The background features a vibrant red-to-orange gradient with abstract, glowing patterns of white dots and lines that create a sense of depth and movement, resembling a digital or technological environment.

Fujitsu
Technology and
Service Vision
2016

Book 1

A conversation with the President

How does the evolution of digital technology impact on business and society?

The evolution of technology is transforming the world. Digital technologies such as the Internet of Things and Artificial Intelligence are changing the way people work, making processes more efficient and helping create innovative new products and services. This is digital transformation. These technologies connect businesses with new partners, enabling them to collaborate and innovate across existing boundaries. If they want to outperform the competition, today's business leaders must make digital transformation a key part of their strategy.

How can Fujitsu help our customers achieve digital transformation?

We want to be our customer's business partner, and help their journey of transformation. Last year, Fujitsu began providing a digital business platform, called MetaArc. This is a cloud-based platform that enables customers to use digital technologies to grow their businesses. We also deliver services which integrate the latest technologies on this platform, to help realize digital transformation. We always focus on our customers' business goals and work together to achieve them. This approach is what makes Fujitsu different.

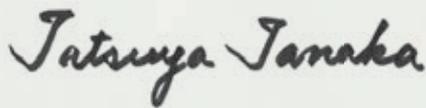


**What kind of company is Fujitsu striving to be?
What value do you believe is the most important?**

Fujitsu has been working towards our “Human Centric” vision for some time. This means putting people at the center of everything. Advances in artificial intelligence are accelerating, which means more and more of what we do can be automated. In this digital era, we have to think about how technology empowers people to work more creatively and maximize their potential. Fujitsu’s technology and services support everyday life, helping all of us live happier and fuller lives.

April 2016

Fujitsu Limited
President and Representative Director
Tatsuya Tanaka



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What is the Fujitsu Technology and Service Vision?

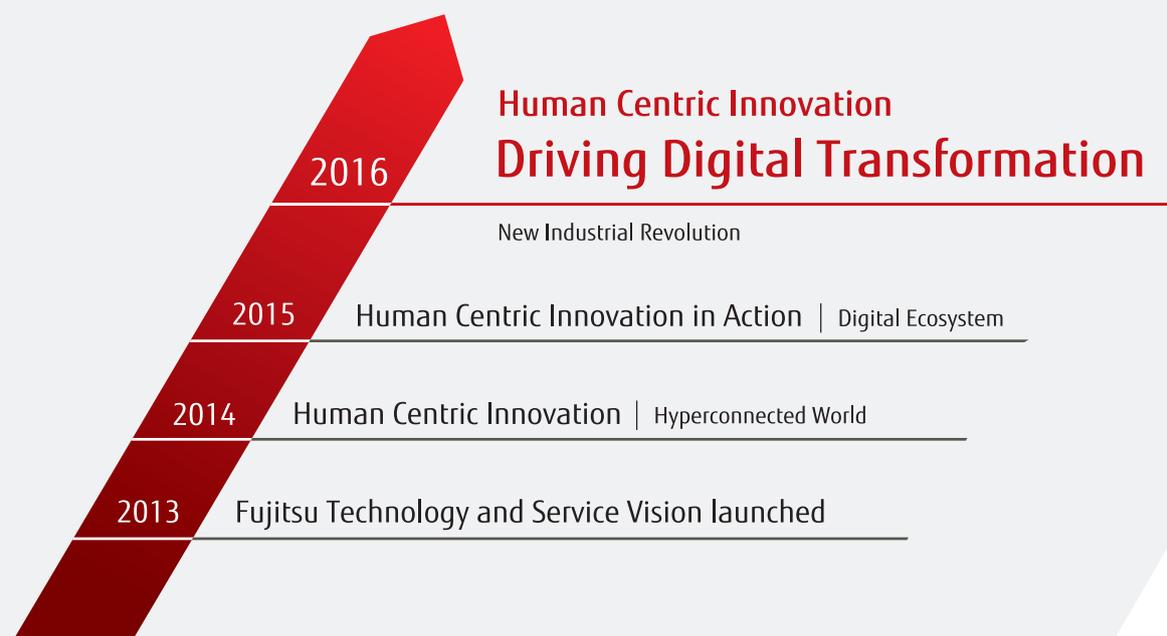
We first launched the Fujitsu Technology and Service Vision in April 2013, and have updated it annually ever since. It sets out our vision and provides insights to leaders of business and the public sector about how they can use ICT*1 to create innovation and build a different future. Our vision underpins all of our operations, from research and development to customer engagement and delivery.

Fujitsu's key proposition is Human Centric Innovation. We first expressed this central idea in our vision in 2014, to describe Fujitsu's unique approach to creating business and social innovation by empowering people with advanced technology. Human Centric Innovation is also a journey. It is how we have been working together with customers and partners from all around the world to deliver innovation.

The theme of this year is Human Centric Innovation: Driving Digital Transformation. New digital technology is becoming incorporated into the heart of business and society. Digital is not a single technology, rather a set of connected technologies such as cloud, mobile, Internet of Things (IoT), analytics, Artificial Intelligence (AI) and supporting security technologies. The promise of digital technology is to transform the everyday lives of people, businesses and communities, bringing about a new industrial revolution.

We believe a human centric approach is the only way to deliver on the promise of digital. We passionately believe this is the approach you need to drive your successful digital transformation. We want to show you how. We hope this booklet will give you the insights you need to thrive in this revolutionary period.

*1 ICT : Information and Communication Technology



Related Information and Website

The Fujitsu Technology and Service Vision 2016 is created by a team of Fujitsu people from around the world. We are communicating it in these formats:

- Book 1 (this booklet) sets out our vision along with some insights on how business leaders can leverage digital transformation.
- Book 2 provides insights on how IT leaders can provide digital leadership. It also features our customers' stories of their digital transformations as well as Fujitsu's portfolio of services, solutions and products.
- Executive summary
- Website : <http://www.fujitsu.com/global/vision/>
- Contact : +81-3-6252-2220

The Business Agenda

We are at the beginning of a new chapter in the story of technology. The world is undergoing a new industrial revolution, triggered by the evolution of digital technology. The prizes are huge, but so are the risks.

Today's business leaders are aware of the impact of information technology and what it can do. Many of today's CEOs have seen the march of technology at first hand, from mainframes, the PC and the internet revolution, to the smartphone explosion.

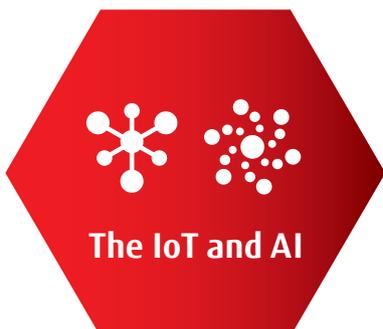
But in 2016, digital technology will begin to play a more fundamental part in the way businesses function. As a result, it is driving a new business agenda. This will come to underpin the way businesses grow and innovate, and define the way they create value for customers. In a digital era, it will determine the businesses that thrive and the ones that die.

The change that businesses must contemplate making, is not cosmetic nor is it about gadgets and gimmicks. The implications of this business agenda go to the heart and soul of any organization.

The Business Agenda



By bringing connected, digital technologies into their core operations, businesses can undergo a metamorphosis. Transforming themselves to a higher-value level of working. They have the ability to become dynamic and agile: more efficient, more intelligent and more responsive to their customers. There are no limits. Businesses in any industry have the opportunity to leverage digital to transform the value of their products and services.



Two technology trends will be particularly transformative and disruptive for businesses. The Internet of Things (IoT) will enable the bringing together of digital and physical worlds, with profound implications for how organizations create new services and engage with their customers. The potential of AI is greater still. It promises a new level of automation, enabling technology to learn, solve problems and create new insights with the minimum of human effort.



Digital transformation has the potential to impact the structure of industries. In the digital era, value is created in three ways. From the creativity of people, from intelligence and from connectedness. New digital arenas – like 'wellbeing', 'mobility', or 'smart cities' - will emerge across traditional industry structures, to bring about a new industrial revolution. As a result, organizations will need to question and redefine the role of their businesses in this digitalized economy.

How to Choose Your Future?

Digital technology is influencing our lives more completely than we ever could have imagined. From the trivial: where can I park my car? To the fundamental: how can we stop people dying from heart disease? Increasingly we look to information and technology to provide the answers.

But there's a problem. Becoming more digital requires change and change we know is difficult and uncertain.

Digital does not of itself guarantee a better future. It is for us to choose, and we have to live with the consequences. To show what we mean, let's consider how an everyday scene plays out in four different scenarios...

Lucy is making a business trip abroad and her flight just landed at its destination. She disembarks the aircraft and heads into the terminal building. It is peak season and the airport is packed. Lucy hopes it won't take too long. At the forefront of her mind is the short stopover she made en-route to change planes. Did her bag make it onto her flight?

Scenario 1:

Digital technology is... undeveloped

Lucy arrives at the back of a long queue for immigration. She looks around, but there is no way to avoid it. After a long wait, her passport is checked and stamped by an official.

All the while she was waiting, Lucy has been anxious about her bag. She arrives in the baggage hall, and is relieved to finally see her bag appear on the carousel.

Lucy thinks how much better her experience would have been if the airport invested in more technology.

Scenario 2:

Digital technology is... uneven

The airport has implemented biometric palm vein and face recognition technologies for immigration control. But when Lucy tries to use a gate, the system is not able to validate her. She discovers it has not been integrated with the system of her local passport authority. So Lucy has to go back and join the long queue for the manual passport check.

Lucy would like to use her airline's smart bag tracking system to check her bag has arrived. Unfortunately she discovers it has not been integrated with the airport's baggage handling system. So she has an anxious wait for her bag to appear.

Later, as she leaves the airport, Lucy considers how much better her experience would be if the airport could connect its technologies better.

