



Creating a Vision for a Sustainable Future

The world is changing beyond recognition. Society is increasingly demanding that companies address sustainability as part of their transformation to a post-pandemic world. Sustainability is now firmly on the C-Suite agenda and it's at the heart of NTT DATA's vision for the future.

Table of contents

Introduction - IOWN – a vision to create sustainable technology	3
Chapter 1: Artificial Intelligence and its Role in the Sustainable Revolution	8
Chapter 2: Gastronomy, Fishing and Sustainable Trading Using Blockchain	16
Chapter 3: Adaptive Design for a Future World	27
Chapter 4: Harnessing the Power of IoT	35
Chapter 5: Delivering the Future Faster	47

Follow Us: [NTT DATA](#) | [LinkedIn](#)

Join the Conversation: #DisruptiveInnovation
#SocialInnovation #Innovation

Connect With Our Experts:

AI – David.Pereira.Paz@everis.com

IoT – Wolfgang.Moeller@itelligence.de

Design – Antonio11.Grillo@nttdata.com

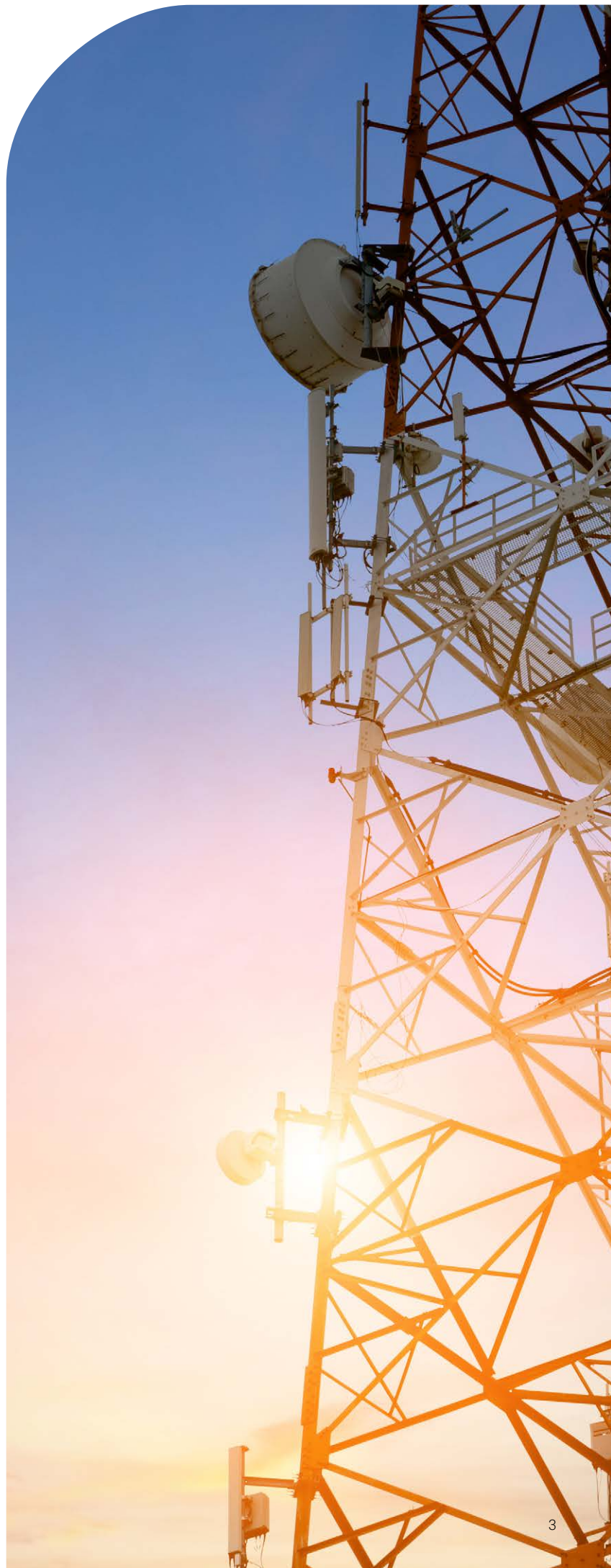
Blockchain – Roberto.Fernandez.Hergueta@everis.com

DevOps – Oliver.Koeth@nttdata.com

Introduction

Technology innovates at giddy speed every year, but 2020 proved to be an innovation leap year. It gave the world a new reason to take sustainability seriously. For much of 2020, planes were grounded and both international and domestic travel was curtailed. As a result, our carbon emissions dropped by an estimated [6.4%](#). This was significant but it is astonishing that even in a year when the world stood still, it's not enough to meet climate-change prevention targets. It is estimated that data centres currently use around 1% of all electricity generated globally. This is forecast to increase to over 8% by [2030](#). Some models predict that 20% of the global electricity production could be consumed by the ICT ecosystem by the mid-2030 since networks, personal devices and televisions are included.

We must look to technology for answers, and NTT DATA is ready to answer the call.





IOWN is a vision to create sustainable technology

IOWN is NTT's vision for fundamentally changing technology, delivering the communication infrastructure of the future. IOWN, or "Innovative Optical and Wireless Networks," reimagines the internet - some people call it 'the green internet'. IOWN transforms today's existing networks and data centres by introducing a new architecture that brings photonics into the chips.

The potential is huge.



REDUCE POWER CONSUMPTION BY

100 x



INCREASE TRANSMISSION CAPACITY
OF NETWORKS BY

125 x



LOWER END-TO-END LATENCY BY

200 x

IOWN is led by the IOWN Global Forum which guides the vision. There is a growing membership of the IOWN Global Forum, of which NTT, Intel and Sony are founding members and sponsor members include Cisco, Dell, Ericsson, Fujitsu, Microsoft, NEC, Toyota and Oracle.

We spoke with Dr. Masahisa Kawashima, Vice President, Head of IOWN Development Office & R&D Vision Group, Research and Development Planning Department, to find out more about IOWN.

What is your vision for IOWN and how did it come about?

“The more technology we invent, the more energy we consume. Technology has a lot of potential to help people, but we do not fully consider the environmental impacts of our use of technology. For instance, Internet of Things (IoT) and Artificial Intelligence (AI) are key digital technologies but they consume a huge amount of energy and increase data management demands exponentially. NTT has estimated that the AI inference software in each street camera consumes energy that’s the equivalent of one light bulb. There are currently 770 million cameras in use globally – now imagine all those as lightbulbs. We must change from constant to event-driven consumption.

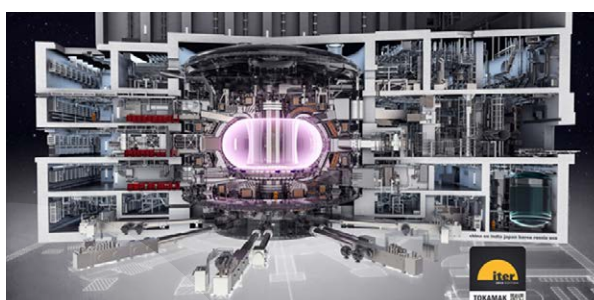
Long-term sustainability is a serious issue. I think we will soon see carbon taxes implemented in order to speed up the reduction of waste and emissions and to meet our climate change goals. The benefit of IOWN is that you will already be ahead – you will not be impacted by emissions penalties because your technology will already be carbon free.

We know from experience that electronics are good for processing and photonics (fibre optics) are good for sending data. The problem with current technology comes at the interface between the two, where we introduce latency and waste power in the conversion. We want to define a green return on investment, enable innovation for good and get smarter with no carbon emissions..

What is the alternative to IOWN? Is there an alternative?

“When we consider how to increase the speed of computing we cannot just think about upgrading specific components such as GPUs or adding Artificial Intelligence (AI) accelerators. This is because there is so much that is not optimum in a system. In simple terms, if you upgrade your GPU then your CPU might be overloaded. There are always bottlenecks. IOWN will redesign the total end-to-end architecture.


As an example, the Internet Protocol (IP) which underpins today’s internet is very inefficient, it traces its history to the 1970s and we still use it today. For IOWN we use a network protocol that is not based on IP. Upgrading the IP or TCP layer reduces latency.



NTT, IOWN, and fusion power

Fusion-based nuclear power has long-promised to give us clean nuclear energy without the downsides of fission-based nuclear energy. NTT is working with ITER to provide IOWN technology in the world’s largest ever nuclear fusion project set to launch in 2025. The core challenge with nuclear fusion is containing the reaction. By having the computing power and low latency infrastructure to model the plasma in real-time, we are better able to contain it. Solving this challenge holds great promise for green, renewable energy.

Read more: [Conclusion of a Cooperation Agreement with ITER](#)



Why is now the time for IOWN and are we really reaching the end of the road for silicon? How will photonics take over from silicon?

