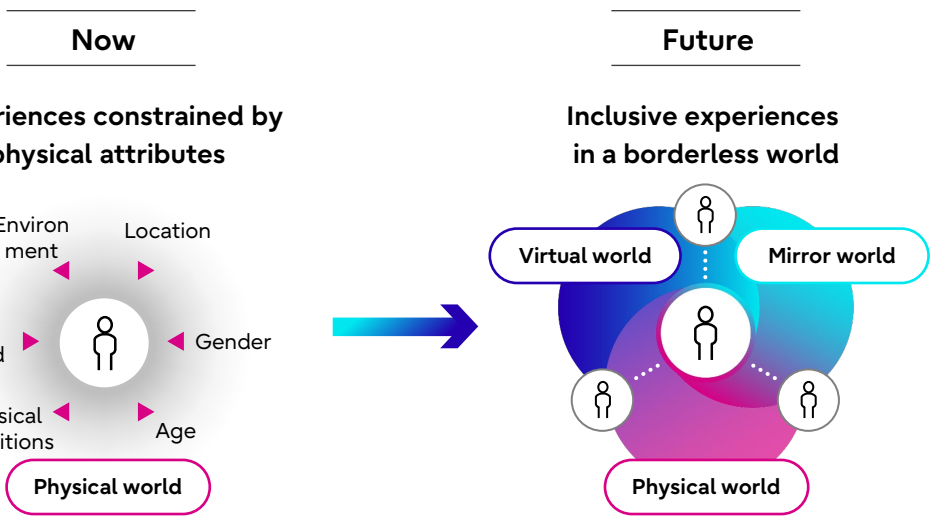
Living a full life with physical disability

Diah has lived in Indonesia for 20 years. Since her childhood, she has been interested in history and culture, and her dream has always been to travel. Previously, this would have been difficult due to her physical challenges, but the borderless world can now help to make Diah's dream come true.

Diah works as a guide by operating tourist robots in cities of Indonesia from her home using digital twin technology. In a digital twin, Diah can share the same experiences with tourists, while sensing the same real-time information like the atmosphere, wind, and sunshine in a city.

Diah also uses the metaverse to replicate historical content that can enhance the experience for tourists. She is able to give a tour of an extended city like a museum with historic characters, where historic sites and people are superimposed in the physical world.

These new interactions in a borderless world are enriching Diah's life.

Intelligent networks

Integrating physical and digital with 6G and AI

What technologies are working in the background to enable Diah's experiences? First, enormous amounts of data generated by countless things and people in the physical world must be replicated exactly in the digital twins. Next, exceptionally high-resolution images generated in the metaverse must be overlaid and made accessible with VR and AR technologies in the physical world, creating a borderless world.

To make these possible, many simultaneous processes need to be handled at ultra-high speed, seamlessly connecting the three worlds. The key enabler is the network technology supporting the real-time communication of large volumes of data. 6G technology is being developed in preparation for its expected launch in 2030. 6G is expected to offer a tenth of the latency, 10 times higher capacity and 10 times more multiple connections than 5G.

In addition, AI will be integrated into 5G and 6G, allowing high-quality and highly-available networks with low power consumption. Intelligent networks powered by AI can flexibly connect distributed ICT infrastructures in response to dynamic changes in network traffic and power requirements.

This evolution will allow us to manipulate robots remotely, transmitting high-definition 3D holograms and ultra-realistic images to many people in real time. Various technologies will be orchestrated in an intelligent network, helping people enjoy inclusive experiences regardless of physical constraints.

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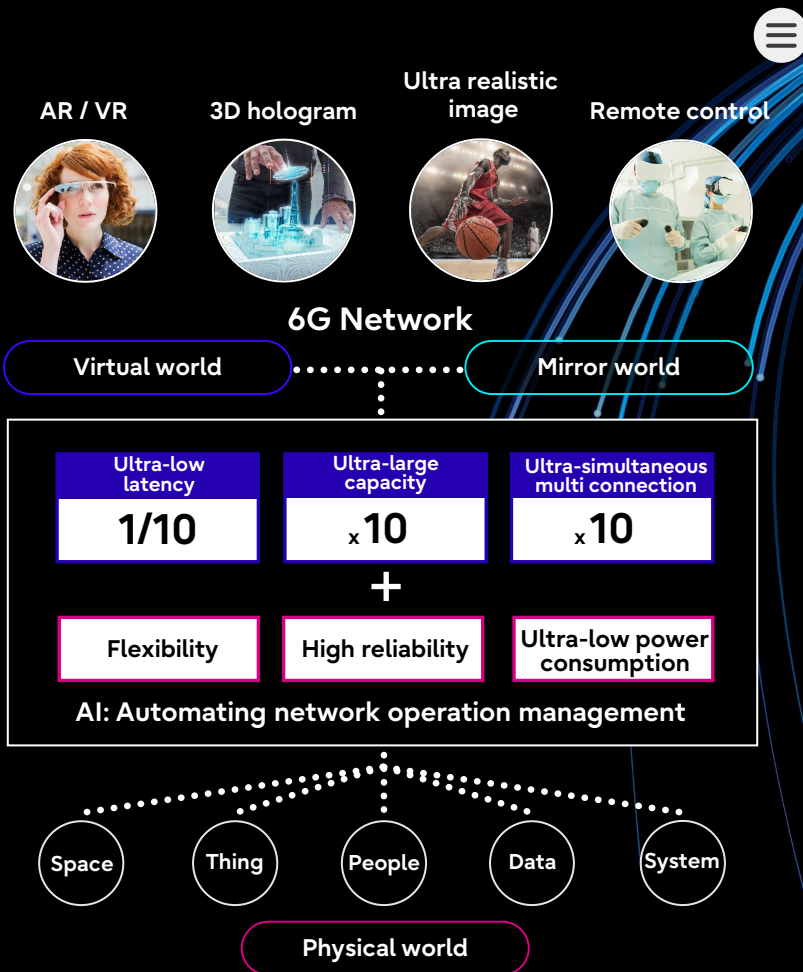
Connecting the borderless world

Fujitsu is developing future network technologies to create seamless experiences and a sustainable future

We are developing fully virtualized software-defined 6G networks with high capacity and low latency. Fujitsu has already developed O-RAN Alliance[1] compliant open and virtualized cloud-native 5G software base stations and deployed these globally, for example supporting Dish Network's 5G infrastructures across North America. Fujitsu is also developing new borderless experiences by combining private 5G with partners' VR and AR technologies.

In intelligent networks, we are automating control of virtualized network resources by using AI models to deliver seamless physical-digital converged experiences and reduce power consumption.

To achieve more radical advancement both in network performance and power reduction, we are working with our partners to develop photonics-electronics convergence technology that will wire computing chips optically, and disaggregated computing technologies that will enable dynamic configuration of ICT resources toward 2030.

1) Alliance to make radio access networks more open and intelligent

2023   **2030**

Network

- 5G Software Base Station
- Private 5G
- Photoelectric fusion technology (long-haul transmission)
- O-RAN Security

- AI controlled networks (Power saving)

- AI controlled networks (Power saving + better user experience)

- Intelligent networks

- 6G
- Photoelectric fusion technology (in computers)
- Disaggregated computing

The impact of experience evolution

Environment   **Cities reborn**

Cities will increasingly embrace the emerging virtual and mirror worlds. Physical and mirror cities will merge, enabling people to have augmented experiences, for example showing the CO_2 impact of vehicle rides. People, organizations and governments will also be able to shape their shared plans and visions in a virtual world together. This will help them understand potential environmental impacts, suggesting options that help to protect the planet and create a more sustainable future.

Well-being   **A more inclusive society**

Employment and educational opportunities vary greatly depending on location and economic situation. Indeed, there are still over 60 million children around the world without access to education. Expansion of 5G, 6G and satellite communications at an affordable cost will help all people learn in the virtual world.

Economy   **Transformation of engagement**

Organizations will experience significant transformation as they engage with customers, partners and employees across the physical, virtual and mirror worlds. This will radically change current business models. How can you provide seamless customer journeys, and empower your employees, across this borderless world? It is increasingly important to take a human-centric approach, exploring how organizations and individuals can build resonant, empathetic relationships.

Innovation

3

Developing at quantum speed

We need to accelerate innovation in order to overcome the systemic challenges we face. In our survey, about 60% of business leaders recognized that rapidly evolving computing power will be critical to helping us solve these challenges.

Previously, the pace of innovation has been limited by the need for endless rounds of planning and testing in the physical world. In the future, ultra-high-speed digital simulation by HPC and quantum computers coupled with AI models will enable us to complete the entire innovation process in the digital world. This radically different approach has the potential to shorten innovation lead times from years to months.