Scenario 3:

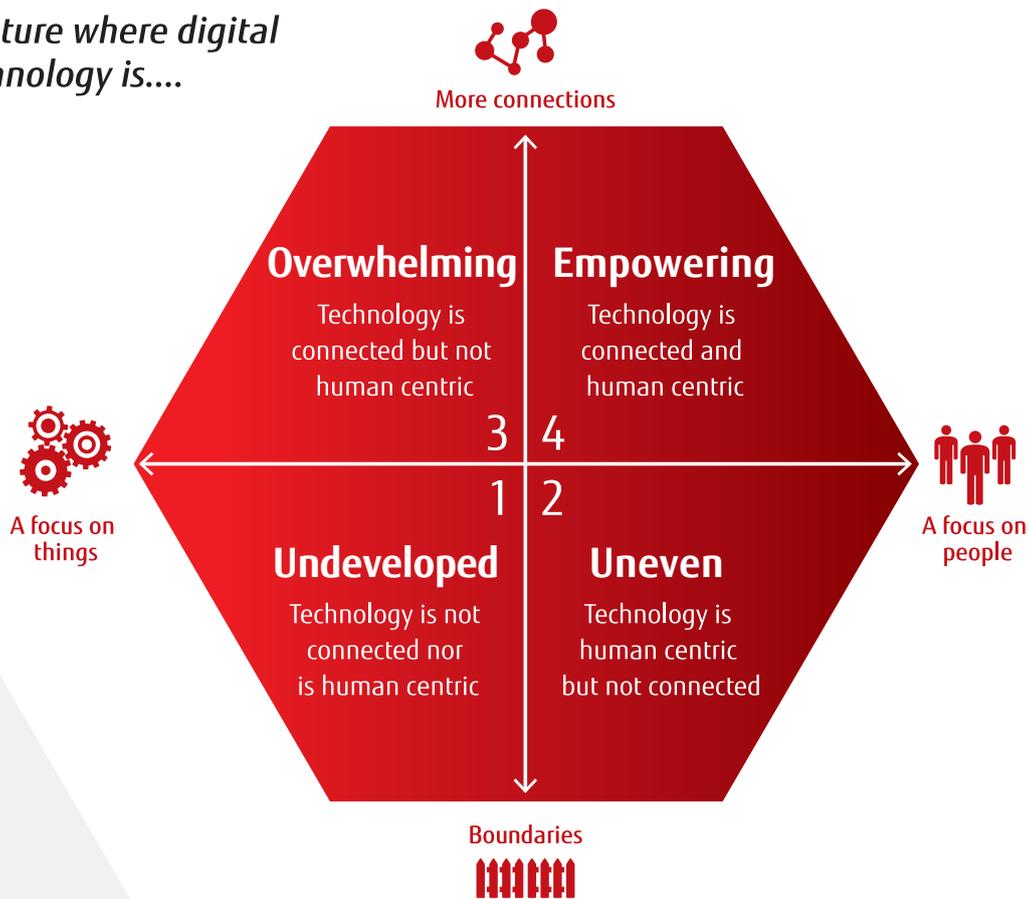
Digital technology is... overwhelming

At the automatic immigration gate, a computerized voice interrogates Lucy about previous trips she has made abroad. The system is clearly well integrated with other sources of data but Lucy cannot remember the exact details of previous trips and who she travelled with. She feels uncomfortable about how much the system seems to know about her.

A text arrives from the airline announcing it has important information regarding the arrival of her



A future where digital technology is....



baggage. It directs her to a login page for the airport's baggage tracking system. However Lucy has no clue what username and password she needs to enter.

Later, as she leaves the airport, Lucy reflects on the impersonal nature of the technologies and the intrusion into her privacy.

Scenario 4: Digital technology is... empowering

Lucy uses the biometric palm vein and face recognition authentication gate at immigration. The system is so efficient she barely needs to stop. "Welcome back, Lucy" says a friendly avatar, directing her through to the baggage hall.

A text arrives at Lucy's smart phone, informing her bag is in transit between her plane and the baggage hall. A few minutes later a second text arrives announcing her bag will be on the carousel in a few seconds. And sure enough, there it is.

Lucy thinks to herself how well the processes have been connected and what a great experience she has had. She must travel more often!

Solving the Digital Paradox

We may believe digital technology has the key to a better future, but if we take the wrong approach, 'digital heaven' may quickly turn into 'digital hell'. We may have high expectations for digital technology, but success is by no means assured. This is the digital paradox.

How do you secure systems that are more connected and open than before? How can you keep up with such an unremitting pace without creating instability?

And, can you be sure you will be better off by adopting digital technology? Will people accept having our lives controlled by intelligent machines?

But we can solve this paradox. We have the power to determine which path we go down.

Taking value from digital starts by having the right approach. We believe the best way to achieve this is by building connections and putting people at the center. This is how we can leverage digital in a way that secures value for businesses and society as a whole. We call this Human Centric Innovation. This is the central idea of our vision. We will develop it through this booklet.

Chapter 1

Digital Transformation

Powerful results come from bringing digital technology into the heart of business and society.

The key is to put people at the center of everything.



Digital Transformation

It might seem unusual for a financial organization to want to improve the experience of school lunches. But that is exactly what Sberbank, a leading Russian bank, has achieved with a new digital solution for children. The company turned to Fujitsu PalmSecure, a contactless, intuitive ID platform that captures unique palm-vein signatures.

The technology reduces queues and ensures that everyone gets fed within a tight daily timeframe. Students no longer need to carry cash into school, which can be problematic and even lead to bullying. And parents get visibility over what food their children are having.*2

It is a simple example, but it shows how digital can be applied in any walk of life. It can radically transform how the world works – from school lunch queues to complex industrial production lines. In the latter case, for instance, a manufacturer can leverage a connected, digitalized production line to gain a real time view of its operations, and make changes more quickly, transforming its efficiency. Connectivity greatly reduces transaction costs, and therefore improves the bottom line.

But digital technology can also impact the top line of a business. How the organization attracts - and delights - its customers. It can allow a company to innovate in its business models, driving and accelerating growth, opening it up to new markets.

These technologies fundamentally change an organization, how it operates and how it creates value. Digital transformation is metamorphosis. A core change, not a cosmetic change or an extension. A reconfiguring of a business to provide higher value products or services.

Many business leaders are already aware of the potential of digital. According to Gartner, private sector CEOs expect that 41% of their revenue will be digital by 2020. The public sector is even more bullish, Gartner cite public sector CIOs anticipating 77% of their processes to be digital in 5 years.*3

Fujitsu's own research of business and IT leaders in Europe supports a similar conclusion. However we found beneath this optimism lay uncertainty. Only 25% of business leaders classed themselves as 'extremely confident' in their ability to deliver digital, and only one in three agreed that their digital priorities are aligned.*4

Furthermore, business leaders can see the real and present risk that others can use these very same digital technologies as a means of taking market share from them. These may not be traditional competitors, but start-up businesses or even companies from different industries.

Making the lunch payment cashless and smarter in a school



*2 For detail please see Book 2 page 18, Customer Stories, "Transforming the school canteen helps increase security and safety" Sberbank

*3 Gartner : Gartner Symposium ITxpo 2015 "The 2016 CIO Agenda Building the Digital Platform" Dave Aron, 28th October 2015, Global Survey, Private Sector: CEO Survey (n=400), Public Sector: CIO Survey (n=344)

*4 Fujitsu : A Fujitsu Report "Walking the digital tightrope", 2016

Waves of digital technology

To understand digital it is important to see the context of the continuing evolution of technology. The story of digital is the story of four waves.

The Internet

The internet established a new shared platform which people and businesses have been using ever since. It gave rise to technology innovations and new business models too numerous to name, from e-commerce to social networking.

But from an economic point of view, perhaps the greatest impact has been on transaction costs. Whenever business has been able to substitute physical transactions with digital transactions, they have enjoyed huge reductions in costs.

And this has brought benefits to consumers beyond only cost savings. The so-called 'long tail' effect has enabled suppliers to cater for unique and specialized customer demands without any corresponding increase in price. If you are looking for an obscure book or an unusual clothes size, the internet can provide it. The emergence of the internet has also started a process of disruption to established industries that continues today. For example, the media, retail and financial sectors have already experienced radical change.

The digital story starts with the internet but doesn't end there.

The Mobile Internet

The internet has given rise to a second, larger wave. Consumers have been attracted to mobile phones on a scale that no computing technology has generated before. They have become essential items that everyone must own.

Even in developing parts of the world like Sub-Saharan Africa, 70% of people have access to cellular coverage,^{*5} which is more than plumbed water or grid electricity. Today, 2 billion people have smartphones – powerful, network connected mobile computing devices.^{*6} By 2018 this will have risen to 2.5 billion.^{*6}

The implication of this second wave is that computing is no longer anchored in physical locations, like offices and homes. Digital services and experiences can be delivered and consumed anywhere that people go.

^{*5} Ericsson "Sub-Saharan Africa, Ericsson mobility report appendix", 2014

^{*6} eMarketer "2 Billion Consumers Worldwide to Get Smart(phones) by 2016" 2014

4th Wave

AI and Robotics

3rd Wave

Internet of Things / 50B+ in 2020

2nd Wave

Mobile Internet / 10B in 2010

1st Wave

Internet / 1B in 2000

The number of users or devices



The Internet of Things (IoT)

If the mobile wave extended the internet into people's everyday lives, the IoT extends it into the physical world around us.

A conservative estimate indicates there will be 50 billion connected things in the world by 2020^{*7}. The IoT enables us to overlay information anywhere in the physical world – whether that is a water pipeline, a moving car or a pair of shoes.

Like a giant nervous system, the IoT gives us the ability to sense and control the world around us. As a result businesses can build powerful new services around the technology. For example, an industrial equipment supplier can provide machinery as an ongoing service, instead of selling it in a one-off transaction. Collecting detailed usage data and analyzing it enables predictive maintenance and the prevention of failures: a new business model.

As the size and cost of sensors and computer chips continues to reduce, digital services can easily be applied not just to expensive, high tech equipment, but to everyday items, from office furniture to light bulbs and clothing. We can even use this technology inside of our own bodies, opening up new possibilities for medical innovation.

AI & Robotics

Research into AI is not new. It has continued to varying degrees since 1950s. However, now it is becoming

possible to use the outcomes of AI research in real business situations. The rapid advance of computing power is one reason for this.