“People have been aware for some time of silicon’s limitations and have been looking for alternatives to bypass inherent bottlenecks in silicon chips. One of the breakthroughs came almost three years ago when NTT researchers, alongside university colleagues, discovered that they could map vibrations in molecules to photons in waveguides in a way that could represent a reprogrammable photonic chip. Photonics is not new. Today optical communication is used widely but usually inter-data centre or from premise to premise. By 2030 we will see more photonics expanded end-to-end – that means that photonics will come into the computer itself. Photonics will be used as an integral enabler in our daily lives. One challenge with today’s systems is that the hardware cannot be replaced. Protocols can’t be changed easily, and old hardware must be disposed of. That is why configurable hardware will be part of IOWN. We plan to use FPGA (programmable) chips so we can de-configure network interface cards and reprogramme the hardware with a more efficient protocol. Photonics will not replace silicon, but it will become integrated. That is the vision, it will be complementary to current technologies.

What’s the hardest technological hurdle to overcome?

“The most difficult part is the total networking infrastructure, replacing all the software stacks in networks and changing the security protocols. There are a lot of components to develop and the challenge is there is just too much work. We need a huge team of developers and this is why we established the IOWN Global Forum - to work with leading companies in this area. We know we cannot do it alone.

What has been the response from the market and companies signing up?

“We have been talking to the CTOs of network suppliers and Executives in large IT organisations. The common thread in our conversations is that the CTOs are aware of the inefficiencies of today’s architecture. They fully agree with our idea and are very supportive of our ambition to redefine the architecture and to create the new market. They appreciate NTT, as a service provider, taking this very important action. With this initiative, NTT aims to be the first mover in creating a technological revolution. This is creating real excitement within the company, with our partners and our clients.



How is the IOWN R&D being used across the group?

“IOWN is not just a vision, it’s a reality. We’re already using it across security, photonic network operations and for efficient AI computing. IOWN is already being deployed in smart city solutions like public safety where the IOWN is a key component of the infrastructure orchestration. It shows that you can create innovation without generating waste. For example, in Las Vegas, we set up a smart city solution that uses infrastructure orchestration and technologies that are core to IOWN. We are also using IOWN in sports. We have an ultra-reality viewing service for major league baseball that transmits high definition images, 12K wide, in real-time to a super-wide screen to recreate the atmosphere of watching a baseball game live from the stadium.

What are you most excited about on IOWN?

“When you think of technology innovation, you often think of Silicon Valley and the West Coast of America. While it is true that many innovative companies are based there, innovation is happening all over the world. IOWN is a global community of companies coming from Asia, Europe and North America. We are proud that so many members are contributing, and proud of NTT to be the first mover in this initiative. A traditional Japanese company’s CEO would take the second mover position, but our CEO Sawada-san (NTT CEO) has been leading us to take the first mover risk. We have a very exciting journey ahead of us.



Masahisa Kawashima
Vice President, Head of IOWN
Development Office



Chapter 1:

Artificial Intelligence and its Role in a Sustainable Revolution





AI in 2021 and Beyond

According to Gartner, the business value of Artificial Intelligence (AI) is **forecast to reach \$3.9 trillion in 2022**, and represents the most disruptive class of technologies of the next decade. Gartner expects the biggest contributor driving value to be AI Augmentation – where people and AI work together to enhance cognitive performance.

NTT DATA is at the forefront of this change, using AI to improve how its centres of excellence work. From using Machine Learning Operations (MLOps) in DevOps to AI-driven design to speed up the design process, AI is becoming an enabler that allows organisations to move more quickly and efficiently.

Transforming How We Work

AI is transforming the modern workplace. It is opening up new ways to connect and collaborate virtually from anywhere. It is reducing administrative burden with automation – and freeing up workers to focus on creative tasks and solve complex problems. One area being transformed is customer support services. According to research carried out by Juniper, **90% of bank related interactions will be automated by 2022**, largely driven by the rise of conversational AI. Banks are focusing on intelligent virtual assistants to simplify communications with their customers and



Mayte Hidalgo,
Head of AI Strategy at everis

“ At NTT DATA, we define AI as a technology that can generate value at speed for businesses, organisations, and society. It is a disruptive force that is changing the ways we can generate value across different sectors.”

to build long-lasting relationships. Robotic Process Automation (RPA) uses robot agents to automate repetitive tasks such as invoice processing. AI adds the ability to recognise patterns in a workflow, such as image or speech recognition.

Kris Fitzgerald,
Chief Technology Officer,
NTT DATA U.S.



“Automation is not about replacing human with machine or human agent with robot. It is about supporting human abilities and ingenuity. Automation enables people to do what they're best at: create and innovate.”

RPA helps to make businesses more sustainable, reducing the requirement to print documents, digitising processes such as purchase orders and receipts, and optimising complex processes such as supply chains.

AI and Healthcare

The use of AI in healthcare is a rapidly growing field. AI technology is helping to design new, innovative drugs, it is helping doctors with diagnosis, and it monitors patients undergoing treatment to improve patient outcomes. Rather than replace the work that doctors and clinicians do, AI supports and augments their work to help them make decisions and free up time.





NTT DATA and AI Diagnostic Imaging to detect Tuberculosis in India

Tuberculosis is one of the top ten causes of death worldwide, claiming 1.4 million lives in 2019. Ending the TB epidemic by 2030 is one of the health targets of the UN's sustainable development goals, which NTT has signed up to.

One of the challenges of eradicating TB is delays in diagnosis. This leads to greater severity for individual patients and further spread of the disease. Early detection of TB patients in areas with poor access to health care is critical.

NTT DATA has been conducting research, development, and verification testing for AI diagnostic imaging technology. It is working together with DeepTek and Microsoft to improve TB examinations in India, which has the most TB patients in the world, using a medical examination vehicle.

X-ray images are analysed using AI diagnostic imaging technologies, and when TB is suspected, clinicians are able to take appropriate action.

Smart Intensive Care

In Intensive Care Units (ICUs), the ability to constantly collect and analyse a patient's vital signs efficiently and accurately is critical. Patients require constant monitoring, and the quicker any changes or abnormalities are detected, the better the patient outcomes.

NTT DATA in Spain has been working with the Virgen del Rocío University Hospital, the largest ICU department in the region. Prior to working with NTT DATA, much of the recording of patients' vital signs was completed on paper, with information only being documented around every half an hour.

NTT DATA realised that in order to create an effective AI solution, a more comprehensive and detailed body of data was required. It began by building a data infrastructure. Data collectors were applied to machines operating within the unit, monitoring all types of vital signs and taking a measurement every second. This data was digitised and stored online, and then used to help develop use cases after consultation with medical experts.

Once established, a machine learning model was created that could predict complications and inform doctors at an early stage. Septic shock, rapid drops in blood pressure and hypoxemia were just some of the conditions that could be detected with the technology, leading to faster recovery and helping to save lives.

Adil Moujahid,
Technical Manager at the AI
Centre of Excellence, everis



“ The project was made possible by collaboration. AI specialists from Japan led the project, liaising with medical experts in Spain to help devise an AI solution with tangible societal benefits. It is an example of ‘glocalism’ in action, where innovation from one side of the world is realised and applied on the other.”



Fernando Apezteguía,
Head of Health
at NTT Disruption



“Virtual Patient Observation serves as a milestone to transform healthcare institutions into smart hospitals aimed at making people’s lives better and safer.”

Virtual Patient Observations

The pandemic has brought a huge amount of pressure on medical professionals. With resources stretched, how could AI be used to help doctors and nurses meet the challenge?

NTT Disruption partnered with Xilinx to help address this pressing problem. Together they developed an AI solution using the Alveo acceleration platform to create the Virtual Patient Observation solution.

It runs event detection inference models on video streams that monitor ICU beds. When a critical event occurs, such as an IV line being removed or a patient falling out of bed, the technology sends real-time alerts to healthcare practitioners. Nurses can also use the solution to request assistance when needed.

The solution is non-intrusive, easy to use and helps safeguard the privacy of the patient by processing the footage in real-time, removing the need for storage.

With the help of NTT DATA Brazil, the VPO solution is being tested at the Heart Institute InCor University of São Paulo Medical School, one of the world’s most recognised centres of cardio and clinical excellence in cardio pneumology. The solution helps ease pressure on medical practitioners without sacrificing the round-the-clock care needed in ICU units.

Ethics and AI – From Plato to Python

When discussing the potential of AI, ethical concerns need to be considered. In October 2020, a study conducted by NTT DATA and Oxford Economics found that business leaders were vastly underestimating the ethical challenges presented by the technology. Ethics can often seem intangible. Business leaders need to be able to take a seemingly abstract concept and translate the principles into an actionable framework for an organisation.

At NTT DATA, we have formulated AI guidelines that are aligned with the principles of the United Nations’ Sustainable Development Goals. They help shape our actions and ensure innovations within AI are modelled with sustainability, diversity, and inclusivity in mind.

Ethics throughout the process

As machines increasingly make decisions, we must also pay more attention to the decision-making process to ensure it stands up to scrutiny. NTT DATA is leading the way with AI ethics. In 2019 we published our [AI Guidelines](#) to ensure we pay close attention to the potential harm machine-derived decisions could cause.

In order to fully embed ethical concerns in AI development, it is important to ensure it is considered at every stage of the AI lifecycle. At NTT DATA, we have developed a checklist for all stakeholders involved in the process. This process recommends actions to take at each stage. For example, at the business identification stage, we suggest to stakeholders that they consider if the proposed initiative will impact a particular group of the population, extend human capabilities, and whether it is set to replace a human action. During the development stage, it is vital to guarantee privacy and protect against bias in the data selection. The potential underrepresentation or non-existence of elements of the population needs to be considered. The best way to achieve this is to view the quality of the AI solution as an ethical concept. AI is like an employee and should be treated as such when it comes to behaviour. Ensuring the technology meets the required quality allows businesses to align the behaviour of the solution with their own values.