Now

Innovation in the physical world

Future

End-to-end innovation in the digital world

Computing

AI
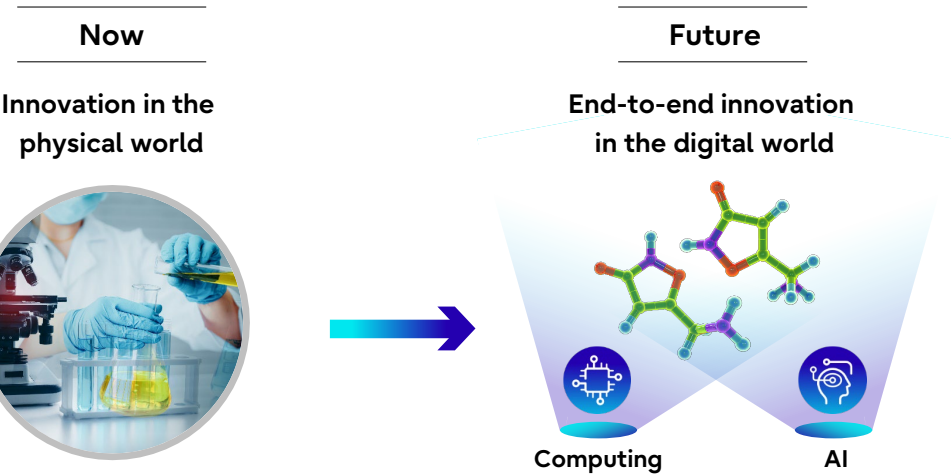
Digital brings energy innovation

Ayman works in the development of hydrogen energy for a materials manufacturer based in Egypt. In the past, the development of new energy has involved lengthy timescales and huge R&D investment.

This process has been transformed. The whole innovation cycle is now conducted in a metaverse lab, from searching for new catalysts that enable efficient hydrogen production using solar and wind power, to designing the equipment and facilities required to convert this hydrogen to its liquid form.

In addition to materials manufacturers, transportation, power and mobility organizations are also operating in this digital lab, collaborating on various aspects of hydrogen supply chain optimization. This new approach has the potential to significantly shorten time to market.

All necessary high-speed computing resources and AI models are provided via the cloud, allowing people without deep IT knowledge to quickly perform design work and run sophisticated digital simulation models. It's an exciting new world, in which everyone can be an innovator.
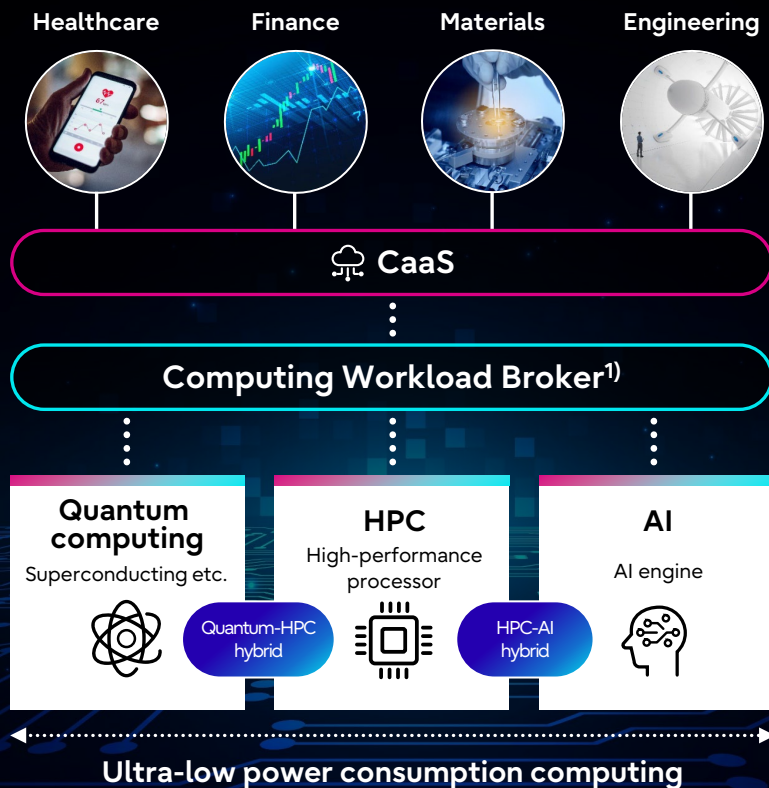
Integrating Computing and AI

Enabling ultra-fast innovation processes

Digital simulation on HPC has been used for drug discoveries, new materials research and in some areas of engineering. Conducting the entire innovation process through digital simulation, as we have seen in Ayman's future story, will require significantly greater computing power than currently generally available. However, the rate of processor performance increase has slowed in recent years. There are two pathways to accelerate the processing speed.

- The first is to integrate AI models symbiotically into high-speed simulation. An HPC-AI hybrid system can reduce the computing resources required by substituting parts of the simulation process with trained AI models. This training data can also be generated by HPCs, enabling dynamic, bi-directional interaction between the computing simulation and AI model.

- The second is to leverage the emerging power of quantum computing, which will far out-perform conventional computing. While quantum computing is expected to achieve 1,000 logical qubits in 2030 or later, its early applications may be limited, for example to quantum chemical calculations. We therefore expect to see the development of hybrid quantum and HPC computing models, complementing each other's strengths.

These super-technologies will be provided via Computing as a Service (CaaS) through the cloud, helping to shape open innovation ecosystems.

Healthcare   Finance   Materials   Engineering

CaaS

Computing Workload Broker[1]

Quantum computing
Superconducting etc.

Quantum-HPC hybrid

HPC
High-performance processor

HPC-AI hybrid

AI
AI engine

Ultra-low power consumption computing

1) Computing Workload Broker: Software technology to automatically select the appropriate resources

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Leading in computing technologies

Fujitsu actively contributes to solving environmental and social challenges by advancing computing technologies

We are working in the digital space, for example in drug discoveries and materials informatics, by integrating our world-leading computing technologies with advanced AI models. For example, we are undertaking joint research with RIKEN on next-generation IT drug discovery technology, using the supercomputer Fugaku and simulation-integrated AI models.

We will continue to increase the performance of HPCs, for example by realizing the next-generation green data centers through the development of new high-performance, low-power processors called FUJITSU-MONAKA (code name).

In quantum computing, Fujitsu is exploring software and hardware technologies in collaboration with world-leading research institutions such as RIKEN, Delft University of Technology and Osaka University. In March 2023, we contributed to the launch of Japan's first quantum computing services, working jointly with RIKEN and other partners. We are also working to scale up the number of quantum bits and improve quantum error correction technologies to help us accelerate the development of Fault-Tolerant Quantum Computing (FTQC) toward the Early-FTQC era.

Quantum Computer

Joint research with RIKEN on a superconducting quantum computer

Source: RIKEN

2023 **2030**

Computing

- HPC (A64FX)
- Digital Annealer[1]
- Quantum simulator
- Computing Workload Broker

- Quantum computer (64 qubits, NISQ[2])

- Quantum computer (256 qubits)

- Quantum computer (1,000 qubits)
- FUJITSU - MONAKA

- Quantum computer (Early-FTQC)

1) Quantum inspired computer   2) Noisy Intermediate-Scale Quantum device

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The impact of quantum-speed innovation

Environment   **Reducing the environmental impact**

To keep the average global temperature increase within 1.5°C, CO_2 emissions needed to be reduced by 45% by 2030, compared to 2010 levels. HPC and AI models are expected to play a key role in exploring new materials for producing alternative energy sources, including hydrogen and ammonia. For example, Fujitsu and Atmonia, an Iceland-based startup, are collaborating to discover new catalysts for synthesizing ammonia that will not generate CO_2 in the production process. HPC and AI have already helped us to halve the previous average search period for these catalysts.

Well-being   **Accelerating drug discoveries**

New drug discovery is a long-term process, traditionally taking at least 10 years. However, digital technology can now reduce this lead time significantly. HPC and AI models are currently being applied to the development of medium and large molecular drugs, beyond the capability of conventional simulation.

Economy   **Digital innovation ecosystem**

New innovation processes in the digital world will shape new, open innovation ecosystems. Many organizations and individuals across different fields and industries will collaborate in digital laboratories. In the past, physical innovation clusters attracted global talent. In the future, global digital innovation ecosystems will be built in the virtual and mirror worlds.

Resilience

4

Redesigning the future

We're living in an uncertain and complex world. Many issues are interrelated, making accurate future predictions very difficult. Instead of just responding to unexpected challenges as they arise, how can we be more proactive, rather than responding passively to events?

We can be better prepared by rehearsing possible future scenarios using digital twins that can replicate dynamic events in the physical world. The key lies in developing federated digital twins that can exploit data from multiple sectors and industries, such as mobility, energy, healthcare and the environment.

These federated digital twins will help us perform digital rehearsals of complex environmental, social and economic challenges, anticipating what's likely to occur in the future and suggesting proactive actions to design the future we desire.

Now	Future
Passively responding to unexpected challenges	**Actively redesigning the future through digital rehearsal**

Passive response

Future Vision → Digital Rehearsal → Actions

Behavioral changes
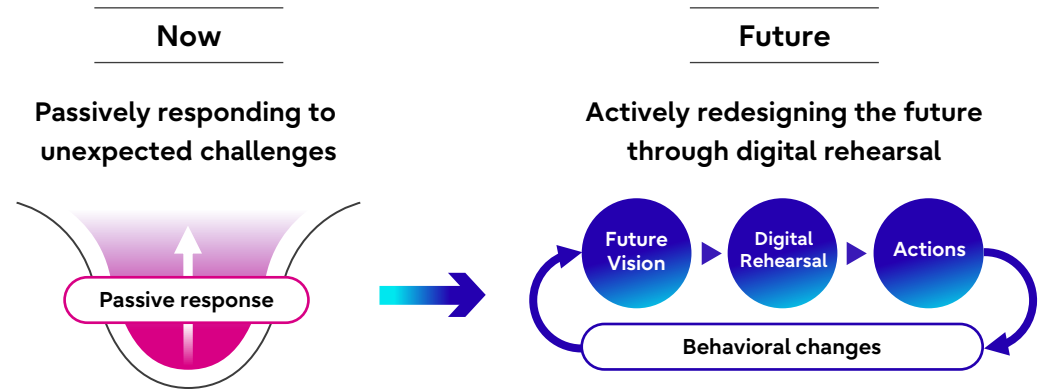
Building resilient cities using digital twins

Nicolas is the mayor of a major city in Brazil. Many issues in the municipality such as environmental issues and disaster response are related to multiple organizations and sectors. It has been difficult to grasp the overall impact, with data individually managed in each silo.