But AI is also being driven by the huge amount of data that is available for machine learning to exploit. Data that the three previous digital waves have been driving. In addition, we are discovering new techniques. For instance, the most recent developments of deep learning, which uses neural network computing, are enabling a computing program to recognize features of visual images without any human help.

Combined with the IoT, we expect AI to have a significant impact on business and society. Algorithms that use machine learning^{*8} and deep learning have the potential to analyze real-time data from any connected physical objects and processes. This holds enormous potential for businesses and key social infrastructure to operate autonomously. Furthermore, these are autonomous, robotic processes. They can use data to self-learn and self-improve.

We have seen the first and second waves drive the emergence of many on-line digital companies. However, we believe it is the third and fourth waves, enabling us to digitalize physical assets and provide autonomous control, will turn out to have the greatest impact on established industries.

*7 Cisco Systems "Embracing the Internet of Everything To Capture Your Share of \$14.4 Trillion", 2013

*8 Technology that provides computers with the ability to learn as a human does without being explicitly programmed

The challenges of digital

Digital transformation is not easy. It involves upheaval and will test even the most determined business leader. There are many challenges to overcome in a digital transformation, but we believe they come into four categories.

Leadership and Talent



43% of C-suite executives named finding talent as the most significant challenge in meeting digital business priorities.*⁹ Building digital capabilities

requires unique skills. It requires understanding not just of emerging technologies but also of business and customer needs. It requires fresh thinking.

The issue of strategy and leadership is equally critical.

How do you build the right strategy? How do you create consensus in your organization of the right approach, and who is the right person to lead it?

Security

While digital is good for creating efficiency and new value, it creates new vulnerabilities. In 2015, 66% of CEOs named cyber security the biggest challenge to their company.*¹⁰ A characteristic of a more connected world is that physical assets are also facing cyber security risks, in addition to IT infrastructure and information. From connected cars to important social infrastructure like electricity grids or pipelines, these things all face the risk of hacking.



*⁹ McKinsey "Minding your digital business", 2012

*¹⁰ Fortune "The results of the 2015 Fortune 500 CEO survey are in...", 2015

Complexity

The fact is that new technologies emerge faster than people can respond. Today organizations have to see change as a normal part of business.

However, change creates complexity. For instance, where once most retailers had only a single channel to their customer – their stores – now they must consider multiple channels – online, mobile and so on. It is one thing to implement these new channels to customers, it is quite another to knit business systems and processes together. The business needs to approach its customers in a coherent manner through all its channels.

A failure to deal with the issue of complexity will prevent an organization benefitting from digital.

Adoption

A major hurdle to overcome is caused by people's attitude to change brought by new technology. Convenience alone does not lead to adoption. Old habits die hard and people can take a long time to modify their behavior.

Worse still, if people do not trust technology they will never see the benefit of using it. Unless privacy of personal data is adequately protected, people will be deterred from using a digital service.



A New Industrial Revolution



The industrial revolution started in the mid-18th century and gave rise to huge gains in productivity. We tend to think that technology change, for example, the steam engine, drove this economic expansion. However, these new technologies could not deliver unless businesses and society made fundamental changes to the economic framework. Establishing rights of ownership, the accumulation of capital, division of labor and the creation of a new market economy turned a technology revolution into an economic one.

It is still the way business works today. Under this framework, value is exploited through the management of assets – natural resources, plant and machinery, labor and financial capital.

We have seen advances of course. Businesses have optimized their value chains to produce standardized products at lower cost and at larger scale. Computing technology has accelerated the change by automating processes and improved operational productivity. But management of assets and resources remains the focus of most modern businesses.

But like the steam engine before it, today digital

technology is poised to bring a seismic change to the economic model. Cloud, mobile, IoT, analytics, AI and robotics provide a new technology toolkit for businesses to use.

In the digitalized economy, the key value drivers are creativity, intelligence and connectedness. People empowered with digital technology can be more creative to deliver innovation – whether that is in new products and services or in new business models. The analysis of data and computing algorithms produce new intelligence. The cloud, mobile internet and the IoT connect not only people but also many things around us.

It is a new industrial revolution. It means that individual customers can enjoy using customized products and services tailored to their needs, instead of standardized ones. Businesses can exploit ecosystems of suppliers, partners and customers to co-create value. This can greatly increase the size of the market and the set of customer needs they are able to address. Business operations become more autonomous and fluid, instead of hierarchical and rigid. People work more openly and collaboratively within their organizations and with external people.

Human Centric Innovation

Digital transformation therefore is not about technology innovation alone, but about changing the way businesses create value for customers. It is about how people work. It encompasses the transformation of organizations, operational process, and customer relationships.

Digital must be about people. It is about using technology to get the best out of our human potential – our creativity and our ability to make judgements. And it is about using technology in ways that positively impact people’s experiences and lifestyles.

For most businesses this requires a change of mindset. The key to successful digital transformation comes from knowing that value is created from connectivity and putting people at the center of digital technologies.

Human Centric Innovation is an approach to creating business and social value by empowering people with digital technology. It is about bringing together three key value drivers – creativity, intelligence and connectedness. Each value is derived from dimensions of people, information and infrastructure.

Human Empowerment

Empowering people with digital technology

Creative Intelligence

Using intelligence derived from analyzing data and employing algorithms

Connected Infrastructure

Connecting things and the infrastructure of business and society

To address the challenges of digitalization, organizations must consider the impact of culture, resilience and trust.

To realize digital transformation, organizations must nurture a new culture to support a new way of working, while keeping the existing business running.

They must also build resilience to cope with increasing security risks and complexity.

And they must be able to build and secure trust. Trust is forged through working for the common good, and having a shared vision.

Fujitsu believes Human Centric Innovation is the key approach to achieving real business and social value from digital transformation. Digital technology of course is crucial to this. But unless we build it around people, we put the potential at risk.





Human Empowerment



Better Experience



Quality of Life



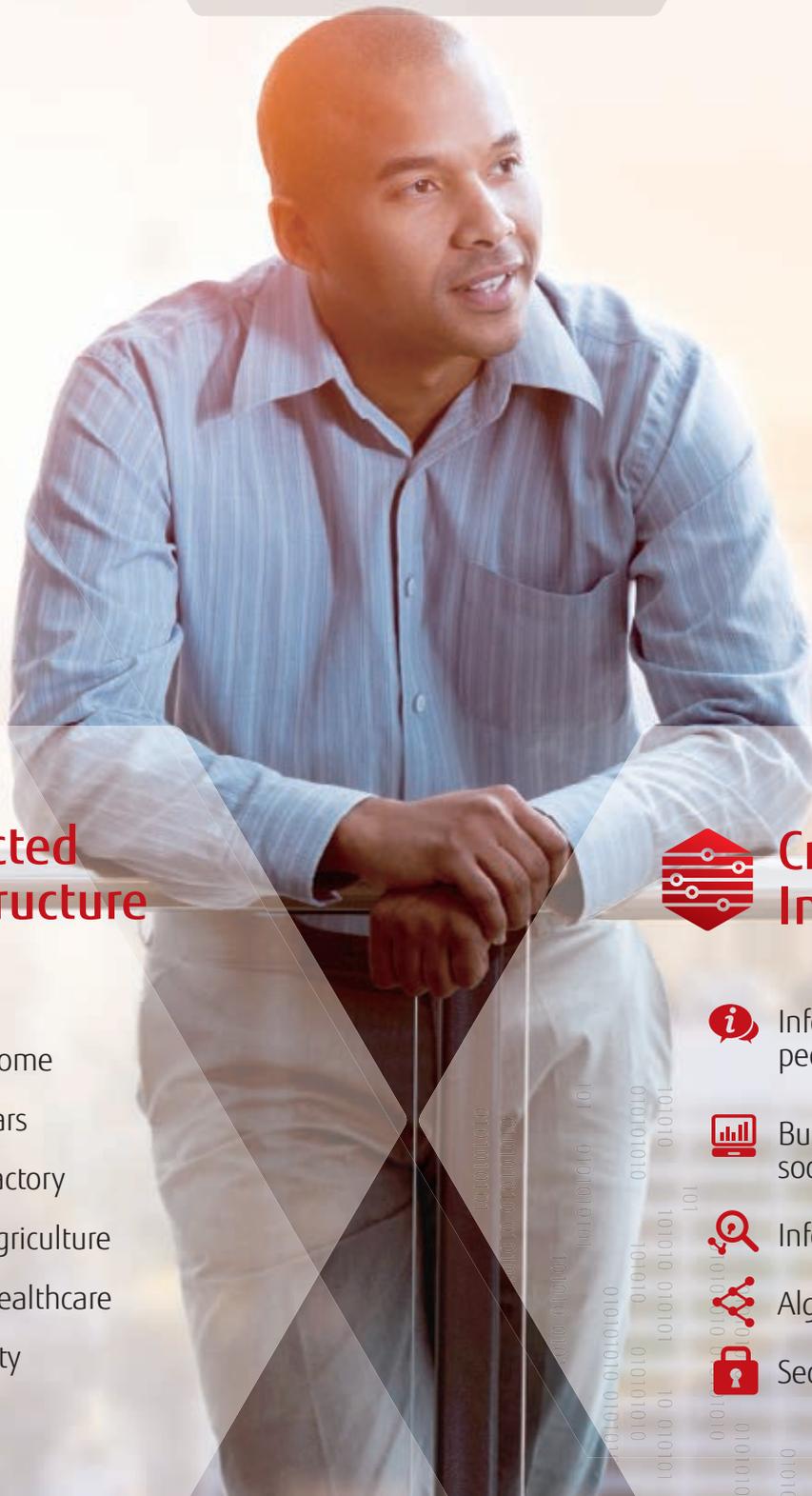
Creative work



Decision support



Acquiring knowledge and skill



Connected Infrastructure



Sensors



Smart Home



Smart Cars



Smart Factory



Smart Agriculture



Smart Healthcare



Smart City



Robots



Creative Intelligence



Information from people and things



Business and social information



Information Analysis



Algorithms and AI



Security and Privacy

Chapter 2

Making the change

How can an organization achieve digital transformation?

It is meaningful to think of digital transformation at a project level, a business level and an industry level. A digital business platform helps an organization to empower people, to use intelligence from data, and to build connections with external ecosystems.