AI for good

NTT DATA's approach to ethics goes beyond AI being explainable. Whilst it is important to be able to make the technology understandable, having a system that questions the ethical consequences of decisions throughout the lifecycle is key to ensuring AI solutions work for the betterment of society. Such measures, when coupled with transparency, mean AI can be used to elevate human capabilities.

AI systems are often seen as an impenetrable black box. At Ensō, NTT Group's first innovation and co-creation space in Europe, we demystify the process. 'Explainable AI' gives insights into the black box of machine learning, and the rationale for its deductions.

NTT DATA Group's AI Guidelines

- 1. REALIZING WELL-BEING AND SUSTAINABILITY OF SOCIETY** - AI should empower humans by supporting their lives and extending their capabilities.
- 2. CO-CREATING NEW VALUES BY AI** - NTT DATA strives to harness the potential benefits of AI and promote innovation by interacting and co-creating with AI stakeholders.
- 3. FAIR, RELIABLE, AND EXPLAINABLE AI** - NTT DATA invests in ensuring decisions can be understood by humans and don't cause unfair discrimination.
- 4. DATA PROTECTION** - Privacy and security is critical to NTT DATA in providing AI services.
- 5. CONTRIBUTION TO DISSEMINATION OF SOUND AI** - NTT DATA will work to further the understanding of AI in order to accelerate its acceptance.

Mayte Hidalgo,
Head of AI Strategy at everis



“Our view is to leverage ethics on real projects, to make AI more explainable for all stakeholders, and to eliminate any discrimination from the process. We support all organisations with our well-defined approach, helping them explain to their employees what AI ethics is all about, and provide specific training to help them implement these values into the lifecycle..”

Understanding why the AI delivered any given outcome or directive is essential to quantify if the system is trustworthy (indeed, whether it's trusted by the users is a key success factor). An overall detailed understanding of how the system is set-up, and a clear view of the advocacy of the data being used, is the foundation of trust.

Diana Hauser,
Innovation Lab Manager &
Head of Lean Innovation at
NTT DATA DACH



“ Ethical standards should be in the DNA of a company to ensure every step taken on the road to innovation is taken thoughtfully... These changes are fundamental to every business that wants to continue to innovate.”

Conclusion

AI is driving the fourth Industrial Revolution

In 2016, the theme of the World Economic Forum meeting in Davos was “Mastering the Fourth Industrial Revolution,” describing automation through smart technology as the fourth industrial revolution. Five years later, it is clear that of all the technologies described, it is AI that is the driver of this industrial revolution. Even though the technology is still early in its maturity, the benefits are already being realised. Digital transformation is here to stay.

Through IOWN, AI will be able to be applied in more situations, and with more processing power behind it. Our homes and cities will become smarter and more sustainable. We will be able to realise the full potential of the fourth industrial revolution without damaging our fragile environment.



Chapter 2:

Gastronomy, Fishing and Sustainable Trading Using Blockchain

Introduction

Few technologies have generated as much hype and excitement as blockchain. Despite being barely over a decade old, blockchain and distributed ledger technology have already been identified as the most disruptive technological advancements of the 21st century.

According to the Gartner Hype Cycle for Blockchain Technologies 2020, blockchain has entered a quiet period - the 'trough of disillusionment' - but within two years will move to the 'slope of enlightenment' as the "optimised convergence of private and public blockchains" emerges. Driving this is the use of private blockchains and their ability to strengthen and validate supply chains. Companies are now exploring the art of the possible, even though many projects are in their infancy.

Forrester remarked in a recent note that the speed of enterprise projects with a tangible benefit attached to them is accelerating. The analyst firm predicts that more blockchain projects than ever before will move from the experimental phase into production in 2021. Organisations are beginning to see real value from the technology. As we'll see in examples of NTT DATA's work over the next few pages, some of the most exciting projects in blockchain are those that work across borders and support the sustainable agenda.

Jorge Lesmes,
Global Head of everis Blockchain
Banking Practice,



Identified three criteria for the successful application of blockchain technology:

1. There are multiple parties who are involved in a process
2. There is a lack of trust (or potential lack of trust) between counterparties in a process
3. There is opacity within a given process



Traceability and Blocktrace

Do we really know the provenance of our food and goods?

Now more than ever, businesses need to be transparent about where their products come from. Traceability is a priority for all businesses involved in the supply chain, yet progress is being held back by antiquated methods. Data is still manually inputted in many supply chains, increasing the chance of human error and inevitably incurring costs down the line. Trust is an issue between upstream and downstream companies, making data sharing problematic. Blockchain offers a standardised and trustworthy solution to this problem.

NTT DATA has devised a BlockTrace system. Built on a notarisation model, BlockTrace is designed to help track material through every stage of the supply chain.

Jorge Lesmes,
Global Head of Blockchain
Banking Practice at everis UK



“ Trust is the key thing. With computer code there are no trust issues, it just does what you tell it to. Trust is an issue for businesses because it always involves an element of risk. Blockchain can help remove this necessity.”

Blockchain For Good: Alleviating Food Poverty With BlockTrace – A Case Study

Part of the innovation process at NTT DATA involves discussing how technologies such as blockchain can help perform social good. For NTT DATA Italia, it became clear that food loss and redistribution was a pressing issue both locally and on a global scale.

A 2017 report by Eurispes, the Italian Institute of Political, Economic and Social Studies, found that close to half the families that participated struggled to provide food consistently month to month. In order to help remedy this problem, the BlockTrace4Sharing platform was born.

In Italy, retailers are rewarded for efficient food donation through tax reliefs. BlockTrace4Sharing provided these donors with the appropriate tool to certify their donation and distribution process, using a notarisation tool to reduce potential fraud. This streamlined the donation process, allowing more food to reach those families that need it most whilst also reducing food waste from retailers.



Maria Vittoria Trussoni,
Technology Strategist and Champion of Sustainability Goals at NTT DATA Italia



“ We have plans for a national roll-out of BlockTrace across Italy by May 2021, a little later than expected due to barriers created by the pandemic but it is coming soon. Beyond that we hope to look internationally. We’ve had conversations with one of the largest foodbanks in Japan, with the hope of replicating the project with an innovative business and operational model. This is a huge challenge but one we can’t wait to rise to.”



Sustainability via traceability

Visibility in the supply chain remains a problem. As consumers increasingly expect to know the details of how products are sourced and delivered, businesses are looking to blockchain to provide solutions.

In South America, NTT DATA has been developing blockchain solutions for one of the largest fishing companies in Ecuador. All of the companies' fish is exported to either North America or Europe, with a supply chain that can often involve up to ten different organisations. NTT DATA has used the Hyperledger fabric framework to provide a means of tracing every element of this supply chain. The result was the creation of IoTrace, a blockchain system that manages traceability in a comprehensive and secure fashion.

One of the key components of IoTrace is its ability to trace sustainability. It incorporates information on fishing coordinates, what kind of tools were used in the process, what kind of boat was used and even certification of each fisherman's employment contracts. The blockchain platform logs timestamps of all this sustainability data.

Looking to the future, brands and supermarkets will be able to offer QR codes to provide consumers with detailed information about the food on their plates, linking this information with the product's sustainability footprint and its certification history.

Sustainable Trade

One of the key areas where blockchain can help businesses innovate is trade. A large number of the internal processes in international business remain antiquated. Essential tasks such as archiving documents, inputting data and communicating with regulators are still done on paper, making authentication a laborious and inefficient process. This is further exacerbated by the storage of key information across different fragmented systems, which carries a security risk in terms of the falsification or tampering of documents.

Blockchain technology can be used to help address these problems. It can dramatically streamline the process of sharing information between stakeholders in a secure fashion, and help businesses digitise whilst maintaining transparency.





Tradewaltz- A Case Study

NTT DATA is working with its business partners to create a new trade eco-system to overcome potential for fraud. This began with the establishment of a trade consortium in August 2017, bringing together fourteen of Japan's leading companies in the fields of banking, insurance and shipping. With NTT DATA acting as secretariat, the consortium is creating blockchain-based proof of concepts for a number of use-cases.

In banking, blockchain helps reduce the risk of theft whilst also cutting lead time and mailing costs. Insurance companies could mitigate the risks of double payment and also simplify their documentation. Importers and exporters could reduce demurrage and prevent bill of lading crises.

In April 2020, this work led to the development of the TradeWaltz platform. The platform allowed members of the consortium to centrally digitise all their trading operations, cutting workload by up to 50%.

Imagine four different countries are engaging in trade. The TradeWaltz platform allows these users to deploy data within their own country whilst maintaining security and data synchronisation. There is no need to replace the current system, as it can be connected to the TradeWaltz platform using an API.