However, federated digital twins are now being built in cooperation with various industries. Digital twins relating to tourism and urban transportation are inter-connected and provide citizens and tourists with information on efficient means of transportation with less environmental impact. By encouraging people to change their behavior, this helps to realize smooth, eco-friendly urban transportation.

As there is high flood risk in this area, digital twins are also used for disaster mitigation by linking data on transportation and disasters. Digital rehearsals enable prediction of people's evacuation behavior in the event of a flood, and associated risks such as power grid disruption. In the event of an emergency, real-time data is used for prompt evacuation guidance, as well as optimal supply-demand matching and delivery planning of relief supplies.

A resilient city is being shaped by simulating risks and benefits in advance and changing citizen behaviors.
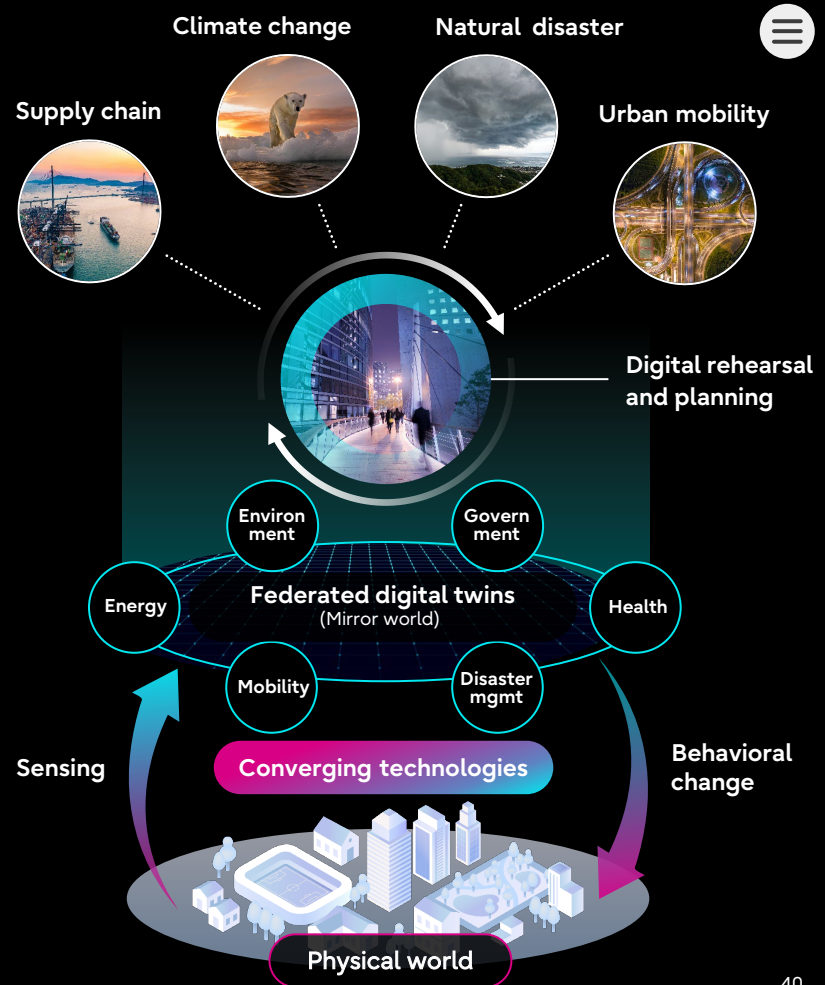
Federated digital twins

Helping to solve complex challenges

Digital twins are already used to visualize the dynamics of the physical world in several domains, from manufacturing and urban mobility to weather and disaster mitigation. However, two breakthroughs must be achieved to deal with systemic challenges more effectively.

- Firstly, it is critical to integrate human behaviors into simulation models of digital twins. As people's values and behaviors are increasingly personalized and liable to change, we need to combine digital technology with human-centric insights cultivated by the humanities and social sciences. We call this 'converging technologies'.

- Secondly, we need to connect multiple digital twins for different domains to run detailed simulations of complex, real-world problems. This requires the necessary interfaces for data sharing, as well as the relevant legal, regulatory and privacy considerations.

Dynamic digital rehearsals, as we have seen in the future scenario, can be carried out by integrating human behavioral models into federated digital twins. This will help us to make decisions more swiftly, understanding the impact that different policies and actions are likely to have across multiple domains. This will enable more harmonious approaches to resolving complex issues, issues that may previously have involved conflicting trade-offs between the environment, well-being and economies.

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Towards a more resilient society

Fujitsu is developing digital twins by advancing converging technologies

We expect federated digital twins will experience several phases of development towards 2030.

One early milestone is Fujitsu's work on creating a Social Digital Twin that can replicate the dynamics of a whole city. Fujitsu is developing key technologies for digital rehearsal and multi-aspect simulation, replicating social incidents from multiple viewpoints by using physical world data and AI. For example, we are participating in the UK National Digital Twin Programme, including its proof-of-concept project on the Isle of Wight.

In addition, we are conducting joint research with Carnegie Mellon University to integrate human behavioral models into digital twins. We are developing advanced sensing technologies capable of capturing human behaviors and building behavioral prediction AI models by integrating AI with insights from the behavioral sciences and behavioral economics.

We continue to work with organizations and research institutions globally to expand the capability of federated digital twins, helping us address the challenges faced by both individual and multiple cities.

Social Digital Twin

Proof of concept of various core technologies on the Isle of Wight, UK

2023   **2030**

Converging Technologies

- Social Digital Twin for a regional scale
- Digital twins generation technology
- Digital rehearsal
- Social Digital Twin for a single city
- Enterprise metaverse
- Federated digital twins
- Multi-aspect simulation
- Behavioral prediction technology
- Social Digital Twin for multiple cities + Enterprise metaverse

The impact of digital twin evolution

Environment ## Greener, healthier cities

Given that transportation accounts for about 20% of global CO_2 emissions, we need to develop means of transport with lower environmental impact. However, if these alternatives have a negative impact on quality of life (QoL), they are unlikely to be adopted in practice. We need policies that drive both lower environmental impact and higher QoL. Digital rehearsal provides a useful tool. For example, a digital rehearsal on the Isle of Wight has confirmed that shifting from cars to e-scooters can reduce CO_2 emissions without adversely affecting QoL, with a proof of concept underway from April 2023 to improve the operation of a new shared e-scooter service.
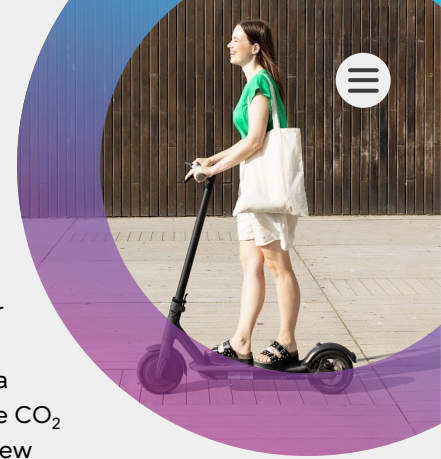
Well-being ## Personal health

It is possible to predict future personal health by analyzing personal health information, medical history and test results. Of course, to make this possible, people, medical institutions and governments need to cooperate and share data. For example, Fujitsu and Tohoku University are collaborating on the development of digital twins that can ensure patients receive optimal medical care, improving their health and reducing the risk of future medical problems.

Economy ## Predictive business model

Currently, one third of food is discarded, while there is also significant wastage in food production processes. Such waste can be reduced by using digital simulation to forecast demand more accurately. For example, simulation based on customer purchasing trends, relevant local events and weather data will enable more efficient inventory management, as well as more timely responses to demand fluctuations. Predictive business models like this will help to reduce loss and waste, minimizing the consumption of resources.

Evolving Web

As we have described, the borderless world has the potential to deliver many benefits. However, we also need to consider a potentially darker side. We continue to experience information leaks, privacy invasions and the flooding of fake news and untrustworthy information. Cyber-security has become a major issue.

We're operating in a zero-trust world where nothing can be trusted. How can we build trust in people, data, things and processes connected across the borderless world? The evolution of Web3 will be key. Autonomous, distributed trust will ensure trust across everything that's connected.