Outcomes of Digital Transformation

For business leaders, digital transformation means a fundamental change to the way their organizations work and the very nature of their products and services. Digital technology helps businesses improve efficiency and engage with customers more intimate-

ly. It enables them to reinvent business models and bring innovation and value for customers, with significant effects on revenue, profits and potential for growth.



*11 Application Programming Interface : An API is a pre-defined set of functions which specify how software components should interact with each other

Transformation at 3 levels

The immediate challenge for any organization embarking on a digital journey is to understand what it means for their business, and what approaches are needed. It is not easy to define a scope for Digital transformation. What's more, different industries are at different levels of maturity with digital. We find it helpful to think of digital transformation at three levels: A project level, a business level and an industry level. At each level, value is created on a larger scale.

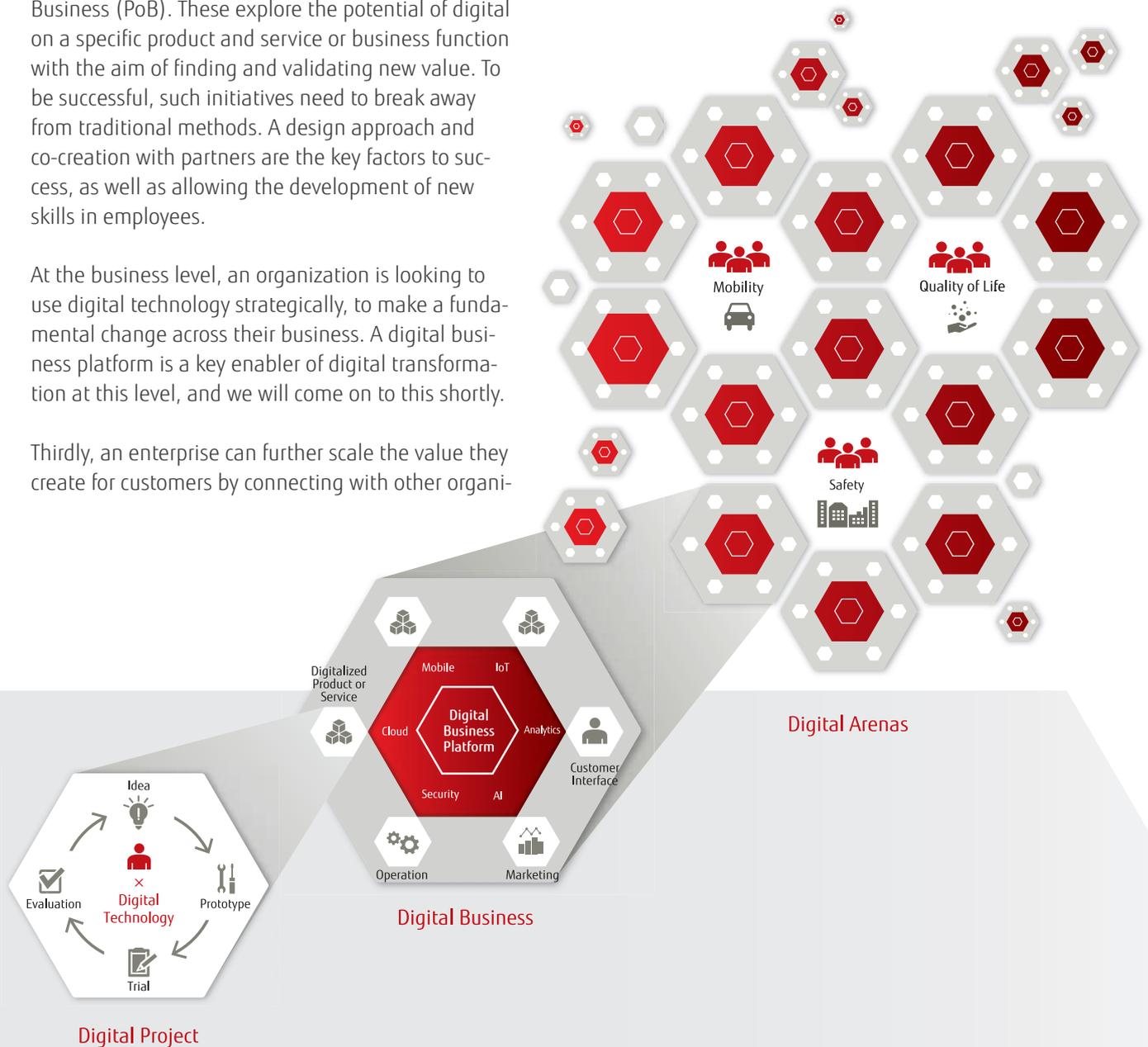
At the project level, digital initiatives often take the form of a trial: a Proof of Concept (PoC) and Proof of Business (PoB). These explore the potential of digital on a specific product and service or business function with the aim of finding and validating new value. To be successful, such initiatives need to break away from traditional methods. A design approach and co-creation with partners are the key factors to success, as well as allowing the development of new skills in employees.

At the business level, an organization is looking to use digital technology strategically, to make a fundamental change across their business. A digital business platform is a key enabler of digital transformation at this level, and we will come on to this shortly.

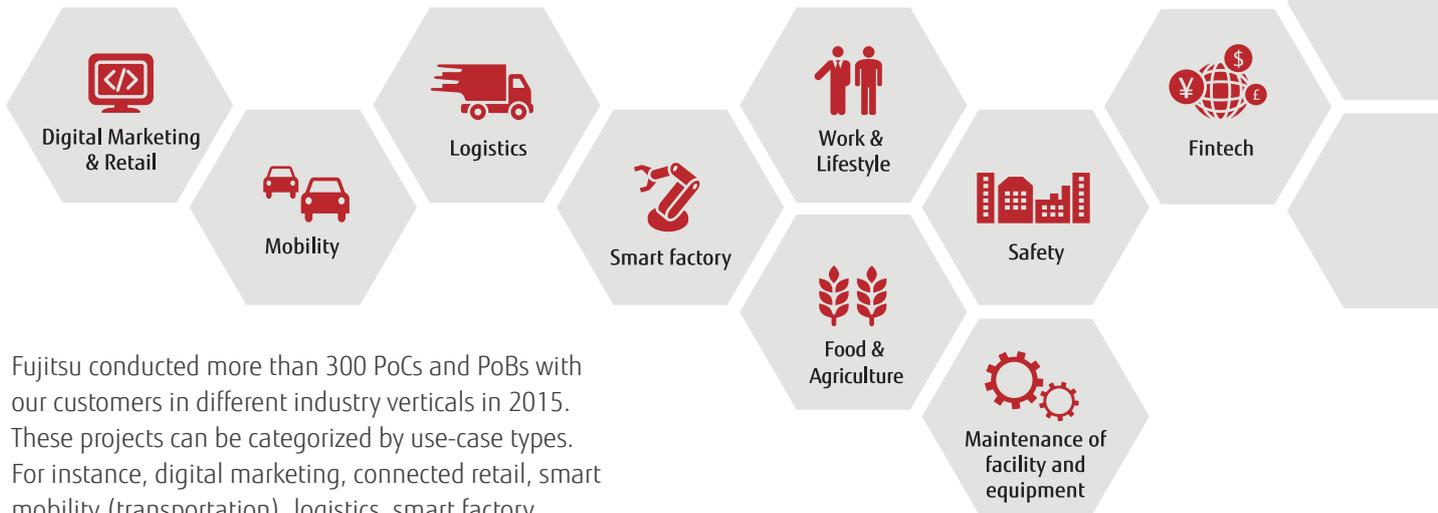
Thirdly, an enterprise can further scale the value they create for customers by connecting with other organi-

zations and beyond their own industry. In the digitalized economy, the borders of existing vertical industries are increasingly blurred and reshaped. But these new structures are shaped around customer needs and values, rather than physical assets. We call them 'digital arenas'. At this level, interfaces are key, and particularly APIs which enable different digitalized products and services in different verticals to connect and interoperate.

Let's investigate these three levels in more detail.



Starting a digital project



Fujitsu conducted more than 300 PoCs and PoBs with our customers in different industry verticals in 2015. These projects can be categorized by use-case types. For instance, digital marketing, connected retail, smart mobility (transportation), logistics, smart factory, workstyle transformation, personal safety, smart agriculture, facility monitoring, Fintech,*¹² and so on. Many of them used IoT and data analytics, supported by other digital technologies.

These projects have demanded closer collaboration with our customers, and benefited from the combination of their business knowledge and our digital technology expertise.

What makes these projects different is they attempt to apply technology directly to the business instead of using it to enhance back office productivity. The purpose is to discover new value from innovation.

To make digital transformation a reality, an organization has to encourage different types of employee skills and approaches. It may even require cultural change. People's creativity is key for digital innovation. It also requires a multi-disciplinary approach - business leadership, technology leadership and engineering capabilities. Data scientists need to be involved to deliver insights from information and designers are crucial for ensuring good customer experience. In fact, a design approach is essential to the process, from creating a vision, developing a prototype, to testing and updating it, and all in a fast iteration cycle. This is lean innovation. It moves fast and with greater agility.

One of our customers, Mitsui Chemicals, wanted to take just such a new approach. They held intensive workshops to transform their workstyle, with Fujitsu's

design team facilitating. Mitsui brought together people from many different business competencies who together developed a future workstyle vision. This resulted in a radical change to office spaces and workstyles using digital technology to enable more fluid collaboration.*¹³

A critical concern for business leaders is to deliver digital projects while keeping their existing business running flawlessly. In normal business operations, failures are prohibitive. Measurements and incentives are structured for minimizing them. In contrast, in a digital project, it is important to learn from failures. It is only through failure that successful business patterns can be found. But quick decisions are required whether to continue or stop a project. Business leaders must manage and align these conflicting management principles.

Open Innovation is playing an important role in digital transformation. In June 2015, Fujitsu launched Open Innovation Gateway to activate innovative practices faster through partnering with the most talented people and progressive institutions in the Silicon Valley ecosystem and beyond.

*¹² An abbreviation of financial technology, Fintech companies are working to create financial innovation leveraging digital technology.