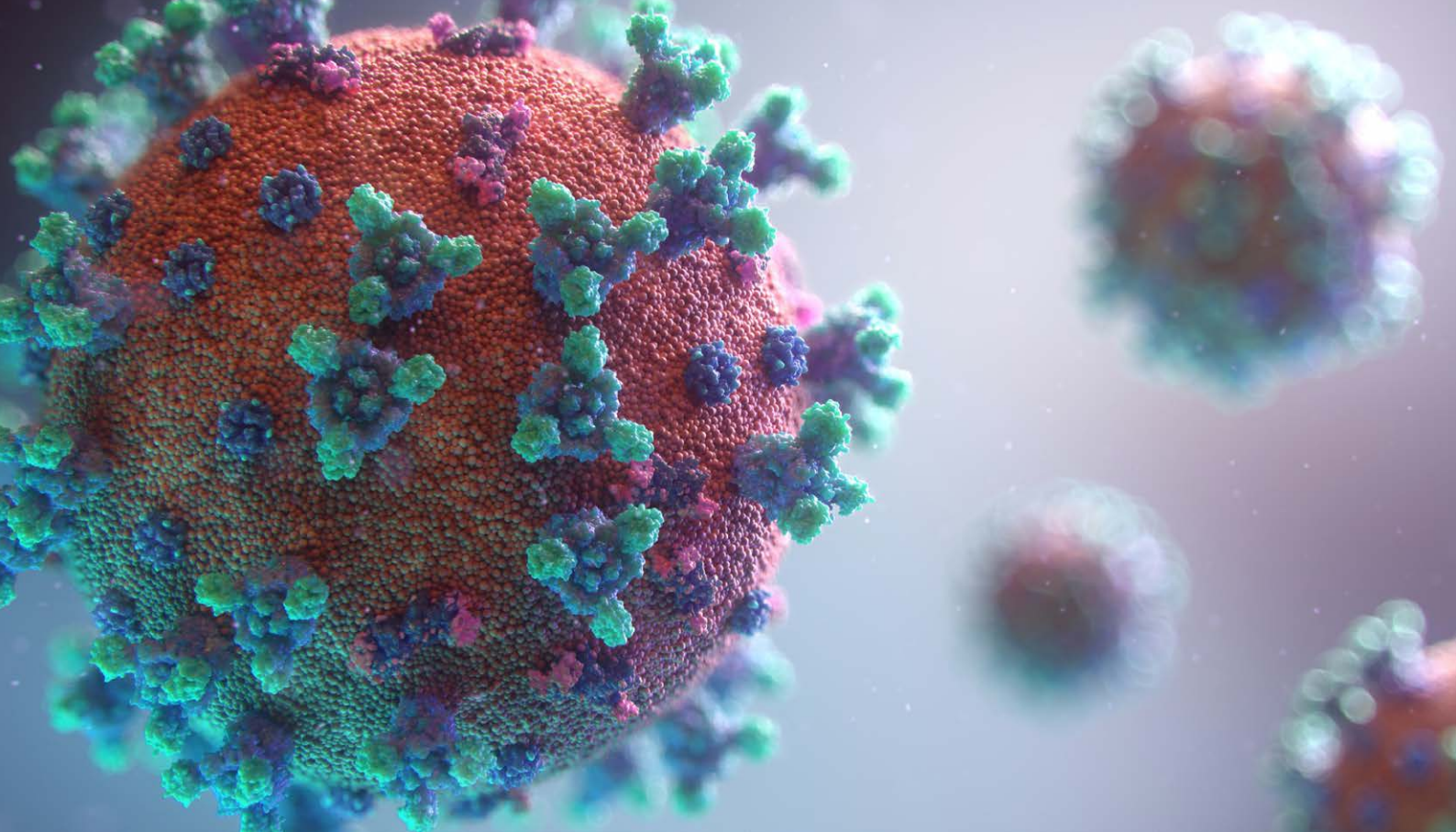
Free from the limitations of creating paper trails, a 'ubiquitous original' can be created and shared with all stakeholders in a secure manner. The next

steps will involve a sequential rollout of the platform, ensuring it is able to adapt and evolve in line with specific needs. Looking further ahead, it has the potential to connect government agencies with service providers and all other stakeholders, digitising their documents in a secure and efficient way.

Hisashi Matsunaga,

Executive Vice President and Director, NTT DATA Corporation

“Trade is one of the most important areas of the transition to digitalisation. TradeWaltz is a revolutionary platform that incorporates blockchain technology, and I am delighted that we have been able to gather cross-industry expertise to deliver it to the world. NTT DATA will continue to support this business's development both in Japan and around the world, and we will make our best effort to stimulate the growth of new social infrastructure in the digital age.”



Blockchain and the pandemic

The COVID-19 pandemic has forced healthcare institutions to engage in adaptation and innovation with unprecedented pace. NTT DATA has worked with healthcare provider LSI Medience Corporation to create an electronic certificate issuing service for COVID-19 test results.

The aim of the service is to use blockchain technology so that companies can receive their employee's test results in a secure manner, helping them manage the return to office and overseas working in a safe way.

Employees are given a PCR (polymerase chain reaction) test, which is then used to create a digital certificate of health for both employee and employer. The system was trialled in September 2020 and is being rolled out more widely in 2021.

The use of blockchain in the pandemic response does not stop there. As an unprecedented vaccine rollout begins across the world, the technology is being used to help monitor storage and supply in the UK. By using blockchain, hospitals can ensure the data on vaccine storage is verified and accurate, ensuring the vaccine is safe and effective as it is rolled out.

Blockchain for Energy Conservation

Blockchain is a powerful technology for peer to peer power trading, removing the need for a middleman when exchanging energy securely and transparently between producers and consumers. By cutting administrative overheads and costs to a minimum, even private homes with solar panels on their roof can sell energy to their neighbours for consumption or storage in a wall battery or electric car battery. This helps to balance the electricity network and reduces reliance (and power losses) on high voltage transmission lines and substations.

In Japan, NTT DATA has been harnessing blockchain for use in smart grids and electric power system transformation. Based on the public Ethereum platform, it demonstrated blockchain-based P2P power trading.



Sustainable Finance

Blockchain and financial services are natural partners. The technology offers clear solutions to banking and financial institutions that can increase efficiency and reduce costs for consumers. One of the most exciting recent innovations involves cross-border international payments.

In many countries emigration rates have risen over recent years as people seek better paid jobs abroad. This has led to a subsequent increase in remittance payments as foreign workers send the money they've earned back to their families at home.

In Chile alone, the number of remittance payments doubled between 2017 and 2018. Existing international payment networks such as SWIFT are not well placed to cater to this demand; transactions are traditionally subject to high service charges relative to the amount being transferred and poor exchange rates. Blockchain technology is being used to address this problem.

Transbank, one of Chile's leading bank transfer support companies, approached NTT DATA to build a solution that uses blockchain technology to help

streamline international payments. The solution allowed the bank to provide remittances services over blockchain by converting fiat payments into bitcoin then back into fiat, as opposed to completing multiple fiat-to-fiat conversions. By using bitcoin as an underlying asset, the solution was able to transfer the payment internationally at nominal cost.

As the bitcoins were not held for a meaningful length of time since transfers were instantly liquidated into native currency, any issues around potential volatility were mitigated.

Blockchain makes the remittance process smoother and cheaper for foreign workers looking to transfer money to their families back home. The technology is being embraced by younger generations in particular who are less wedded to the big brands in banking, and as it becomes more normalised banks will need to cater for these consumer demands or risk losing them in the future.



Blockchain and gastronomic wellbeing

Taste is not only one of life's greatest pleasures, but also plays a vital role in our general wellbeing.

At the recent NTT R&D Forum, NTT unveiled an innovative way of leveraging blockchain technology in the field of gastronomy. By utilising the digital archiving potential of blockchain, the intricacies of Japanese food culture can be analysed and then used to form personalised recommendations for individuals.

For this project NTT collaborated with the All Japan Food Association, an organisation which seeks to promote Japanese food culture, and Ritsumeikan University, which has a wealth of knowledge on the relationship between humans and eating.

NTT began by leveraging blockchain technology to create a digital archive of finished dishes and every detail of the cooking process that led to their creation. This was complimented by an analysis of good taste, taken from psychological studies and the more general history of our relationship with food.

The technology can not only assist in the reproduction of dishes and help foster culinary innovation but can also help the elderly recreate forgotten tastes and flavours.

Looking to the future, this technology has potential to help individuals find a balance between good taste and good health, offering personalised recommendations that are infused with Japan's rich culinary history.

Carbon Trading

The UN and the World Bank are promoting the development of financial solutions which can reward economic efforts undertaken by sustainable leaders. This allows them to generate Carbon credits, which in turn can be purchased by less sustainable organizations in order to compensate for their carbon footprint.

Standard software solutions can do the job. However, reaching the required levels of security, and assuring that fair play is attained at the trading platform, will imply a significant increase in both the cost of development and platform maintenance. This is where blockchain can add a differential value.

Blockchain guarantees a more efficient technological approach and can deliver the most important component of a Carbon Credit trading platform, the avoidance of CO2 emission reductions double counting.

Blockchain for Carbon Emissions Trading

NTT DATA partnered with Bankia, a major financial institution, and AENOR, a multinational Certification Agency accredited by the UN, in order to develop a Carbon Credit emissions trading platform.