Trust

5

Now	Future
Zero trust	**Distributed trust in the borderless world**

Virtual world · Mirror world · Physical world

Virtual world · Mirror world · Physical world

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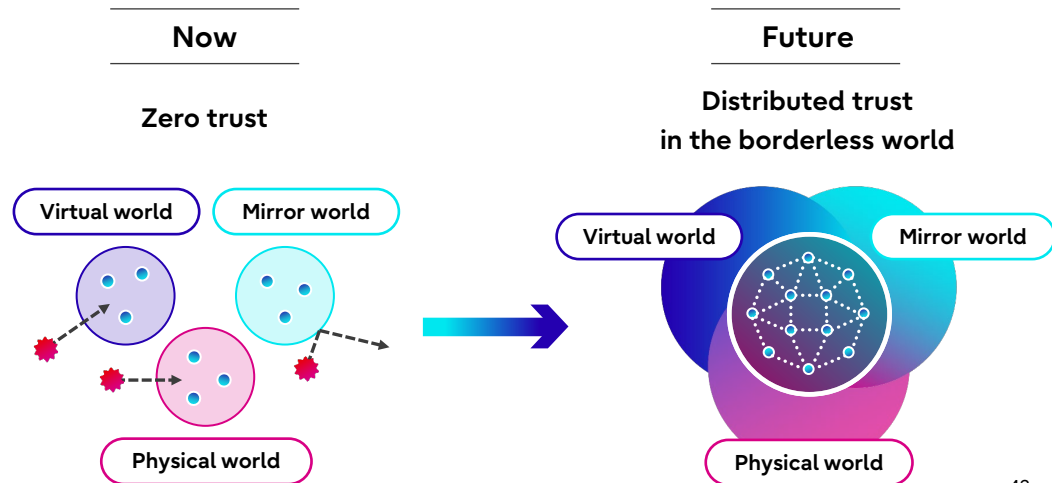
Everyone becomes a member of a regenerative society

In addition to their original jobs, Kumiko, Diah, Ayman and Nicolas are members of a DAO[1], which promotes foods with high environmental and social values.

The environmental values of foods, certified by sustainable food certification bodies, are tokenized according to their contribution to sustainability and distributed on the blockchain. Certified foods have minimum environmental impact and have been produced taking maximum care of workers' human rights. These tokens can be converted to other types of tokens through decentralized exchanges. Diah's DAO is promoting sustainable foods through social media, receiving tokens according to their contribution in promoting sustainable foods. This sustainability-oriented digital economy supports their autonomous activities.

While each initiative may have limited impact, these grass-roots activities are spreading through networks. The collective power of individuals, DAOs and organizations, that share a common purpose, drives the development of new types of ecosystems, leading to a regenerative society.

1)DAO (Decentralized Autonomous Organization)
A form of blockchain-based organization characterized by the autonomy of each member without the need for a centralized administrator.

Trusted value chains

The foundations of a regenerative society

In the future scenario, we see the creation of a new economic model in which environmental and social values will circulate globally. This new economy will be enabled by Web3, built on a set of distributed trust technologies like blockchain. In the borderless world, distributed trust technologies will allow people and organizations to develop trusted value chains by creating, connecting and protecting new value.

- **Creating value**: Distributed trust empowers individuals to connect with each other autonomously, through a DAO for example, to create new value. It also enables us to tokenize and distribute the sustainability contribution of individuals and organizations, supporting the development of new ecosystems.

- **Connecting value**: Blockchain interoperability technology connects these new ecosystems across regions and sectors. Exchangeable data and tokens flow through transparently, helping to shape a regenerative society.

- **Protecting value**: Distributed trust ensures the trustworthiness of data and technologies, such as AI models connected in the borderless world. It also allows individuals to manage their digital identities.

Although we may need to develop relevant laws and regulations to support these innovations, we expect Web3 will continue to evolve, providing the trust foundation for a regenerative society.
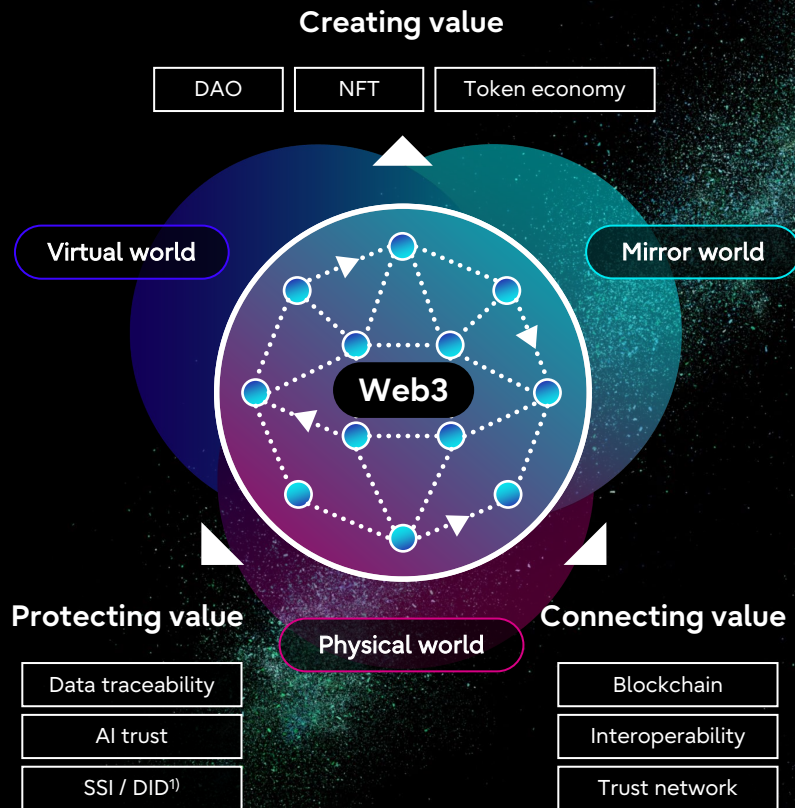
1) SSI(Self-Sovereign Identity):Concept of allowing individuals to own and manage their identities
DID(Decentralized IDentifier): Identifiers used to implement distributed identity management

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Distributed trust technologies

Fujitsu is committed to building trust in society through technology innovation

Trust is one of Fujitsu's most important values. For many years, we have been exploring distributed trust technologies, to ensure trust across physical and digital domains in an increasingly complex world. For example, we have developed ConnectionChain technology that can link multiple blockchains, envisioning the new digital economy where environmental and social values will circulate freely. In a joint project with IHI, we are using this technology to tokenize values of CO_2 reductions for distribution across ecosystems.

Fujitsu is also enhancing a wide range of trust technologies, from anti-fake and AI trust to network technologies that can verify the trustworthiness of information on the internet. For example, we have set up a security R&D center in Israel, where together with Ben-Gurion University of the Negev, we are researching geopolitical trust technologies that can pinpoint exactly where data and communications originated.

We are also offering the Fujitsu Web3 Acceleration Platform, providing a set of trust technologies, such as self-sovereign identity and Chain Data Lineage, to manage the history of data. This distributed trust technology is contributing to the development of a new Web3-based economy.

2023

2030
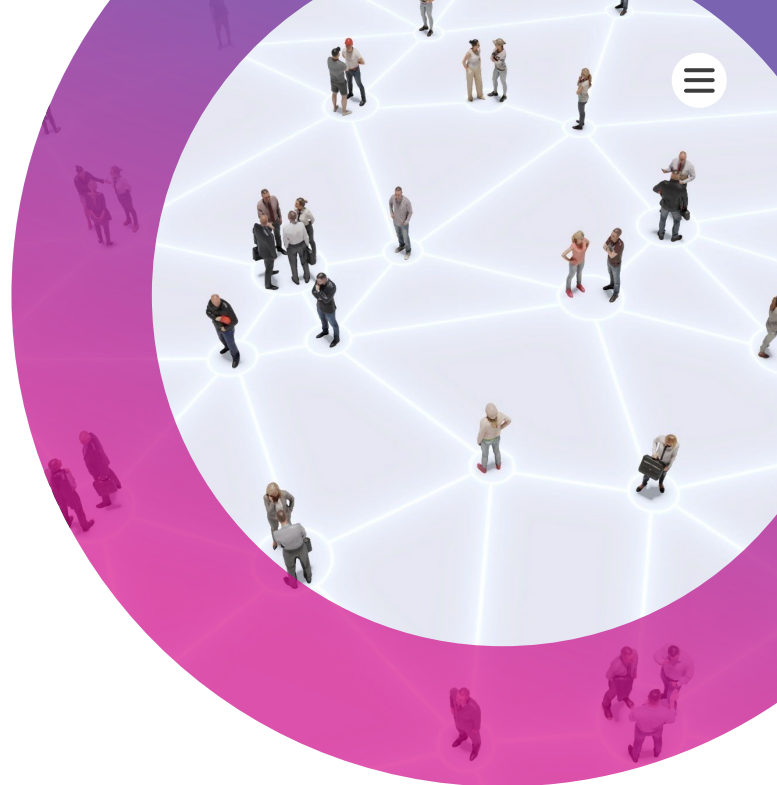
Data & Security

- ConnectionChain
- IDYX, Chain Data Lineage
- Multimodal biometrics authentication
- Transparent trust transfer

- Web3 Acceleration Platform

- Continuous authentication
- Data governance across organizations

- AI Security/Trust
- Trust network

- Trusted Web3

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The impact of web evolution

Environment **Towards carbon neutral**

Significantly, in 2021, carbon credits reached 480 million tons, up 46% from 2020. The application of distributed trust technologies like blockchain is currently being explored to make this mechanism more effective. Through developing new circular economies where various environmental values will be tokenized and exchanged, we can expect that people will increasingly change their behaviors towards a carbon-neutral society.

Well-being **Individuals manage their data**

Until now, organizations like digital service providers have managed individual identities and monetized these personal data. Web3 provides the foundation for a society where individuals can maximize their data potential. Distributed trust technologies will enable individuals to manage their digital identities, as well as manage the use of their personal data by third parties.