*¹³ For detail please see Book 2 page 28, Customer Stories, "Work style innovation encourages creativity, harnessing the aspirations of all employees" Mitsui Chemicals, Inc.



Digital Business

To use digital technology in a strategic way, business leaders have to think about incorporating digital to the heart of the business value creation process. Let's have a look at some digital business scenarios.

Digital Marketing

Digital technology empowers marketing teams by building a rich understanding of individual customers. It uses data analytics and algorithms to tailor the engagement with each customer, thereby automating the marketing process. For example, Nikkei Business Publications, the largest printed and on-line publication company for business people in Japan, embarked on a digital program with Fujitsu. By integrating separate customer databases they were able to build a better understanding of individual customers and enable better ways of targeting them. This resulted in doubling of the effectiveness of their marketing campaigns.*¹⁴

Connected Retail

The first and second digital waves have dramatically changed the landscape of the retail industry. Retailers are under serious competition from a steadily growing online and e-commerce sector. Customer experience is everything. Retailers are working to maximize their experience through multiple channels – in social networking, websites and stores. In stores, for exam-

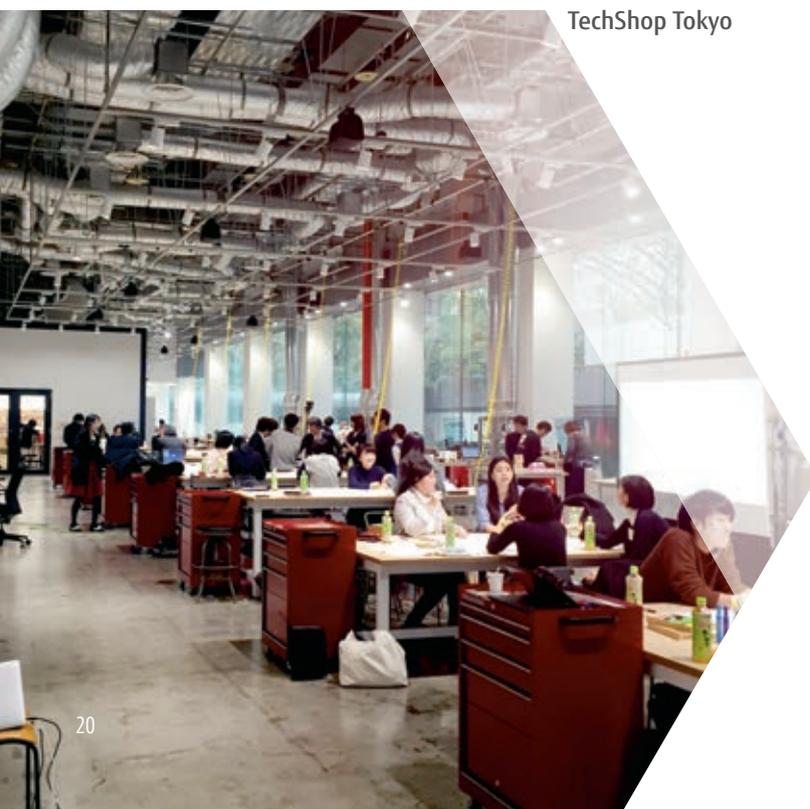
ple, sensors and mobile technology allow a retailer to monitor and analyze the flows of customers. As a result they can arrange the floor layout in a way that best suits their customers and allows the store to provide the best services. The retailer can link the customer's in-store experience with their digital experience, for instance sending messages and offers relevant to their interests.

Fintech

The finance and banking industry is undergoing a huge transformation as a result of digital. New Fintech ventures are providing innovative financial services, using data analytics, algorithms or blockchain technology. New services include mobile payments, personal financial management, peer to peer lending,*¹⁵ autonomous credit assessment and virtual currencies. These Fintech ventures use APIs to connect with the services of banks and other institutions. Fintech ventures and traditional financial institutions are starting to shape a new financial ecosystem. In July 2015, Fujitsu set up a Fintech consortium, called Financial Innovation for Japan, which developed into the community of more than 200 financial institutions and Fintech companies.

Smart manufacturing

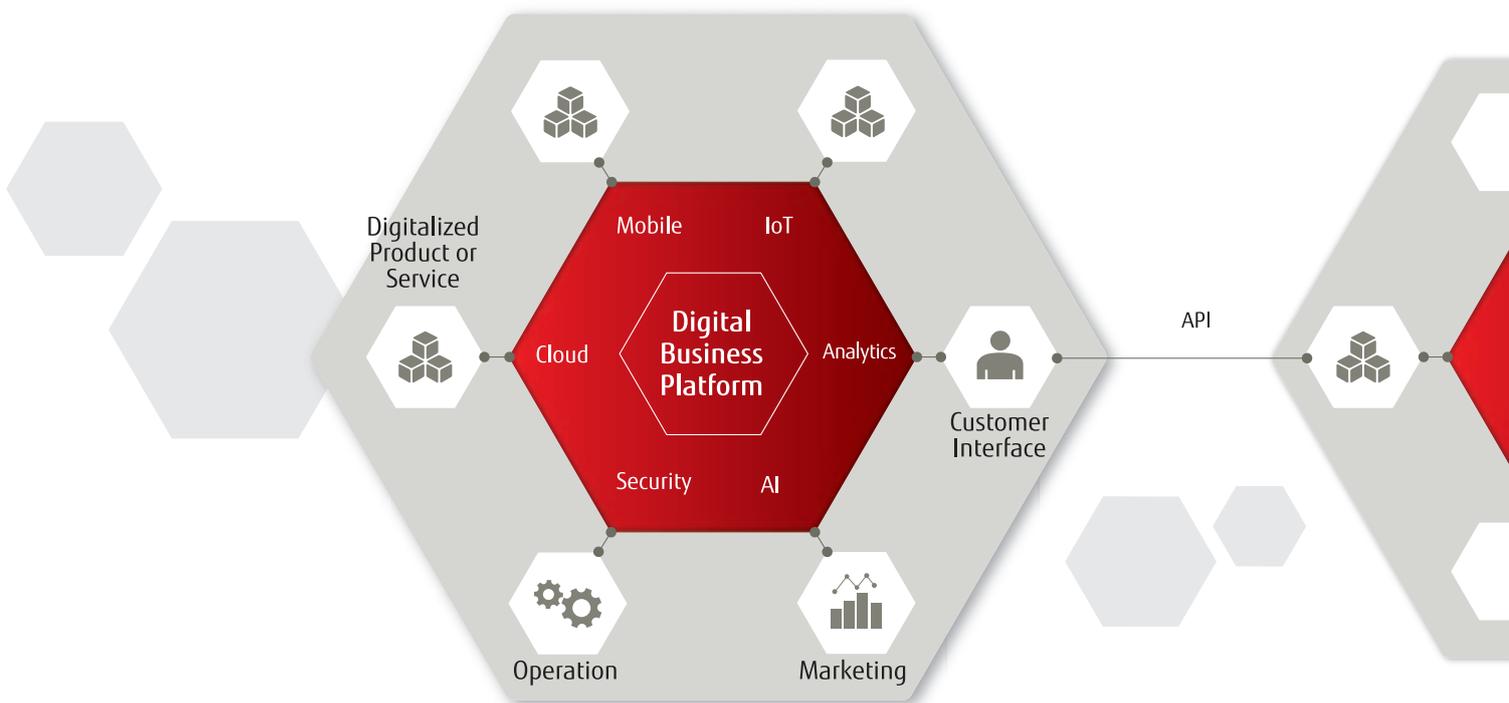
In manufacturing, new technologies such as IoT, simulation, robotics and 3D printing are converging physical and digital operations, transforming the way we make things. The IoT connects separated processes across a single factory as well as across multiple factories in different locations. Workers are assisted by intelligence derived from data analytics to better collaborate with robots on the factory floor. And today small startups and even individuals can have access to the latest technology for making. In February 2016, Fujitsu opened TechShop Tokyo, in collaboration with TechShop, Inc. of the USA. This is a large-scale membership-based maker space. Individual members, startups and businesses create a community, and enjoy working on making, sharing the same space and a wide variety of tools including 3D printers.



TechShop Tokyo

*¹⁴ For detail please see Book 2 page 24, Customer Stories, "Advanced marketing in the new digital era: Rapid integration of dispersed data on customer attributes" Nikkei Business Publications, Inc.

*¹⁵ Lending money to individuals through online services that match lenders directly with borrowers.



Digital Business Platform

How can an organization realize these outcomes? A digital business platform is the key.

In the first and second digital waves, online B2C^{*16} platform service providers accomplished exponential growth. They provided services at low cost or even free, leveraging the scale of a shared digital business platform. Their platform services enabled a wide variety of third parties and even individuals to create innovative hardware products, software applications and services. For instance, smartphone apps are provided by countless developers around the world. In this way, an ecosystem is formed around a platform.

The third and fourth digital waves will have even greater impact on almost every industry. The IoT enables us to connect physical things, sense conditions, analyze the collected data, make a judgment and deliver automated responses. Advanced algorithms allow this process to be conducted much more autonomously and in real-time. Business leaders should think about how they can build and exploit a new type of digital business platform to enable their business to expand and thrive.

Businesses want IT to more directly drive business value affecting their top lines. A digital business platform is a holistic business framework that helps an organization in three ways. It enables them to

empower their employees, to use intelligence derived from data and algorithms, and to build fast, reliable connections both internally as well as with the external ecosystem of customers, suppliers and partners. The platform is data-oriented; it connects all the data within an organization as well as its customers. In addition, it must help an organization to build resilience against increasing threats to cyber and physical security.

In 2015, Fujitsu began providing a digital business platform, we call MetaArc. We named it from two Greek words, meaning 'Beyond' and 'Connections'. This comprehensive framework has been designed for our customers to enable their digital transformations. MetaArc is based on scalable cloud computing infrastructure. It is designed to offer the capabilities of mobile, IoT, data analytics, and AI as a service. By integrating these services, businesses can quickly and easily mash together new digital business solutions and services. Its cloud also enables a marketplace of services to help businesses form digital ecosystems with their partners via APIs. MetaArc offers resilience to businesses with its security functionality. Fujitsu is migrating all our existing business applications on to MetaArc and developing new solutions to operate as an integrated digital business.