The platform allows promoters of sustainable projects to upload their projects' information to the registry, triggering an automated validation process that determines whether the project can generate carbon credits.

Once a project is validated, the certification agency calculates and verifies the number of credits the project generates per period of time, triggering the automatic generation of the Non Fungible Tokens which represent the certified emissions, owned & priced by the project promoter, and linked to the promoter company bank account.

The market place allows investor companies to access the platform after undergoing a KYC ("Know Your Customer") process and purchase generated tokens using their standard bank accounts. If investor companies wish to cancel their carbon footprint, they can do so by uploading their production data to the CO2 footprint calculation module and then trigger the corresponding certification process.

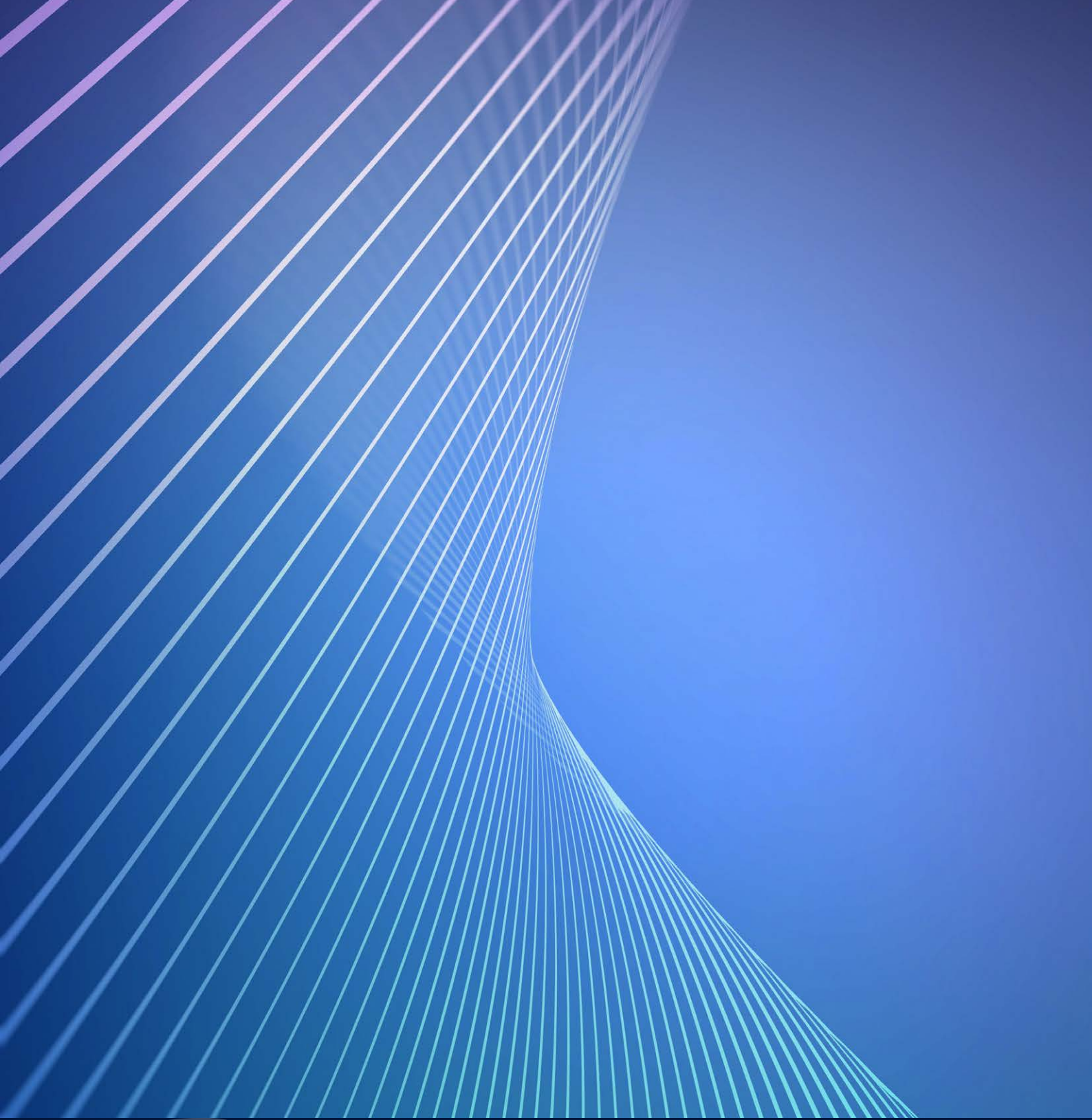
Regulators and authorities can trace the generation and further trading of the emissions credits, allowing for strict control of the market, avoidance of unlawful or improper practices, and for future enhancements of the regulation based on analysis of the trading history.



Conclusion

It is clear that blockchain has moved well beyond its roots. Both businesses and governments are realising the potential of the technology and applying it to use-cases we couldn't have predicted at its inception.

From international remittances to alleviating food poverty, blockchain has the potential to be a force for good. NTT DATA is at the forefront of developing the solutions to make this possible.



Chapter 3:

Adaptive Design for a Future World



Introduction

Antonio Grillo,
Service Design and
User Experience Director at Tangity,
NTT DATA



“ In designing an object, you are designing a way of being.”

The world of design is changing. Increasingly we are designing systems that minimise human effort through automation and this makes every touchpoint even more important. Collaboration is key – when we design together, we create solutions that last.

NTT DATA's network of design studios employ designers who are encouraged to consider how innovation in design can benefit specific societal causes. To help achieve this, the 20/80 project was launched. Under the programme, designers can present an idea of how their work could be used to benefit a humanistic non-profit project, and then devote 20% of their time at work towards making it a reality.

In line with NTT DATA's vision of using teamwork and foresight to help build a better society, the 20/80 projects inspire our designers and enable them to bring about positive changes in society.

Antonio Grillo,
Service Design and
User Experience Director at Tangity,
NTT DATA



“ The role of design within NTT DATA is to orchestrate our capabilities. NTT DATA is a giant of a tech innovator. Our role as a designer is to humanise the technology. We need to preserve a good connection between human beings and technology because technology is accelerating faster than our human capability to adapt.”



“ Every child or adult with autism as unique characteristics. When a teacher is replaced, it’s difficult for them to manage.”

Paola Golzi,
Associazione Nazionale
Genitori Soggetti Autistici

20:80 in Action - Artificial Intelligence Design For Autism

The AIDA project demonstrates the potential of 20/80.

Children with Autism Spectrum Disorder (ASD) can find it hard to communicate. Every child with ASD has a unique way of interacting with the world, meaning a one-size-fits-all approach doesn't work. A personalised solution is needed to help caregivers and educators.

The AIDA project was born to help with this problem. Using the latest developments in AI the team developed a solution that helps caregivers better cater to the individual needs of every child with autism.

Given the sensitive nature of the project, a human-centred design approach was vital and we needed to fully consider ethical AI risks within our programming. A design error in the machine could potentially trigger a child's crisis. It was imperative that the user research was as thorough as possible.

The NTT DATA team adopted three rules for their approach:

1. Involve domain experts
2. Build a collaborative approach between technology such as AI and design
3. Always test with users

Having identified a problem to solve, the team needed quantitative data to train the AI model. In order for this to work efficiently, they created the machine input/output model illustrated below.

INPUTS	OUTPUTS
Child's preferences	Best communication methods
Known/new situation for the child	Best tool and methods
Crisis/non crisis state	Calming sounds
In case of crisis, what the child is doing	How to manage sounds
Known/unknown people	How to manage temperature
Child's kind of communication	How to protect them being hurt
Caregivers' kind of communication	How to structure environment
Sounds	Kind of communication (verbal/not verbal)
Environment	Example of preferred things
Communication effectiveness	Example of preferred activities
Used tool	



It was vital to consider user bias when collecting information for input. A parent's vision and method may differ greatly from that of an educator, and this diversity of opinion could create biases within the AI system. To tackle this, they adopted a weighted decision threshold system that took into consideration the different biases parents or educators may have in areas such as communication, autonomy and learning ability.

In 2020, NTT DATA developed a scalable app as a tool to help with communication among ASD children. By gathering information on the unique characteristics of the child, the technology used AI to help provide consistency in communication between caregivers at school and parents at home. The app was selected by UNESCO for mobile learning week and was recognised for its focus on creating a more inclusive educational environment.

Precision navigation for the visually impaired

For someone who is visually impaired, navigating something as loud as a 20,000-seater stadium is a nerve-racking undertaking. Independence is important for everyone, and technological innovation means there is more we can do to help those who struggle with sight in achieving this. In 2020, the NTT DATA team in London worked with Locatify on a proof of concept to help.

An app was developed, installed with an ultra-wideband infrastructure that can communicate a user's real-time location information with 30cm accuracy. This represents the most precise indoor positioning technology currently on the market. The app uses a Haptic Feedback Device to provide the user with instant prompts, helping them to navigate every turn. The UWB positioning data is passed to a Locatify app, which then uses this information to communicate directions for the user.

The app can successfully guide a user all the way from the gate through to their seat. The 3D positioning of the user required for this to work represents a huge innovation with the technology and has the potential to be applied in numerous other areas.