Economy **New capitalism**

Blockchain technology is changing the way organizations operate. There are already thousands of DAOs in operation around the world. Members who share a common purpose, such as revitalizing their local community, come together to carry out activities autonomously. The relationship between individuals and organizations will change, as organizations can join or set up DAOs to connect with new stakeholders, shaping autonomous ecosystems and complementing traditional structures and processes.

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Fujitsu's key technologies

In order to realize our technology vision, Fujitsu is focused on the following five technology areas, working together with a range of partners. Among these, AI is advancing rapidly, with wide applications and increasing importance.

We are now integrating computing, network, data and security and converging technologies with AI technology to drive our vision.

5 technology megatrends

Amplifying creativity

AI

- Semantic graph AI (Semantic graph, Graph AI)
- Explainable AI
- Discovery AI
- Actlyzer

Being connected, inclusive

Network × AI

- 6G technologies
- Disaggregated Computing
- Optical transmission and photoelectric fusion
- Intelligent networks (AI controlled network)

Developing at quantum speed

Computing × AI

- HPC(High performance Processor)
- Quantum computer
- Computing Workload Broker
- Discovery AI
- Materials Informatics

Redesigning the future

Converging Tech. × AI

- Federated digital twins
- Social Digital Twin
- Enterprise metaverse
- Multi-aspect simulation
- Behavior prediction

Evolving Web

Data & Security × AI

- Web3/Blockchain
- IDYX, CDL, Transparent trust transfer
- Trust network
- AI Security and Trust
- Continuous authentication

Fujitsu's key technologies

Computing · · · Network · · · AI · · · Data & Security · Converging Technologies

Creating an innovation ecosystem

Fujitsu is driving the development of open innovation ecosystems to realize the regenerative society by providing new platforms that integrate our five key technologies centered on AI.

Fujitsu Kozuchi (code name) - Fujitsu AI Platform

This platform enables people to use various AI functions and tools by offering an extensive collection of Fujitsu and other useful AI technologies. This helps accelerate the use of AI technologies in research and development as well as the integration of AI into business systems and services.

Fujitsu Web3 Acceleration Platform

This platform enables individuals and organizations to use a set of distributed trust technologies and connect everything with trust in the borderless world.

With these platforms, we are promoting open collaboration with various stakeholders including our partners, research institutes and communities.

In module 3, we'll look at the business and social transformation made possible by digital technologies.
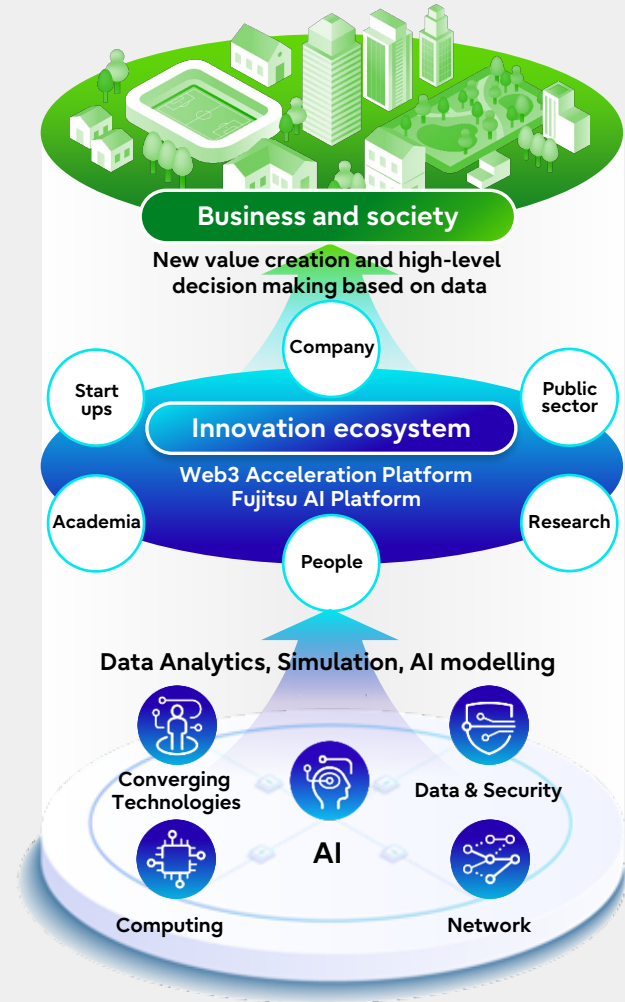
Building a regenerative society

Sustainability transformation through digital innovation

Sustainability transformation is our most important long-term challenge. What are the first steps we need to take on this transformation journey? How can digital technology help you to integrate sustainability into your business?

Fujitsu is your partner in this process, working together to overcome difficult sustainability challenges and build a regenerative society.

In this final module, we share examples of digital-led sustainability initiatives and customer projects that are helping to solve environmental challenges, improve people's well-being and develop a digital society for sustainable economic growth. We also explore Fujitsu Uvance, our business model that aims to contribute to a more sustainable society.

Your sustainability transformation partner

Fujitsu has focused on helping customers solve their business challenges and transform their operations. Now, leveraging our digital transformation skills and experiences, we are transforming our business to address the most pressing environmental and social challenges.

We have established prioritized business domains focused on critical issues for society. Our investment and resources are now focused on addressing three key issues: solving environmental challenges to enable people and nature to co-exist and prosper, improving people's well-being by enabling a human-centric approach to life and work, and developing a trusted digital society that enables sustainable economic growth.

Specifically, we are committed to:

1 | Proposing customer initiatives to overcome specific systemic environmental and social challenges.

2 | Working together to develop digital-led solutions and helping customers transform their business.

3 | Using data to detect changes and improve the resilience of business and society.

To deliver value to customers and society, we are strengthening our consulting capability, investing in our five key technology areas, particularly AI, and developing new services to address global, cross-industry challenges.

Fujitsu
uvance

In 2021, we launched a business model, Fujitsu Uvance, focused on driving sustainability by solving cross-industry environmental and social challenges. Fujitsu Uvance harnesses our advanced technologies, skills and industry knowledge to accelerate sustainability transformation for our customers.
In 2022, we introduced exciting new services, including those contributing to carbon neutrality.
Next, we will share examples of how we're helping organizations transform their businesses, including some customer stories.

Solving environmental problems

Improving people's well-being

Developing a digital society

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Solving environmental problems

Contributing to reduction in total CO_2 emissions

What practical steps can we take to respond to climate change, restore biodiversity and regenerate the natural environment? To achieve these objectives, we need to reduce CO_2 emissions and energy consumption across the value chain as well as enable the most effective use of natural resources through recycling. We also need to develop clean energy and decarbonize urban transportation.

Since our inception in 1935, Fujitsu has been engaged in business that helps people and the earth to coexist in harmony. We have built IT systems for the public sector as well as energy and telecommunications infrastructure. We contribute to addressing difficult environmental challenges, using our skills, experiences and leading-edge digital technologies such as HPC, AI and blockchain.

Fujitsu is helping organizations and cities to be more regenerative and use natural resources effectively, contributing to reduction in total worldwide CO_2 emissions.

Contribution to carbon neutrality

Helping shift to carbon neutrality
Helping organizations to be carbon neutral by delivering technology platforms to measure CO_2 emissions, create strategies and plans, collect and trace environmental data.

Realizing decarbonized mobility using green energy
Using social digital twin covering mobility energy to create cross-domain simulations that help reduce CO_2 emissions from urban transportation.

Developing green materials
Using HPC and AI to help the research and development of new materials that can reduce CO_2 emissions through materials informatics.

Restoration of biodiversity

Decreasing the environmental impact
Minimizing loss and waste by matching supply and demand more accurately, using AI-enabled demand forecast models.

Shifting to a circular business
Using digital technologies, including blockchain, to improve product traceability across value chains throughout their lifecycle and to achieve effective use of resources.
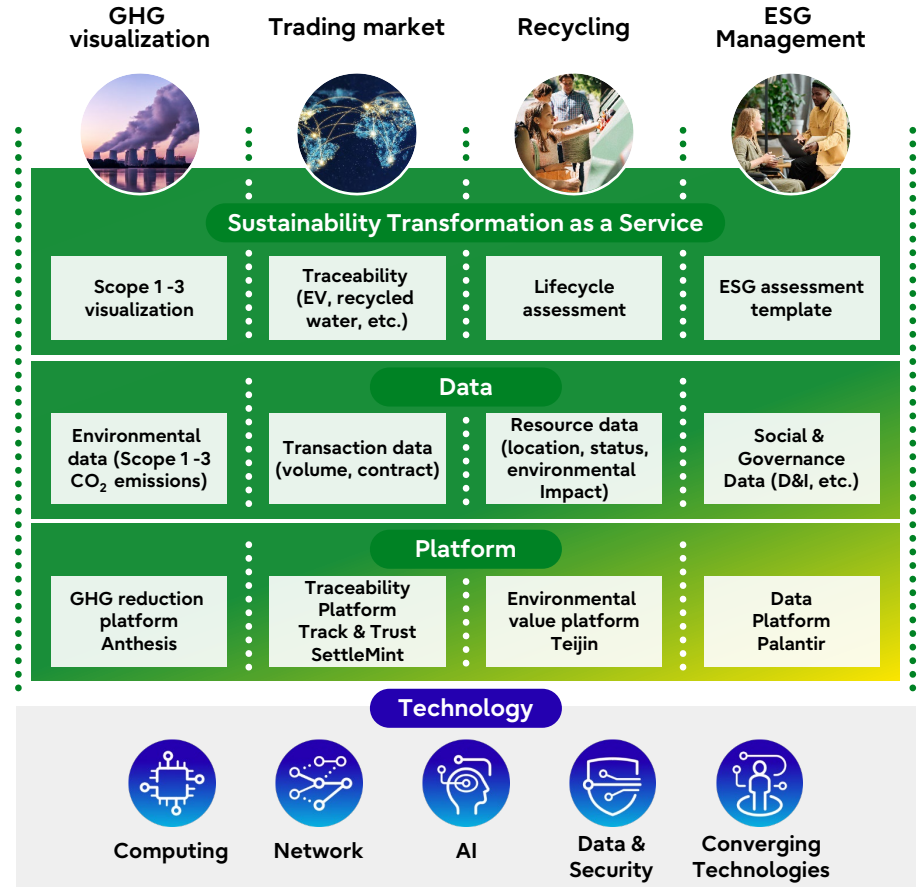
To carbon neutrality

Sustainability Transformation as a Service

To achieve carbon neutrality, Fujitsu will enhance its services for realizing sustainability transformation through collaboration with partners.