*16 B2C: Business to Consumer

Digital Arenas

In the digitalized economy, the borders of existing industries are increasingly becoming blurred and fluid. Different digitalized products and services will be connected via APIs, exchanging information, and delivering greater value for people as a result. In this economy, value that consumers demand will be co-created by suppliers, partners and even the consumers themselves, via shared platforms. A huge amount of information crosses the existing boundaries, brought together, creating new knowledge. Embedded algorithms process information, enabling autonomous operations and empowering people. This is not a future scenario, but it is already happening.

Mobility

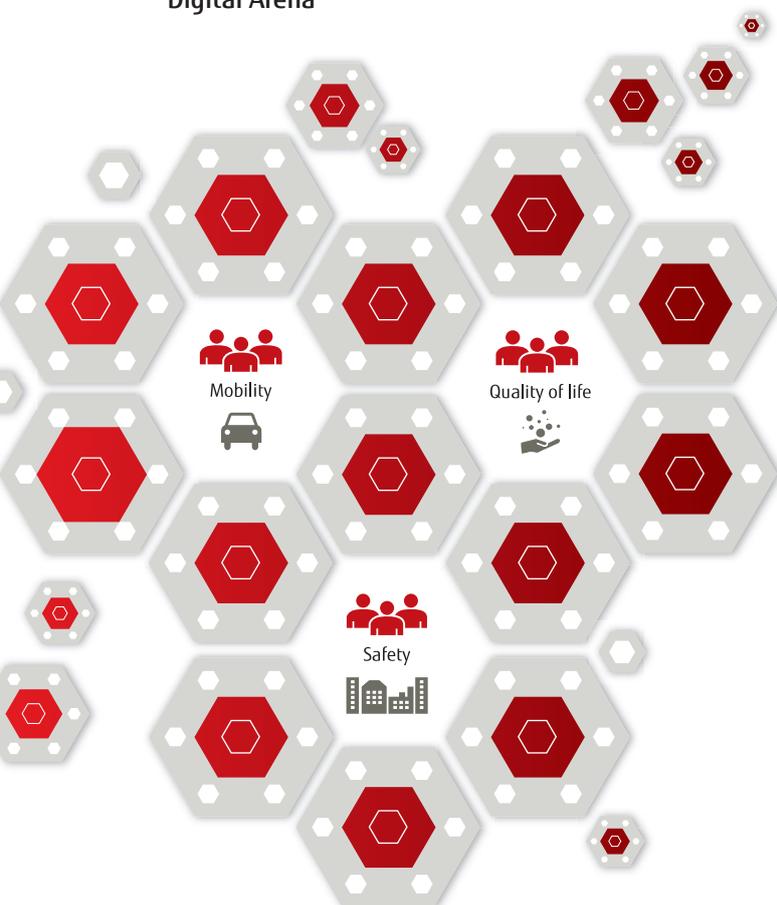
Today, it is said that 'distance is dead'. Yet at the same time location information is vital. Fujitsu has been providing a location information cloud service, called SPATIOWL, since 2011. This cloud service can collect

location information about vehicles, and people too, through sensors and ordinary smart devices, generating a real-time dynamic view of urban mobility. SPATIOWL can map additional layers of information, such as weather, shopping, parking spaces, fuel stations, or public services. It delivers insights through the analysis of multi-layered information. It is used as a shared platform for urban mobility, attracting service providers from across different industries.

Safety and security

Aioi Nissay Dowa Insurance is starting to use SPATIOWL to provide a driving assistance telematics service for their customers in April 2016. Location information can also be used for protecting personal security. Another of our customers, a personal safety service company, is providing a mobile personal security service using SPATIOWL. It enables them to look after vulnerable people like the elderly, children or people with disabilities. It uses sensing and analytics to recognize anomalies in their movements and behaviors, such as having a fall, and generates alerts in response.

Digital Arena



Quality of life

We want to live long but also enjoy a good quality of life. What people want is not just treatment of diseases when they suffer from them, but ongoing holistic support for living well. In an aging society this is becoming increasingly a priority. By connecting services across many different sectors and industries – healthcare, elderly care, pharmaceutical, and IT – we can deliver this. Now, patient medical records can be shared among doctors and professionals in different hospitals, clinics and elderly care facilities to provide more patient-centric services. Such information can be used for finding innovative treatments and drugs. In addition, daily behavioral information collected from wearables can be brought together, helping us live fuller lives. Fujitsu is working hard to connect and secure these different services, helping promote the wellbeing of people.

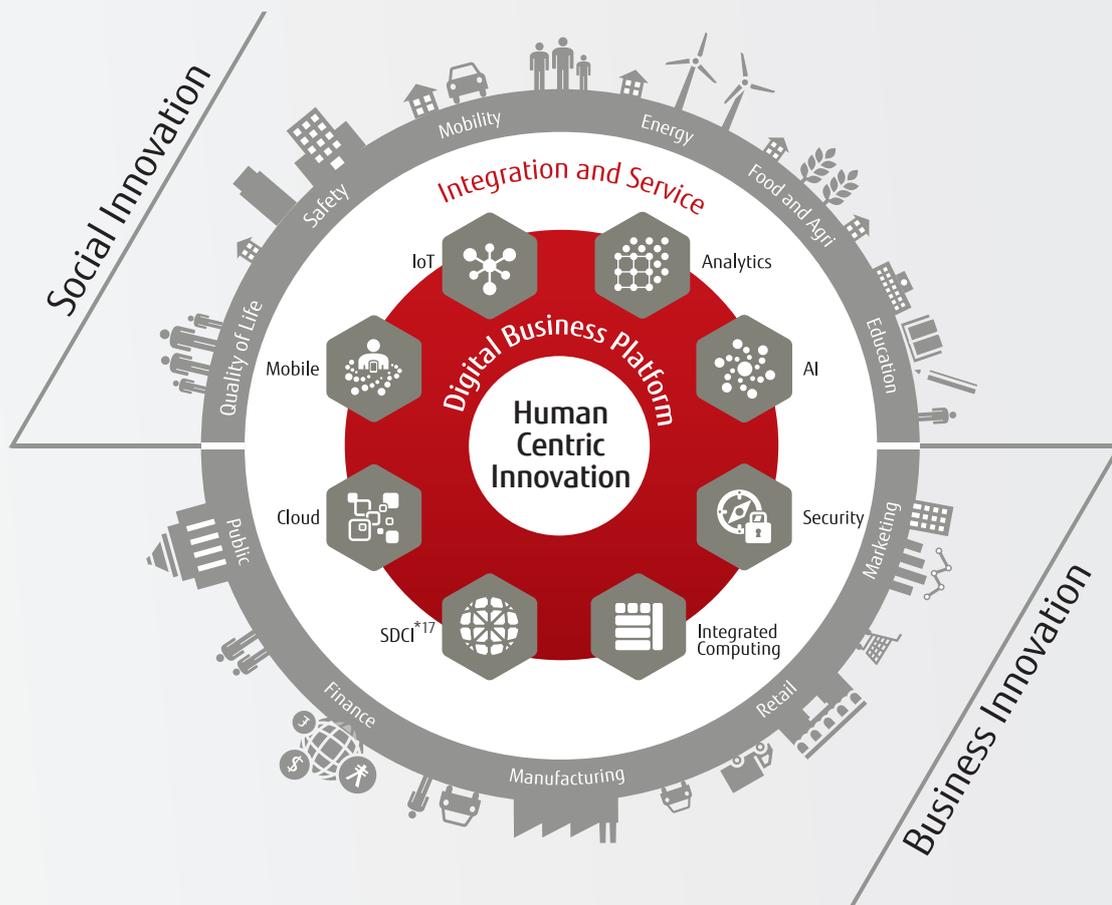
We believe the digitalized economy will be built based on such digital arenas. We will expand further on this in the next chapter.

Fujitsu's value

Fujitsu wants to be our customer's business partner, helping you drive your digital transformation.

- We provide a toolkit of technologies to meet your digital needs – cloud, mobile, IoT, data analytics, AI, and supporting security.
- We help our customers build and use their own digital business platform. To do this Fujitsu provides MetaArc that enables them to use these digital technologies and exploit them in their business.
- We also offer highly reliable computing and networking infrastructure that provides performance and resilience.
- We provide services which integrate these digital tools into the heart of the business and help our customers shape new ecosystems across industries, to ensure that business outcomes are delivered.

You can find more details of our technology portfolio and customer stories in Book 2 of Fujitsu Technology and Service Vision.



Who is Fujitsu?

- The 5th largest IT service provider in the world & the largest IT service provider in Japan
- We have 160,000 employees
- We have 121 datacenters and 74 service desks worldwide
- We were named in Fortune Magazine's 2016 list of "World's Most Admired Companies" for a fourth consecutive year
- We were chosen for the Dow Jones Sustainability World Index for the 16th Time in 2015

*17 Software-Defined Connected Infrastructure

Digital Future

Human Centric Intelligent Society

Intelligent software is exerting ever greater control over the physical world, changing everyday life and the landscape of the economy.

We believe the most critical mission of technology is to empower people, helping create a safer, more prosperous and sustainable future.



Dawn of a new era

What will be the major differences between today and the future?

Let's return to those four waves we introduced in Chapter 1. We might consider the first three waves as a process of digitalizing the physical world. The first wave – the internet – created a connected information infrastructure, the second wave – mobile internet – is digitalizing how people interact, and the third wave – IoT – is digitalizing physical objects.

As a result, we are living in an increasingly hyperconnected world.

So what is happening now?

These first three waves of digitalization will continue to expand and drive change. But now we enter a new phase of exploiting these vast digital resources. This will give us the opportunity to have greater control of the world around us, leveraging new insights and autonomous processes.

There are two major implications of this: Firstly, a new 'genus' of intelligent technologies is emerging. Our fourth digital wave. AI and robotics technologies are advancing rapidly, being used in many different situations, from self-driving cars to disaster prediction.