Digital Twin and Smart Cities

The Digital Twin Computing Initiative creates a virtual mirror world where humans and things interact in a manner reflecting reality. The potential to predict future scenarios and test cases within them offers huge opportunity in designing and building innovative new services and solving critical social issues.

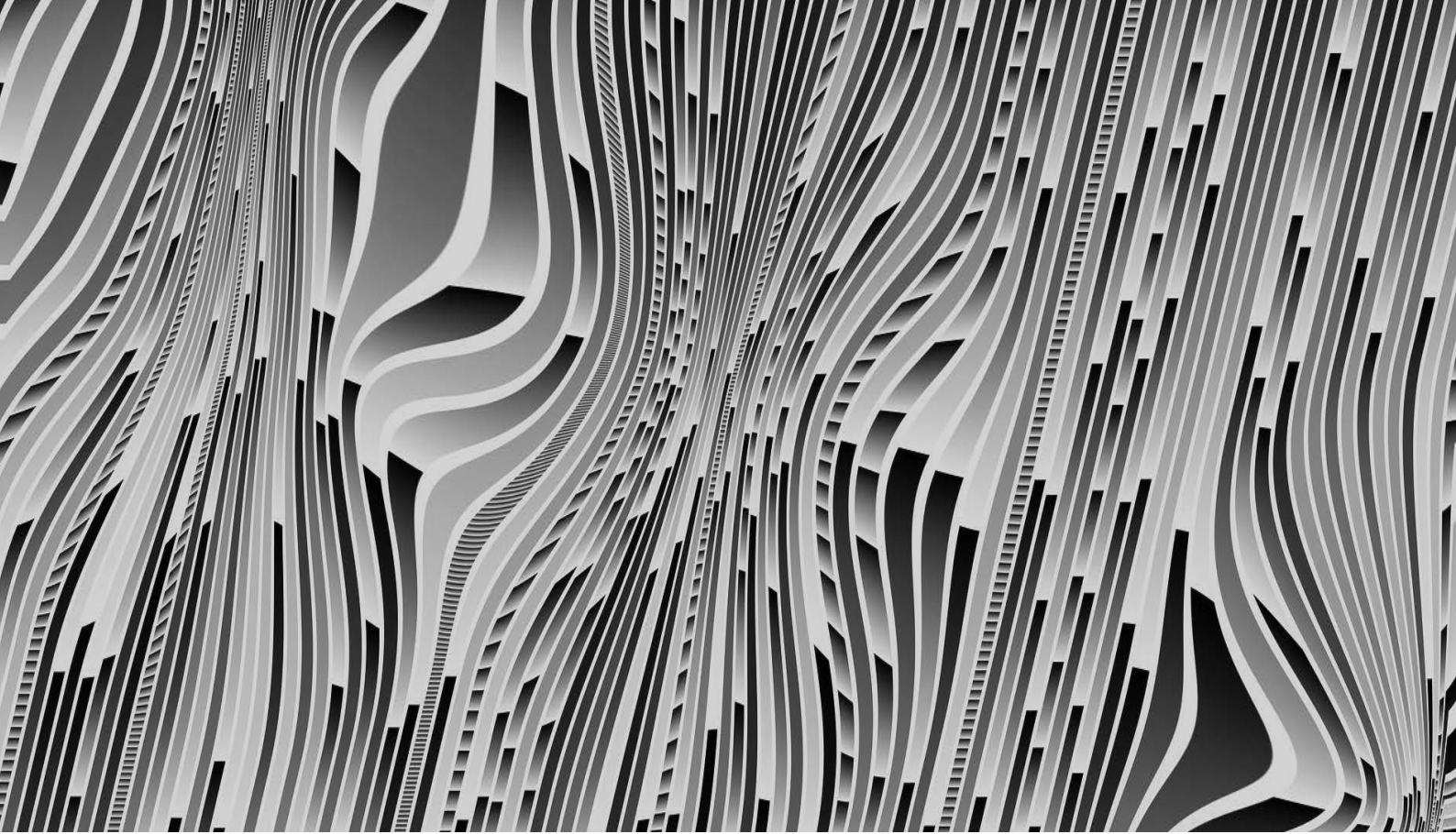
It allows medical professionals to conduct training and practice operational procedures in a virtual setting. In Formula 1, races can be simulated repeatedly to trial technologies and optimise performance.

It can also be used in smart city innovations. At the recent R&D forum, NTT DATA demonstrated how Digital Twin Computing is helping accelerate urban digitisation. Technologies varied from providing healthy lunch recommendations to identifying available stress-free locations where people could escape the hustle and bustle of city life for a moment of peaceful relaxation.

The automotive industry is undergoing its own transformation. Although there has been real progress in realising the potential of connected cars, creating hardware and software that works intuitively for the driver remains a challenge. A recent NTT study in collaboration with PAC teknowlogy found that 46% of connected car users had issues with complexity and poor usability. It is here where designers can demonstrate their skill. The technology is there with connected cars and there is growing public demand to match it. Designers can play a key role in accelerating the process and realising the potential of this technology by making it more useable.

Smart Cities: explained by **Antonio Grillo**, Service Design and User Experience Director at Tangity, NTT DATA

- “ The smart city projects that NTT DATA has been working on in Japan are a perfect example of how collaboration between design and technology is essential for true innovation.
- “ The definition of a successful smart city doesn't necessarily rely solely on digital innovation. A systemic approach is needed, of which technology is just one layer. In order for a city to be smart, components relating to infrastructure and culture need to be aligned.
- “ The key for innovation can be summarised by this simple yet neglected mantra: put people first.
- “ By sharing our methodologies from the beginning of the process, innovation is consistently focused on solving specific societal problems, and operates with a cultural awareness that is vital for success.”



Adapting Design for the Future

As a process that puts people at its heart, the disruption we have experienced in 2020 has forced designers to find new ways of working.

Corinne Schillizzi,
Senior UX and Service Designer at
Tangity.



“During the pandemic and while working remotely, the design process has had to change. There are added complications to how we observe people interacting with our products. We have had to evolve.”

Designers have had to find ways to recreate and reimagine the benefits of face-to-face interaction, especially when it comes to collaboration and prototype testing where virtual alternatives have become the primary way of research.

By identifying and utilising the best technology solution at every stage of the process, it has been possible to make the transition to virtual as seamless as possible. The design group adapted really fast to such needs by using visual collaboration tools and remote user testing tools. In doing so, the team was able to design and test solutions in a completely remote environment. This shows the importance of design methodology and the need to be flexible in applying processes in different situations – for instance by switching to online visual collaboration and prototyping tools.

Design provides the link that helps an innovative new technology become a core part of our day-to-day lives. With design, innovations can have a global benefit and continue to have an impact long into the future when societal circumstances have changed.



As more of our work is conducted virtually, ensuring designers can still collaborate between themselves and other fields of expertise is vital in the pursuit of innovation. At NTT DATA, our goal is to help companies create and build solutions that are designed in such a way that they make as large an impact as possible. The overriding priority should always be the consumer problem. To be human-centric in our design. Every decision made in the design process has to be based on how this helps fulfil the need of the end customer, and ensure their experience is as clear and intuitive as possible.

LivingLab: A home for innovation

everis launched the Barcelona LivingLab in 2018, with the aim of creating a cutting-edge space designed to foster innovation in new technologies and services. It enables knowledge exchange between external and internal participants, creating a collaborative environment to share and democratise the use of emerging technologies.

The space hosts a number of NTT DATA events, including the Global Hackathon and Open Innovation contests. It is also home to innCub3, a school

that provides training courses in creativity and innovation. It sets itself apart with its focus on practical application, whilst incorporating the internal education programs of everis University.

The needs of the user are the key priority for innovation within the LivingLab. A specialised testing room is used for one-to-one interactions with end-users, ensuring their needs are always informing the innovation of new technologies.



DOOR: A virtual world for remote collaboration

The pandemic has forced us to adapt how we collaborate. The need for social distancing has instigated a transition towards a remote world. In response to this challenge, NTT launched DOOR.

This virtual space facilitates mutual participation and creation, ensuring economic innovation can continue despite the need for social distancing. The platform is multi-device compatible, and is available through VR devices, smartphones and PCs. It provides a 3D space where designers can imagine, innovate and collaborate with each other.

At CES 2021 we launched the 'NTT R&D CES 2021 Special Room' on DOOR which showcased IOWN-related videos and content.