In the area of visualization, Fujitsu has begun a partnership with global sustainability company Anthesis Group. The two companies will jointly provide a one-stop service to help organizations achieve carbon neutrality, from strategic planning, data collection and visualization through to information disclosure to supervisory authorities. This service combines Fujitsu's expertise with Anthesis' RouteZero™ platform, helping organizations take practical, positive steps to reduce their GHG emissions.

In the area of traceability, we have partnered with the Belgian software startup SettleMint NV to accelerate the development of blockchain based systems. We are also working with Teijin, a Japanese materials company, on a project to realize an environmental value creation platform for recycled materials.

We will work with our partners to provide new sustainability value, including GHG visualization, traceability, recycling and ESG management.

GHG visualization	Trading market	Recycling	ESG Management

Sustainability Transformation as a Service

Scope 1 -3 visualization	Traceability (EV, recycled water, etc.)	Lifecycle assessment	ESG assessment template

Data

Environmental data (Scope 1 -3 CO_2 emissions)	Transaction data (volume, contract)	Resource data (location, status, environmental Impact)	Social & Governance Data (D&I, etc.)

Platform

GHG reduction platform Anthesis	Traceability Platform Track & Trust SettleMint	Environmental value platform Teijin	Data Platform Palantir

Technology

Computing	Network	AI	Data & Security	Converging Technologies

Environmental value creation

Teijin Limited

All organizations need to respond to increasingly strict global environmental regulations, including achieving reductions in their carbon emissions. To help them, Teijin and Fujitsu are running a joint project to create a platform that enhances the environmental value of recycled materials. The purpose of this project is to develop a platform exploiting Teijin's Life Cycle Assessment methodology and Fujitsu's blockchain technology, encouraging more use of recycled materials and the design for environment.

In a related project, Teijin and Fujitsu are collaborating with V Frames, a leading bicycle frames provider, and E Bike Advanced Technologies, a bicycle manufacturer, to demonstrate the environmental value of using recycled carbon fibers in bicycle frames. This project is raising awareness within the carbon fiber industry, including the environmentally-conscious bicycle market, by visualizing the CO_2 emissions reductions made possible by recycling the end-of-life frames. This platform holds location, status and environmental impact data on multiple processes, from recycling through to sales, creating value by disclosing trace data to bicycle users and helping to control CO_2 emissions across the stakeholder ecosystem.

By collaborating with supportive partners like these, Teijin and Fujitsu are helping to develop the recycling market not only for bicycle frames but also for other industries, starting with the materials industry, to realize the promise of a circular economy.

> " As environmental issues become more important in the future, we will promote this initiative through co-creation with Fujitsu, aiming to contribute to solving social issues by realizing and utilizing the recycling of a large number of materials.
>
> Ryota Hirakawa
> Marketing Department, Environmental Solution Division,
> New Business Development Unit, Teijin Limited

Improving people's well-being

Enabling human-centric life and work

How can we realize a society where people live dignified, healthy lives, maximizing their individual potential? To achieve this, we need to extend healthy life span through personalized healthcare. We also want all people to be able to live their best lives, both at work and at home, regardless of physical considerations like location, age and disabilities.

As always, Fujitsu values a human-centric principle. For example, we are using AI and IoT technologies to enable new approaches to preventive medicine. We are also developing digital health ecosystems, creating new social value from healthcare data in collaboration with well-being organizations, such as insurance companies and medical device manufacturers. We are also working to realize a society where everyone can maintain their physical, mental and social health[1], for example by implementing Fujitsu Work Life Shift, using data and technology to help our own people work more flexibly.

We are now working together with businesses, medical institutions and governments around the world, using data and technology to help all people live fuller, healthier lives.

1) the ability of individuals to form healthy and rewarding interpersonal relationships with others

Good health for all

Digital health ecosystems
Using shared healthcare data to improve the quality and efficiency of medical treatment, to enable personalized healthcare services and to advance medical science.

Preventive care for well-being
Recommending healthy behaviors, and enabling preventive and prognosis care, based on the analysis of individual health data for better individual and organizational well-being.

Digital drug discovery
Helping to accelerate new drug introduction by using computing and AI-based drug discovery and software services responsive to local laws and regulations.

Inclusive experience
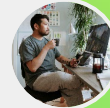
Flexible, autonomous way to work
Enabling hybrid work that allows employees to work anytime, anywhere, and helping to improve their productivity and experiences with the power of AI technologies.

Inclusive shopping experiences
Providing inclusive, personalized shopping experiences by using data to understand diverse customer needs, creating converged online and offline customer touchpoints.
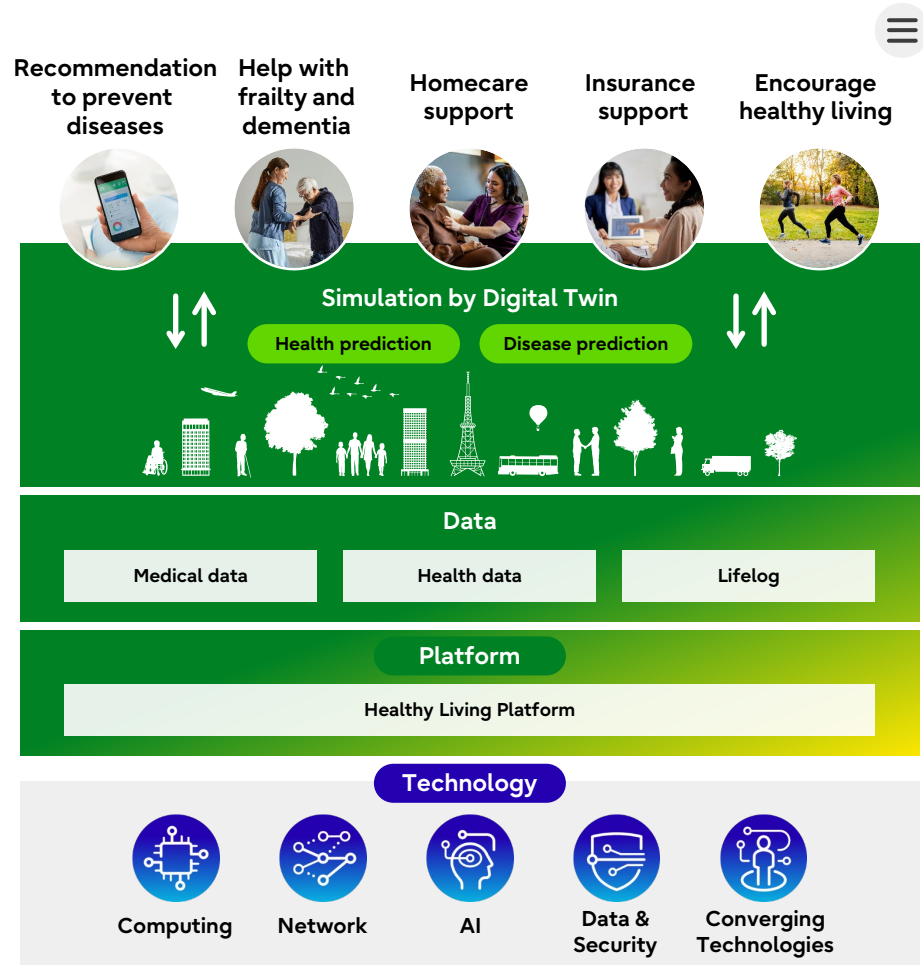
Digital health ecosystem

Healthy Living Platform

Fujitsu aims to realize a digital health ecosystem that enhances data portability in the healthcare field, helping people to manage their health and medical data proactively, and enhancing their healthcare experience. The Healthy Living Platform is at the heart of this vision, collecting, managing, and utilizing medical and health data held separately by healthcare organizations, pharmaceuticals, and individuals.

With the consent of the individual, hospital medical data, receipts and personal life logs are accumulated on the platform to perform health and disease prediction in the digital space, providing value to the individual, hospitals and well-being companies.

Fujitsu will work on preventive medical care through the early diagnosis of disease risk using AI and the visualization of physical and mental health using IoT. We will also work with insurance companies to automatically generate personalized insurance plans based on medical treatment data, and with well-being companies to provide health-related services that promote behavior changes using health data.