Secondly, a new type of digitalized economy will develop. We believe this new economy will be founded on the creativity of people, intelligence derived from data and the hyperconnectivity of digitalized services.

As a result, there is an enormous potential to make

the world work better. Because we now have the tools to do it.

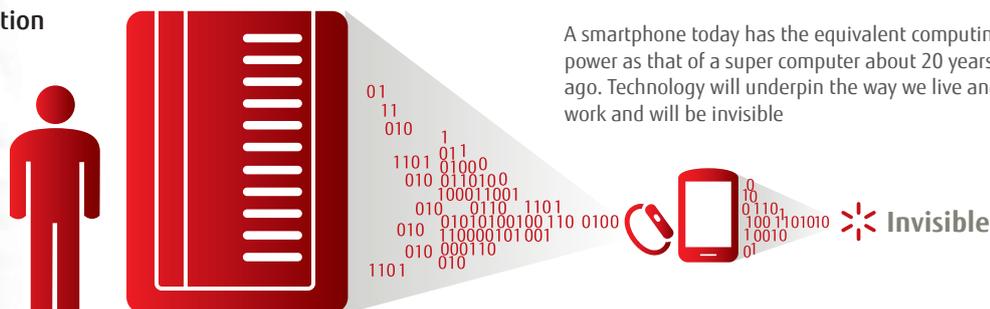
This is the final chapter in our story.

Exponential technology evolution

For those people who would prefer artificial intelligence to remain in the pages of science fiction, time is running out. Computing speed continues to accelerate, and incredible volumes of data can be handled instantly. At the same time, our understanding of how a human brain works is increasing, and we can apply this new knowledge to computing architecture. It is difficult to underestimate the impact the continued evolution of these technologies will have on the world.

In a project for the National Institute of Informatics of Japan, researchers of academic institutions and businesses are collaborating to develop a system (the "Todai Robot"), which, by 2021, will have the cognitive capability needed for admission to the University of Tokyo. The objective of this project is to assess how far AI can do the cognitive tasks we humans can do. Fujitsu Laboratory's researchers have been working in the math exam team. A query and answering system*¹⁸ may relatively easily answer simple questions asking facts, using machine learning and natural language recognition. But it is much more difficult to solve a math question – we have to use reasoning. Our reasoning technology helped the system to achieve a deviation value*¹⁹ exceeding 64.*²⁰ This is already at a level to pass math exams of many universities.

Technology Evolution



*¹⁸ Systems that automatically answer questions posed by humans in a natural language

*¹⁹ Scores that are expressed as differences (deviations) from the mean

*²⁰ A practice mathematics test for National Center for University Entrance Examinations

Human Centric AI

Human vs AI

AI is a core technology which enables many complex processes to be conducted independently of human judgment. Now, deep learning is often featured in the media. But it is not the whole story of AI, just an important piece of the puzzle. Our human cognition is continuously generated from complex interactions between our sensory organs, nervous system, brain and external environments. To achieve an AI, we have to replicate and bring together a range of cognitive capabilities: perceiving, reasoning, making choices, learning, communicating, and moving and manipulating.

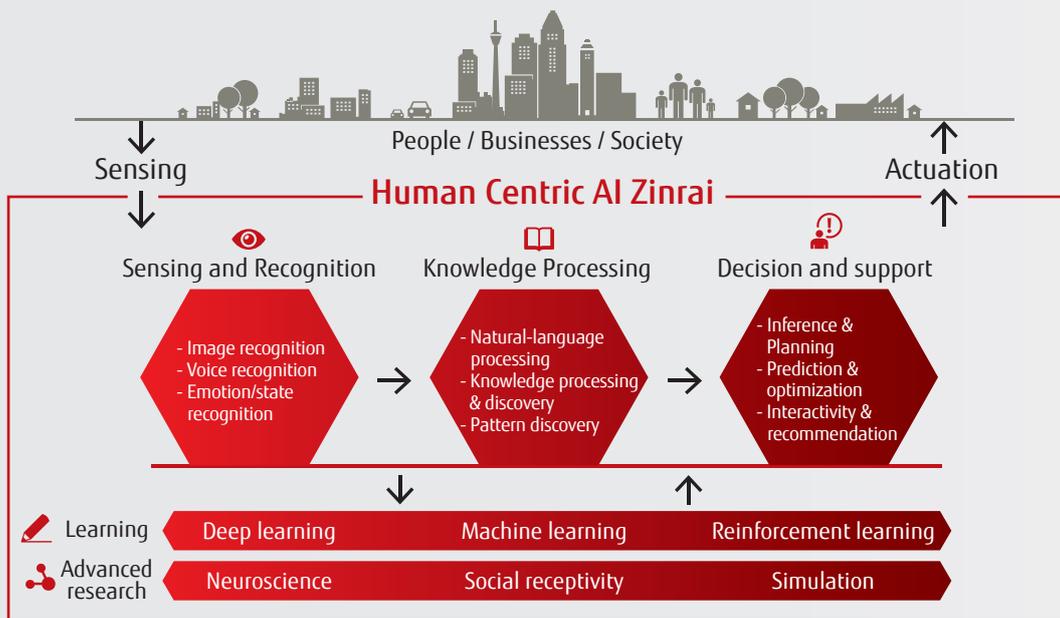
Fujitsu is developing key technologies under a comprehensive framework (see diagram). We call it Human Centric AI, Zinrai. Fujitsu is incorporating component technology such as machine learning, deep learning and visual recognition, into our digital solutions and services.

In February 2016, Fujitsu started a joint project with Coosy Inc., who operate Hapicana, the largest-scale e-commerce site of cosmetic goods and related information in Japan. Fujitsu applied deep learning to 50,000 face images, delivering

eight face types based on features such as shapes of contour, eyes, nose and lips as well as skin color. Using these models, we are working to develop a new service for advising on makeup and recommending cosmetic goods which best suit.

Thinking about what AI is leads us to look back on who we as humans are. We see, hear, smell, taste, touch and sense our world. Our sensory capability is incredible. For instance, our fingers can sense micron-level differences – which machinery cannot achieve. We feel happiness, sadness and a vast range of other emotions. We think intuitively. We are creative. We have a dynamic model of our world, channeled through names and meanings. With these capabilities we can understand the world around us and respond in the ways we need to. And most importantly, we live, work and play with other people. We sometimes hate and even fight each other, but also we laugh together, and love. In that way, we form society. All these are interactive functions of our mind, body and environment.

Computers will be able to understand our language, search through huge reserves of data and return most





useful advice instantly. They can recognize images much faster and even more accurately than we can. They can sense the world differently – for instance seeing ultra-violet light waves. Computers can do specific tasks much faster and accurately. But it will take a long time before computers and robots can respond to any situation as we can do so intuitively. Most importantly, it is unlikely that computers will ever have emotions, or the capacity to be inspired or creative.

Human Centric AI

Many people see AI as incompatible with human life. They see it as a rival to human intelligence, and many have been warning of the dangers of the technology. Fujitsu sees it differently. We believe that AI technologies will be complementary to people's lives. When it comes to AI, taking a human centric approach is more important than ever. The key will be to naturally integrate the technology into human activity – so as people can be saved from repetitive routine work, while at the same time be given maximum support in making decisions about the things that matter.

Fujitsu believes the most critical mission of technology is to empower people and help everyone live a fuller life. We are working to realize a future in which people and AI autonomously collaborate and achieve previously unthinkable breakthroughs. We call it Human Centric AI.

Of course, we shouldn't underestimate the potential impact of evolving technology on human jobs. A study of the Oxford University in 2013 reported that 47% of jobs in the United States are subject to replacement by machines within the next 20 years.*²¹ We have seen in the past how technology, such as factory automation, replaced jobs. However, we should also recognize the positive aspects of new technology. For example, the Internet has created a whole host of new jobs, that were unimaginable 20 years ago, from web designers to social media managers. People will have the opportunity to do more creative work, instead of being like cogs in an industrial process. Education for digital literacy and creativity will be of great importance. Now, many countries, including Japan, are facing the serious problem of aging populations and the decrease in the working-age population. AI and robots will be able to provide meaningful help for elderly people, and potentially fill this shortage in the workforce.

AI and robotics will be embedded in many facets of the hyperconnected world, changing business and the economy.

*²¹ Carl Benedikt Frey and Michael A. Osborne, Oxford University "The Future of Employment: How susceptible are jobs to computerisation?" 2013 (It is also estimated that 49% of jobs in Japan are potentially replaceable by AI or robots within the next 10 to 20 years. Nomura Research Institute, http://www.nri.com/Home/jp/news/2015/151202_1.aspx)

The Digitalized Economy

A consequence of a hyperconnected world is a different sort of economy.

The biggest change is how software is used to support business and society. Intelligent software, including algorithms and AI, is exerting ever greater influence over the physical world. It means we have the capability of connecting and controlling physical assets - appliances at home, cars and public transportation, factory machinery, energy infrastructure, and so on. It also means we have the potential to benefit from autonomous business operations.

In the pre-digitalized economy, physical assets like plant and machinery are mostly fixed. Businesses produce value by investing in and using those assets. In the digitalized economy, everything becomes more fluid. With the power of intelligent software, equipment, machinery and infrastructure will sense changes in environments and respond to them more autonomously.

But we shouldn't forget about people. People also interact with greater fluidity, openly collaborating with colleagues as well as people outside their organizations. Knowledge is brought together across industries and geographies.

The digitalized economy is therefore driven by the trio of people's creativity, intelligence derived from information and software, and the hyperconnectivity of things and services.