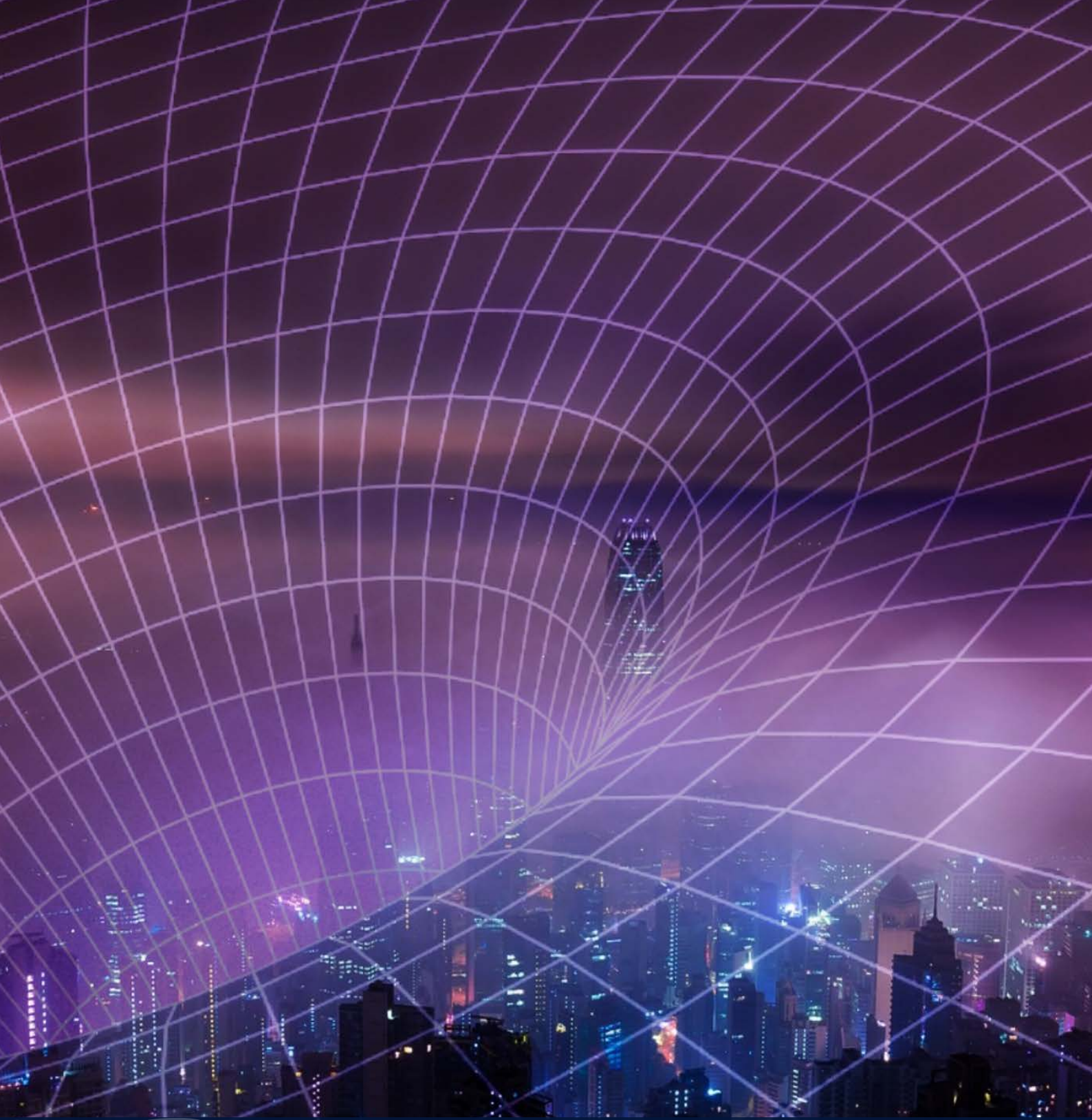
There are four defined areas that persons or businesses can explore in the DOOR:

1. **NTT Town:** A virtual space built like a future city, where all the latest NTT news and services can be found.
2. **Craft Room:** In this space, anyone can easily create their own 3D virtual room, either for personal use or for commercial such as setting up a shop
3. **Culture Park:** Here you can find an entertainment space, used for collaboration with content holders for sports and other cultural events
4. **Parallel City:** This VR urban space is similar to downtown Tokyo, a virtual city that fosters collaborative innovation.

Conclusion

Design is an essential part of innovation. It enables groundbreaking technological solutions to be put into practice by making them user-friendly and intuitive. It plays a vital role in creating technology that centres around humans and is built to enhance the human experience.

As the world of work changes, designers have had to adapt. NTT DATA has been at the forefront of supporting continued collaboration through the creation of purpose-built virtual spaces. Going forwards, virtual collaboration will continue to bring designers from across the world together. Through this continued sharing of ideas and resources, designers will be a key part of the transition towards a more digitally orientated world where people feel supported by the technology around them.



Chapter 4

Harnessing the Power of IoT

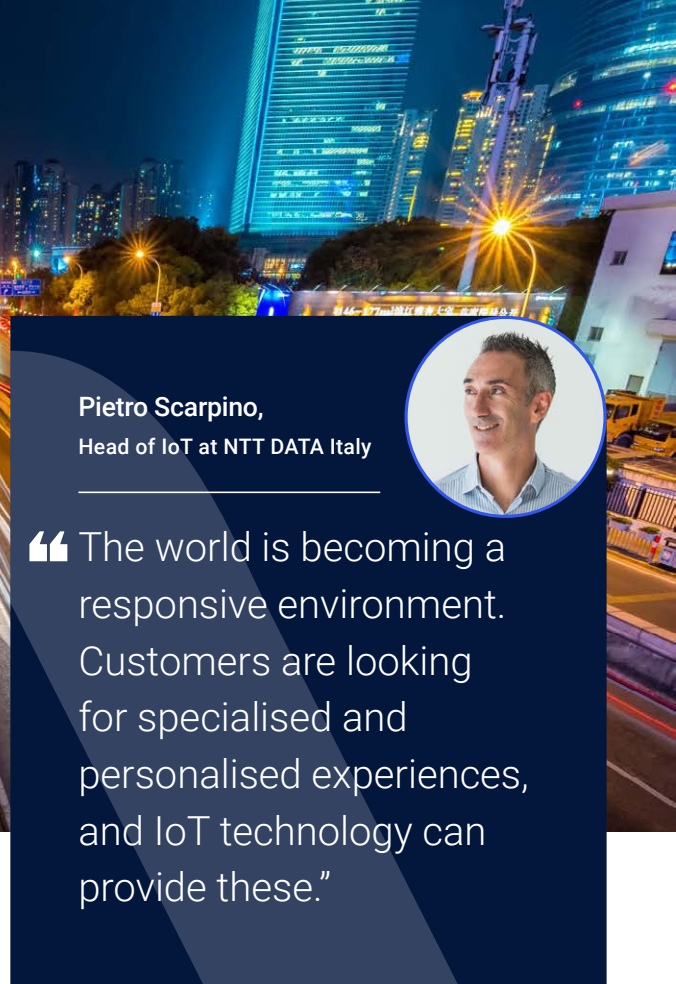
Introduction

The number of IoT devices being connected to the web is growing by an estimated 127 new devices every second. And it's predicted that over 35 billion IoT devices will have been installed worldwide by the end of 2021.

Gartner states, "IoT is an approach to building business solutions using a portfolio of technologies." It is not an isolated application but rather the ability to leverage vast quantities of actionable data that make it invaluable to technological innovation. Harnessing the power of data collected by IoT networks can lead to huge efficiency gains. Resources can be managed sustainably at a vast scale. Labour-intensive processes can become automated. And our lived environments can be transformed into responsive ecosystems that anticipate our wants and needs.

With such capabilities, IoT technology has the potential to help us tackle some of the biggest challenges facing the world today. NTT DATA is collaborating with experts around the world to put innovative IoT solutions into practice.





Pietro Scarpino,
Head of IoT at NTT DATA Italy

“The world is becoming a responsive environment. Customers are looking for specialised and personalised experiences, and IoT technology can provide these.”

Human-Centric Approach

Humans remain at the centre of IoT technology. IoT devices may talk to one another, but they also talk to us. And ultimately, IoT technology is there to make our lives easier, by transforming the way we interact with the world around us.

At NTT DATA, people are at the centre of what we do. That's why we focus on how IoT can help us solve problems and make our lives better. The examples that follow demonstrate this philosophy, revealing the incredible potential that IoT has to help us live more sustainably, in harmony with the natural environments we inhabit.

Smart Cities

IoT technology has the potential to transform our living environments. With technologies that allow real time monitoring and sharing of data, our surroundings can begin to anticipate our needs and wants.

More and more cities are looking to become 'smart', connecting services and spaces to increase safety, sustainability and enjoyment. Smart solutions enable local authorities to operate more efficiently and effectively, helping them to ensure that public spaces are used in an optimal way.



Pietro Scarpino,
Head of IoT at NTT DATA Italy

“The human is of course at the centre of everything. Technology should always be at the service of humankind. To that end, we should focus on the services provided to people that are enabled by this technology, rather than the technology itself.”



Improving Public Safety in Las Vegas

One of the ways IoT can improve our surroundings is by making them safer.

The City of Las Vegas partnered with NTT DATA to produce a smart edge network that uses high definition optical sensors, sound sensors, IoT devices and micro data sensors to improve road safety in the city.

The smart edge network was designed to detect cars driving the wrong way on a one-way road system. Sensors were installed to monitor when someone drove the wrong way, recording information such as the driving pattern of the person and what time of day the incident took place.

Using the data recorded, a more effective response to the problem of wrong-way driving could be developed. Edge data centres near the site enabled the fast processing of information collected by sensors. Emergency alerts could then identify the number plate of the driver concerned in real time, allowing emergency services to intervene in order to prevent accident or harm.