Recommendation to prevent diseases

Help with frailty and dementia

Homecare support

Insurance support

Encourage healthy living

Simulation by Digital Twin

Health prediction

Disease prediction

Data

| Medical data | Health data | Lifelog |

Platform

Healthy Living Platform

Technology

Computing

Network

AI

Data & Security

Converging Technologies

Improving community care

Sapporo Medical University

In an aging society like Japan, patients and their families need access to daily medical data in order to manage their health effectively. However, the scope of use of medical data at each medical institution and information managed by individuals via smartphones is limited. As a result, there is an urgent need to create an effective infrastructure to share the use of personal health data.

Sapporo Medical University and Fujitsu have been collaborating to improve data portability in the healthcare field, to help people manage their health and medical data proactively. Fujitsu has developed a smartphone app, enabling patients to access the clinical data held at the university hospital, and a healthcare data infrastructure to manage patient medical data in a cloud environment.

The university hospital can now use patient data held in the healthcare database to review a patient's health in detail and to improve the quality of personalized medical care. By creating an infrastructure in which partner medical institutions can access and share medical data subject to patient consent, Sapporo Medical University is improving the quality of healthcare across Hokkaido. Patients can now check their health status including test results and prescriptions from the app anywhere, anytime to help improve their health management.

Sapporo Medical University and Fujitsu are accelerating access to individual health data, helping to optimize medical care, tailor services to the individual patient and advance the quality of healthcare across the region.
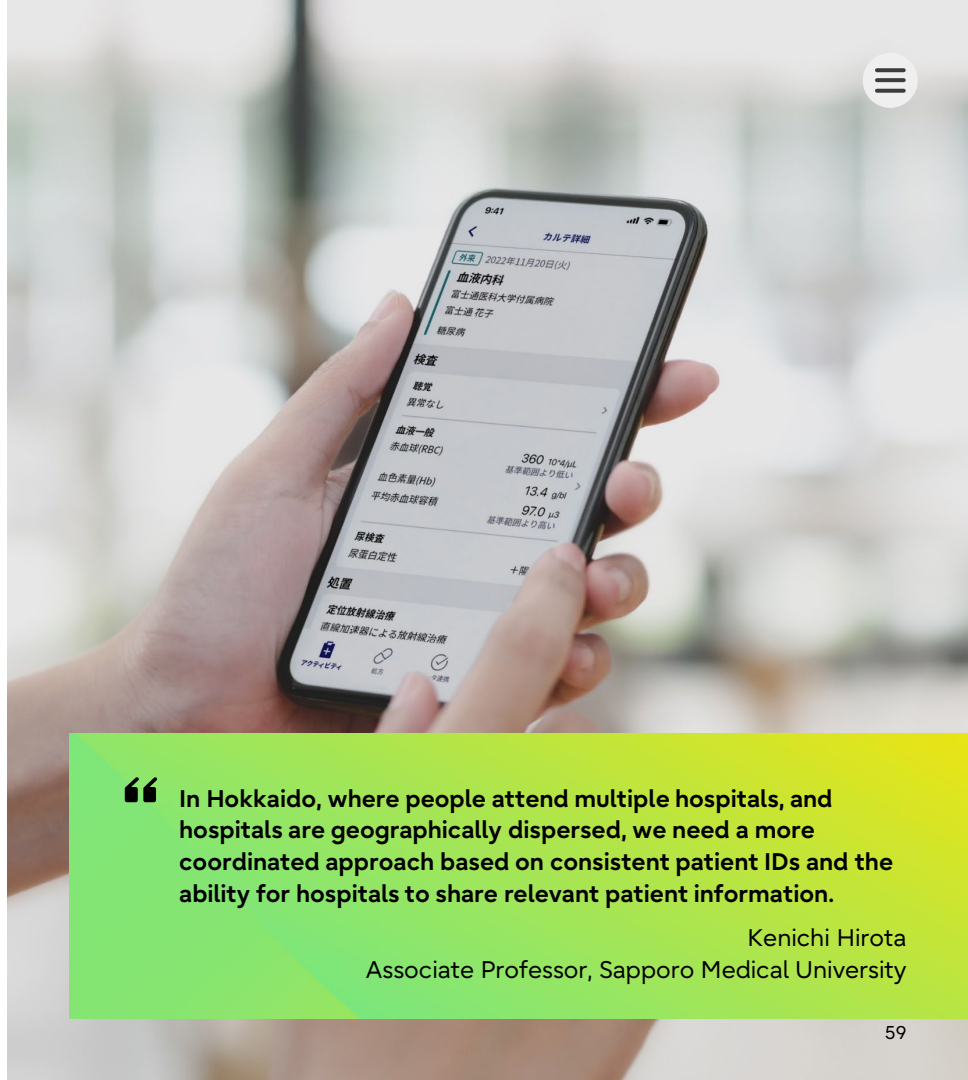
> " In Hokkaido, where people attend multiple hospitals, and hospitals are geographically dispersed, we need a more coordinated approach based on consistent patient IDs and the ability for hospitals to share relevant patient information.
>
> Kenichi Hirota
> Associate Professor, Sapporo Medical University

Developing a digital society

Contributing to sustainable economic growth

How can we achieve economic growth without negatively affecting our planet and people's well-being? It's essential for all organizations to embrace sustainability into their businesses, ensuring they have a consistently positive impact on the environment and society. This transformation must be fundamentally supported by 'trust' across society. Digital technologies for transformation must also be fully accessible and trusted by people.

Fujitsu is delivering innovation that builds trust in society. We help to improve the resilience by using digital twins, HPC and AI to run complex simulations. We also ensure these technologies are accessible, for example providing leading-edge technologies like HPC and AI through the cloud. Through the greater democratization of these technologies, we are helping to enable digital accessibility.

Fujitsu is contributing to sustainable economic growth by developing a trusted digital society.

Resilient business and society

Resilient supply chain
Creating supply chains that can respond in real-time to unexpected events, by simulating the impact of disasters, pandemics and geopolitical events with digital twins, HPCs and AI.

Resilient cities
Helping to build resilient cities through AI-based preventive maintenance of social infrastructure and digital-twins-enabled disaster simulations and evacuation support.

Digital accessibility

Trust in a digital society
Helping build trust in a digital society by providing secure hybrid IT infrastructures that protect both physical and digital worlds from intensifying cyber attacks.

Digital accessibility
Contributing to eliminating the digital divide and increasing the accessibility of public, healthcare and financial services by converging the physical and digital worlds by 5G, 6G and AI.

Democratization of technology
Helping to accelerate innovation by enabling more people to access super technologies like HPC and quantum-computing by delivering them through the cloud.

Resilient supply chain

Consolidating siloed data

In order to respond to natural disasters in real time, it is important to share information and simulate risks across many different organizations and industries. Fujitsu will help to optimize entire supply chains, improving our ability to respond to emergencies by building digital supply chains that connect organizations and processes.
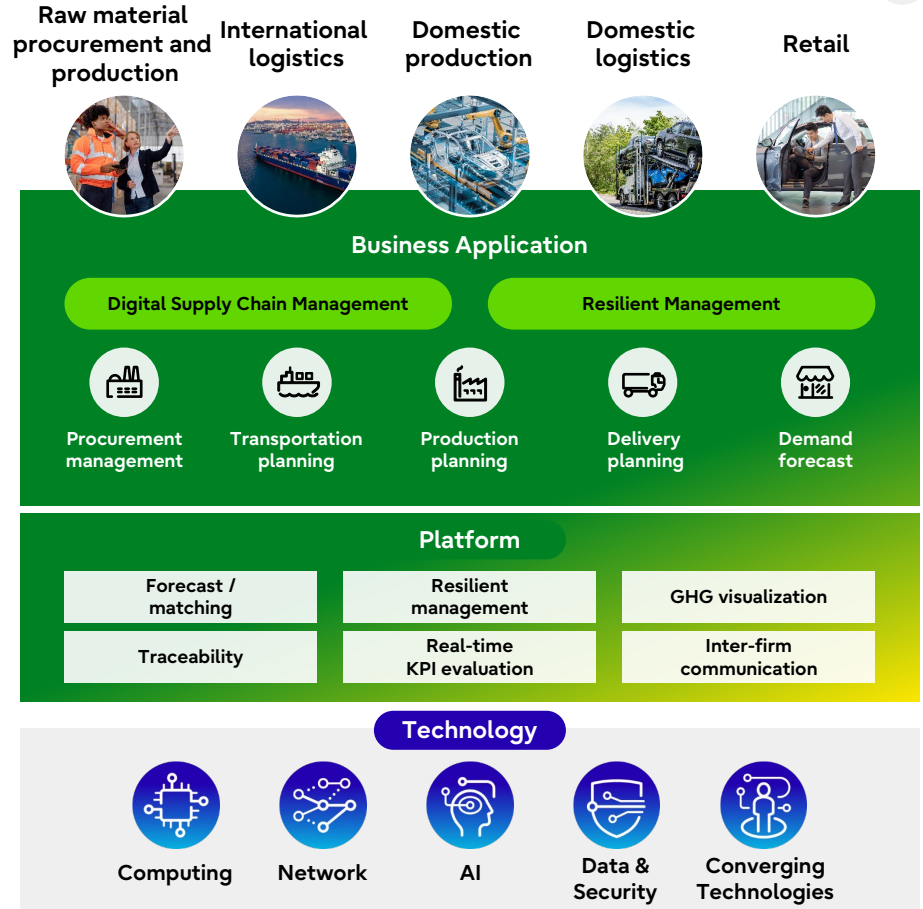
Digital Supply Chain Management

By connecting fragmented data between organizations, we optimize the entire supply chain, improving operational efficiency and helping to reduce waste loss caused by overproduction.