A Hyperconnected API Economy

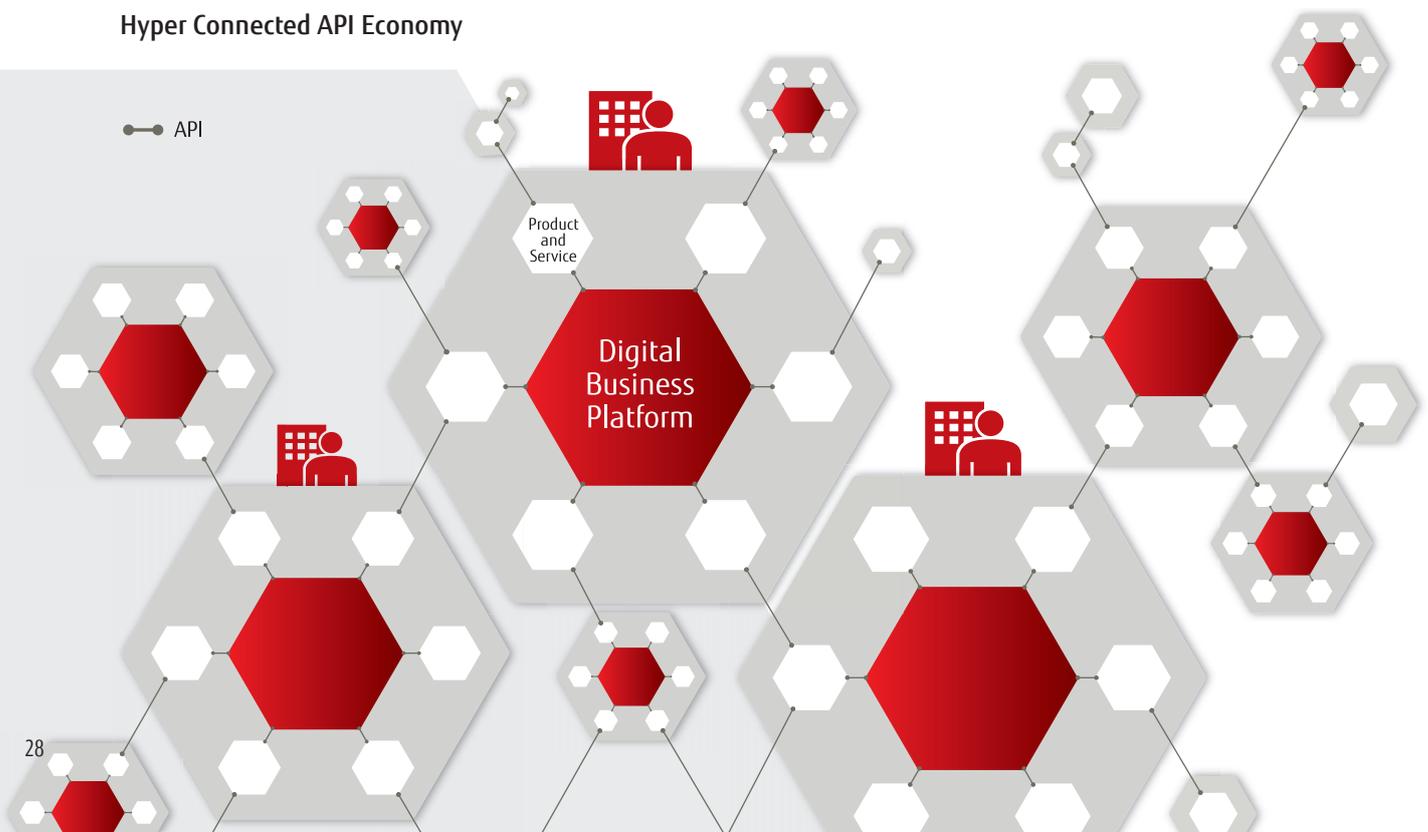
In the new economy, software is connected through APIs. The management of APIs becomes crucial. Instead of thinking of software as discrete and bounded, we must now think of it as modular and extendable. A module of such software is called a micro service. A variety of innovative services are designed, created and delivered by mashing up micro services available in the market. The development is very fast, and the creativity of people is the key.

Such connections may be intra-organization, in which case they would enable that organization to achieve greater efficiencies through automation. But services and processes can be further automated across intra-industry or inter-industry interfaces. Businesses from different industries can collaborate to co-create value.

How business works in the new economy

This hyperconnectivity paves the way for a new economic construct - the digital arena, as we discussed in Chapter 2. In an arena, a user and a supplier depart

Hyper Connected API Economy





from the simple relationship of buyer and seller. They co-create experience and outcomes through continuous engagement. Where industries are orientated around production activities, arenas are orientated around value and outcomes. Where industries are focused on products and services, arenas are focused on customer or citizen needs.

For businesses, it is important to set out a business architecture adapted to be part of a digital arena. This means consciously creating interfaces to the external world. The competitiveness of a business will be measured by the strength of its ecosystem, how many robust value-creating connections it has with partners through APIs.

This must be central to the strategy of the business. To be able to decide what is done privately and what is open and collaborative is a business decision at its most fundamental level. It requires a clear understanding of how the business is differentiated from competitors and creates value in its market. And especially, how the business plans to leverage its digital advantage in the future.

Trust

A further implication of the digitalized economy is that trust takes on a more important role. Who will allow a business to store and process their most private information, such as their vital health data, if the business is not trusted? Which company will allow a business partner to provide their customer a joint

service connected through APIs, if the partner's system security is questionable?

Without trust, it is difficult for businesses and public services to make vast amounts of information flow seamlessly and in a way that brings benefit. We should always ask whether use of technology is good for our life, people's privacy is well protected, and people will be better off. In this respect, it increasingly matters for businesses to align their business goals with the common good of society.

Human Centric Intelligent Society

We are facing serious social challenges. People in many areas still live in severe poverty, suffering from a shortage of food and water, and underdevelopment of social infrastructure, education and healthcare. People are increasingly living in cities, causing challenges of urban transportation and environmental protection. The average age of the population is becoming older in many countries, increasing medical costs and the burdens of supporting elderly people. Furthermore, climate change is a significant risk for all people. In addition to growth, we have to pay extra attention to sustainability of local communities, global society and the natural environment. Resilience to drastic changes, disasters and threats is one of the most needed capabilities. ICT has an important role to help solve these difficult challenges.

In 2015, the United Nations set out 17 Sustainable Development Goals. These can also serve as business goals. Fujitsu is working with our customers and partners to shape a sustainable society, contributing to some of these goals. The following are just a few examples:

Mitigation of natural disasters

In March 2011, a huge Tsunami hit the coastal area of Japan, which destroyed wide areas and killed many people. In response to this, Tohoku University and Fujitsu Laboratories have developed a tsunami model

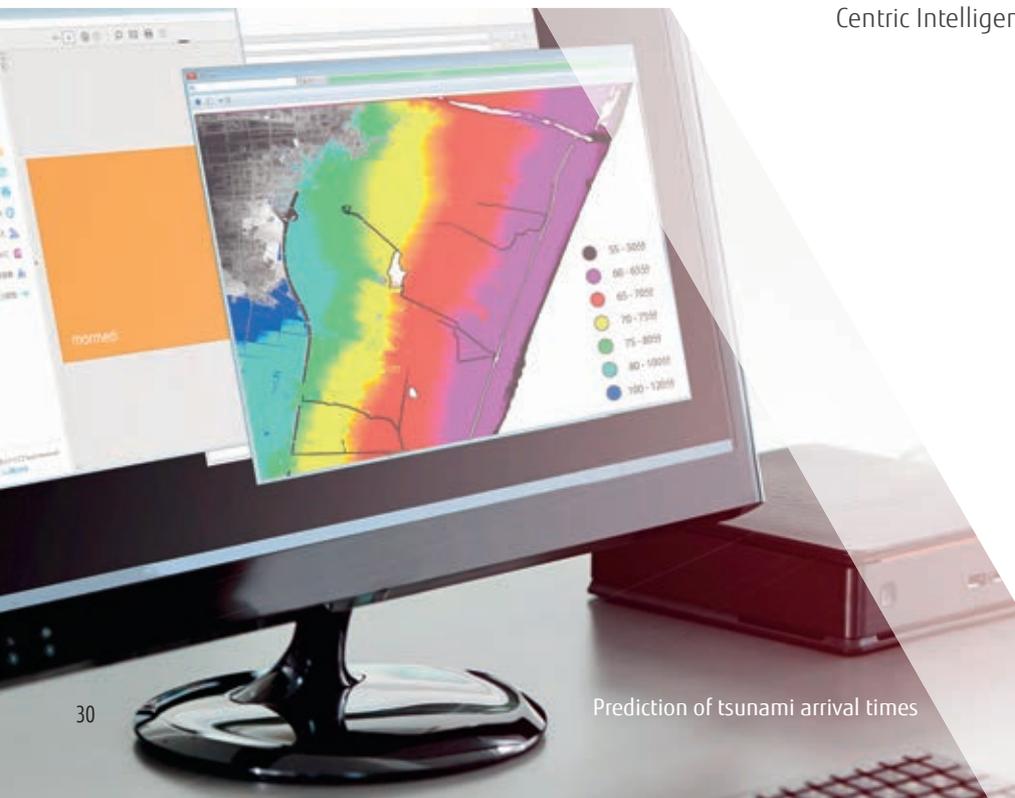
that can quickly predict the extent of potential flooding using a supercomputer simulation. For example, flooding in the Great East Japan Earthquake started in Sendai one hour after the earthquake struck. With this technology basic predictions of where flooding would occur in the City of Sendai can be provided in about 10 minutes.

Urbanization

Singapore is working to realize its vision of a Smart Nation. In 2015, the Agency of Science Technology and Research (A*STAR) together with Singapore Management University and Fujitsu, set up a Centre of Excellence(COE) to jointly research and develop solutions to realize a sustainable city. The COE identified two key areas to explore initially: Maritime and Port Optimization and Dynamic Mobility Management.*²² Fujitsu contributes high performance computing, SPATIOWL, our location information services platform, along with expertise in big data and mobility, working together with the partners using Singapore as a living laboratory.*²³

Our Vision

Now, we come back to the opening future scenarios. Technology is neither good nor bad. How people use it matters. It is each of us who make a choice. Fujitsu believes conscious collaboration by stakeholders will overcome the digital paradox, leading to a safer, more prosperous and sustainable world. We call it a Human Centric Intelligent Society.



Prediction of tsunami arrival times

*²² Examines and improves the dynamics of commuter traffic in urban spaces

*²³ For detail please see Book 2 page 38, Customer Stories, "Industry, Government and Academia establish partnership for sustainable urbanization" Agency for Science, Technology and Research (A*STAR), Singapore Management University



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