Resilient Management

We can realize a flexible supply chain by simulating the impact of a hazardous event on business, for example switching to alternative suppliers and proposing the best alternative transportation route.

Fujitsu will contribute to resilient business and society through disaster prevention and mitigation using digital twin technology.

Raw material procurement and production	International logistics	Domestic production	Domestic logistics	Retail

Business Application

Digital Supply Chain Management   Resilient Management

Procurement management	Transportation planning	Production planning	Delivery planning	Demand forecast

Platform

Forecast / matching	Resilient management	GHG visualization
Traceability	Real-time KPI evaluation	Inter-firm communication

Technology

Computing	Network	AI	Data & Security	Converging Technologies

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Realizing a sustainable society

Hexagon

Since June 2022, Hexagon Safety, Infrastructure & Geospatial division and Fujitsu have been collaborating in the area of digital twin technologies to achieve carbon neutrality and safety, and to optimize operations in cities.

Hexagon and Fujitsu are developing use cases for urban mobility, transportation and logistics, and smart cities by combining Hexagon's visualization tools and IoT framework with Fujitsu's stream data processing platform, video analysis platform, data integration and management platform.

Both companies are providing solutions to private companies, government agencies and public institutions.

Hexagon and Fujitsu have already started an initiative to support the Urban Digital Twin project in Stuttgart, Germany. Using digital twins, we have monitored and analyzed infrastructure conditions in the urban environment including air, water, and transportation, using information collected from various sensors. This will help the City of Stuttgart make decisions for urban environmental optimization.

The two companies will combine data held by private companies and public institutions to create new value and resolve social issues.

> " Cities are playing a leading role in solving global challenges, from addressing climate change to eliminating traffic fatalities. Our partnership with Fujitsu can help cities put data to work to solve these pressing problems and meet sustainability and safety goals.
>
> Steven Cost
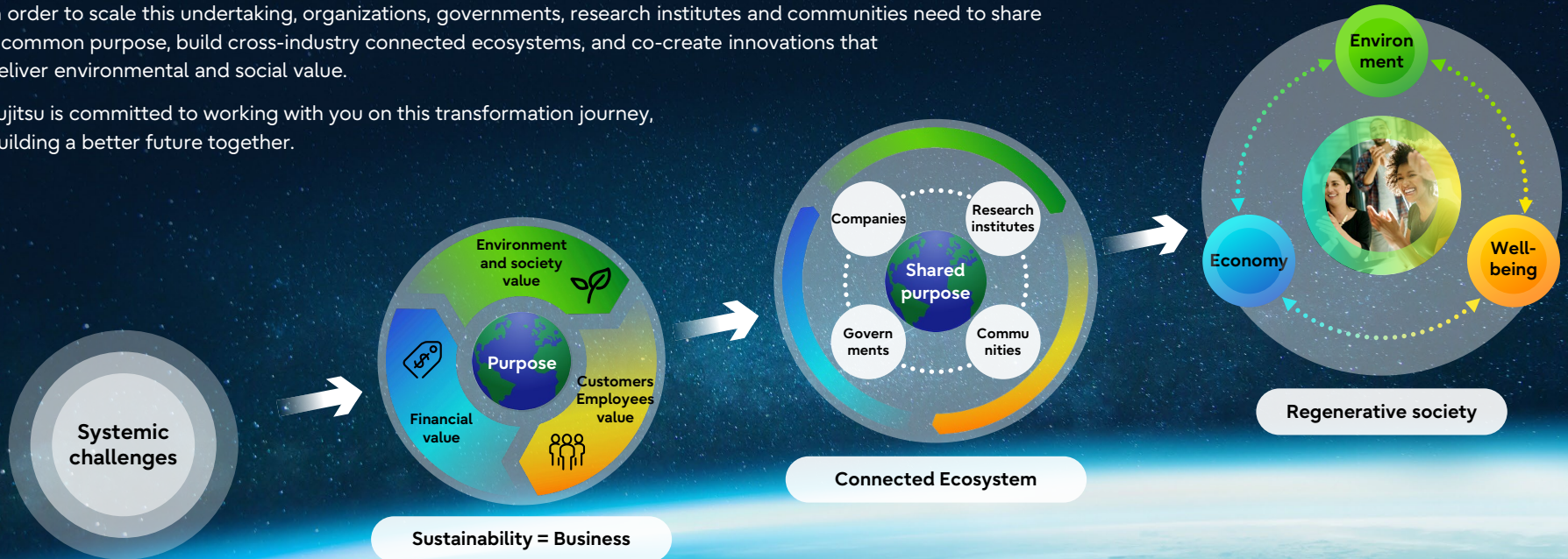> President, Hexagon Safety, Infrastructure & Geospatial division

Our journey to a regenerative society

Nobody can predict the future, but we can shape the future by imagining the kind of society we want to create.
Because the challenges we face are complex and intertwined, it is not easy to realize a regenerative society.
However, if all stakeholders proactively cooperate for common goals, and technology is used correctly, it can become a reality.

The first step is to identify issues that organizations need to address, and to integrate sustainability into business.
In order to scale this undertaking, organizations, governments, research institutes and communities need to share
a common purpose, build cross-industry connected ecosystems, and co-create innovations that
deliver environmental and social value.

Fujitsu is committed to working with you on this transformation journey,
building a better future together.

Systemic challenges

Environment and society value

Purpose

Financial value

Customers Employees value

Sustainability = Business

Companies

Research institutes

Shared purpose

Governments

Communities

Connected Ecosystem

Environment

Economy

Well-being

Regenerative society

Fujitsu Uvance

Fujitsu Uvance comprises four cross-industry business domains: Sustainable Manufacturing, Consumer Experience, Healthy Living and Trusted Society supported by three horizontal domains: Digital Shifts, Business Applications and Hybrid IT.

Through Fujitsu Uvance, Fujitsu will help to realize a world where people can live in prosperity and with peace of mind.

Vertical Areas

Sustainable Manufacturing
Helping manufacturing, people and the planet to live in harmony

Consumer Experience
Unique consumer experiences for all

Healthy Living
Enriching life experiences with digital healthcare solutions

Trusted Society
Innovative solutions to create a prosperous, safe and sustainable society

Horizontal Areas

Digital Shifts
Make the shift bringing the power of digital to business and people

Business Applications
Accelerating sustainability transformation modern applications for pace, intelligence and innovation

Hybrid IT
Seamless, secure and sustainable transformation to address business and societal issues

Sustainability transformation through digital innovation

Fujitsu co-creates sustainability transformation in various areas

The potential of quantum-inspired computing to raise yields

Bayer Crop Science

Bayer engaged in a proof of concept with Fujitsu's Digital Transformation services, assessing the power of the quantum-inspired Digital Annealer to solve complex challenges relating to seed production planning and materials scheduling. Bayer strives to create more robust supply chains and richer yields for farmers.

Food loss reduction through AI demand forecasting

TORIDOLL Holdings

Fujitsu's AI demand forecasting service is deployed across all Marugame Seimen's noodles shops in Japan. Based on weather, POS and other data, TORIDOLL can now accurately predict customer numbers and sales. This helps them to optimize order volumes, improve the efficient operation of air conditioning systems, and reduce food losses.

Improvement of diabetes treatment during pregnancy

Helsinki University Hospital

Gestational diabetes occurs when the body cannot produce enough insulin to meet the extra needs during pregnancy. It does not usually cause any symptoms but can lead to premature birth or difficulties during childbirth. Fujitsu is supporting an application to visualize patients' data, helping healthcare professionals to recommend personalized treatment options.

Trial to expand the use of renewables and improve maintenance

Chugoku Electric Network

To make greater use of renewables and improve maintenance processes, Chugoku Electric Network and Fujitsu completed the proof of concept to test the accuracy of estimation of wind conditions and transmission line temperatures using transmission line vibration data. Both companies are now working together to develop an advanced operation support system.

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Sustainability transformation through digital innovation

Fujitsu co-creates sustainability transformation in various areas

Making ice more sustainable

VELTINS-EisArena Winterberg

The VELTINS-EisArena needed to guarantee high performance for athletes and improve energy consumption. Fujitsu provided a solution based on IoT technology to make this vision a reality. Ice thickness can now be precisely determined, resulting in 10% energy savings and ensuring ideal conditions for the athletes.

Managing work at e.l.f. speed

e.l.f. Beauty

With 3.5 million loyalty program members, e.l.f. Beauty needed a single order management solution that worked with their ecommerce websites. Fujitsu's GLOVIA OM system has helped e.l.f. to consolidate its entire e-commerce business on a single Salesforce platform. By integrating this with its wholesale customers, e.l.f. can now achieve a single view of all orders across its business.
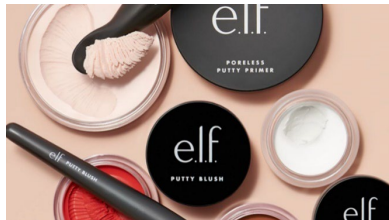
Creating Springboard™ to Azure Cloud

Whitbread

Whitbread engaged Fujitsu to manage its cloud migration, using Fujitsu Springboard™ for Azure as part of the Fujitsu Cloud Management Service (FCMS). This ensured a seamless transition that will foster innovation, improve sustainability, enhance operational visibility and lower costs.

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