Woven City

NTT has partnered with Toyota to create Woven City, a prototype smart city at the base of Mount Fuji, Japan. The 175-acre hydrogen-powered site will house 2,000 full-time residents and researchers who will test and develop smart city technologies including autonomous vehicles and smart homes.

A 'Smart City Platform' will be tested in Woven City. The platform will analyse the data collected from vehicles, homes and public institutions within the city. This information will then be used to improve services, with a particular focus on transportation, energy usage and health. A 'digital twin' city will be created based on the data collected, enabling new solutions to be trialled in the cyber world before being implemented in the real world.

Once implemented in Woven City and NTT's other prototype site, Shinagawa area in Minato-ku, Tokyo, the Smart City Platform will be introduced to other cities.

Transforming Office Environments

As well as public spaces, working environments can also be enhanced by IoT technology. NTT DATA launched an IoT enabled solution, Habität, in 2020. [Habität](#) enables organisations to optimise their resources by maximising their use of workspaces.

Habität involves the use of a specific hardware, as well as a centralised management system, to manage office spaces more effectively. Common office areas are fitted with movement sensors and cameras that enable continuous real-time monitoring. Data are compiled by smart devices and sent to a cloud server before being fed to a display platform that provides the information used to make decisions about space use.

The installation of Habität includes the creation of an IoT distributed network that can connect to already-installed devices, allowing them to

contribute to data collection. In this way, Habität can be used to manage things like temperature and ventilation as well as space use.

Installing Habität at the NTT DATA offices in Spain reduced occupation of workstations by 20% and led to energy savings of 30%.

When companies return to their offices following the Covid-19 pandemic, smart solutions like Habität will enable organisations to more efficiently use their office spaces. This will include ensuring that social distancing and adequate ventilation are considered in reconfigured layouts.





Smart Farming

One of the most exciting applications of IoT technology is in farming.

With the use of IoT devices, farming practices can become more data driven. For example, IoT devices monitoring crop growth can provide information on when individual plants need more water or more fertiliser, and they can tell farmers the optimum time for harvesting. This makes farming more efficient and more predictable, increasing yields and reducing costly resources.

Increased predictability will be especially important as climate change creates greater disruption to the natural seasonal cycles that farmers have relied on for millennia. Increasing yields and limiting loss of produce will also become more important as predicted demands on food supplies increase.

Ultimately, IoT will play an important role in helping farmers to become more robust in the face of increasing natural and human pressures.

Autonomous Tractors

In Japan, farmers currently face severe labour shortages, partly as a result of increasing numbers of farm workers reaching retirement age.

To cope with this problem, many are turning to smart farming. Various technological solutions are helping farmers to maximise their output while optimising human labour.

NTT, working with Japanese manufacturing company Kubota, has helped develop one of the latest smart solutions: the autonomous tractor. These driverless machines rely on a series of advanced technologies – wireless quality prediction, overlay networking, video streaming, image analytics and network-cooperative device actuation – to enable remote monitoring and safety control features.

AI makes these tractors completely autonomous. The tractor chooses the appropriate operation based on multiple sources of data, including data on weather and growth rates. Any data obtained by the tractors themselves is automatically shared with other machines on site to enable efficient and coordinated operation.

The tractor is designed to have as little impact on the environment as possible; it has a carefully designed shape and runs on 100% electric power with a combination of lithium-ion batteries and solar batteries. The machine is a perfect example of how technology can bring about solutions to difficult challenges in a sustainable and environmentally mindful way.



Growing Phantom Rice with Deep Water Farming

Another part of NTT group is bringing a rare cold-water rice variety back from the brink. The so-called 'phantom rice' or sasanishiki variety is unsuitable for modern-day cultivation methods and has been in long-term decline.

NTT Docomo is working with a farmer, Hiroyuki Abe, from Miyagi, Japan on a solution to make sasanishiki rice cultivation more productive: deep-water farming.

Cultivating rice in water that is deeper than the traditional 4 to 5 centimetres makes it difficult for weeds to grow and thrive. But how could Hiroyuki ensure that water levels remained consistently deep enough to keep weeds at bay?

NTT Docomo developed IoT sensors that keep the water level at a constant depth. These paddy sensors constantly monitor water level, water temperature, and air temperature, displaying any changes in graph form. Hiroyuki can access this information at any time using a smartphone or tablet.

Equipping experienced farmers like Hiroyuki with this technology has stabilised crop yields and improved crop quality. In this instance, deploying tailored IoT technology also contributed to regional revitalisation in Japan by helping to bolster a farming tradition that is precious to the local area.

Drones in Farming

NTT East has built drones equipped with cameras to be used in farming. The devices can sprinkle pesticides and seeds, covering 2.5 hectares of farmland on a single battery charge.

The drones also use AI to analyse aerial images of crops to provide better data for farmers, helping them tackle pests as well as suggesting when best to use fertiliser.

This technology, which is yet another solution to serious labour shortages in Japan, aims to raise crop yield by up to 30%.

These drones will come to market in February 2021 with the establishment of new firm NTT e-Drone Technology.



Governments and corporations around the world are increasingly looking to limit waste and ensure that finite resources are used sparingly.

IoT For Resource Management

IoT technology has huge potential when it comes to monitoring and optimising resource use. Networks of devices can monitor resource allocation, showing where there may be shortages or where resources are wasted. Armed with such data, action can be taken to distribute resources more effectively, reducing waste and improving reliability of supply.

TEPCO Power Grid - A Case Study

Japan's largest utility company, Tokyo Electric Power Company Holdings (TEPCO), has harnessed the power of IoT to improve efficiency in its supply of electricity and energy to the Greater Tokyo Area.

The company launched an ambitious project to install nearly 30 million of its smart meters. The smart meters can be monitored remotely, and readings are recorded automatically every 30 minutes, reducing the labour normally required to visit households every month to get readings.

As well as removing the need for manual meter readings, the smart meters provide consumers with detailed information about their energy consumption. In 2020, an additional AI solution was added to the smart meters which enables a breakdown of energy usage, showing customers which appliance categories use the most energy.

NTT DATA was selected as a partner to develop the Meter Data Management System (MDMS) needed to process the huge amount of data involved in this smart meter project. The MDMS has three main functions: MDM (Meter Data Management) accumulates meter readings and makes them available at any time; MAM (Meter Asset Management) manages facility information; and NM (Network Management) manages the network.

TEPCO has also developed IoT-based operational support services on the production side to optimise efficiency and performance within its thermal power plants. Its remote monitoring and IoT optimisation centre uses technology including image and sound processing to enable early anomaly detection, advanced diagnosis and effective communication of developing issues to end users. This optimises the performance and reliability of the power plants, helping to ensure a stable supply of electricity to the city.

Low and Edge Computing

Improving networks is key to enabling the next generation of IoT devices. The Innovative Optical and Wireless Network (IOWN) offers a way to revolutionise our communication capabilities, providing high-speed broadband and extensive computing resources. NTT's R&D in this area aims to finalise specifications in 2024 and realise the concept in 2030.

The key impact IOWN will have on IoT technology will be to reduce delay and latency issues. This will enable the sharing of vast quantities of data in real time.

Likewise, edge computing can help reduce latency. Where IoT devices might normally have to relay

information back to the cloud for verification, leading to latency, edge computing can process information closer to the source for increased speed.

IOWN represents a technological revolution that goes beyond the internet, moving the paradigm of human to machine towards human to human.



IoT and Security

One key problem that is consistently raised when it comes to IoT is security.

IoT devices are always connected to the internet so they are constantly exposed to the risk of cyber-attack. The sheer volume of IoT devices in existence also means that criminals have a vast array of entry points. Furthermore, security protections on many IoT devices tend to be minimal or non-existent, and many are protected only by generic passwords when they are first installed.

Concerns about such vulnerabilities are holding back the production of some IoT devices. NTT DATA has been at the forefront of efforts to improve the security of IoT technology in order to prevent these

security concerns becoming a barrier to progress. NTT Security recommends that organisations carry out penetration testing from both within and outside company premises in order to better map out vulnerabilities caused by IoT devices. Connected devices should, if possible, be capable of supporting encryption, and those that are not should be subject to stricter authentication processes.

Rather than discouraging the adoption of IoT technology, security concerns related to IoT can drive us to better secure our systems and innovate with built-in security solutions. As we have seen, the potential of this technology is vast. If we address important concerns about security as we begin to integrate IoT technology into business models, we can safely and securely reap the widespread benefits it has to offer.

Conclusion

The future of IoT is filled with possibilities. With this transformative technology, we can harness the power of data to manage and control processes at a vast scale. This gives us the potential to embed sustainability into business practice, ensuring processes are as efficient as possible, and resources are used optimally with limited waste.

Indeed, with IoT technology in our armoury, we can address some of the greatest challenges of our time. At the same time, we can make people's lives easier, whether that be through improving safety in the cities where they live, or through creating better goods and more efficient services.

Ultimately, IoT can help us to develop ways of living and working that protect and respect the natural environment and its resources. In this way, IoT technology paves the road towards a more sustainable future.



Chapter 5

Delivering the Future Faster

Introduction

NTT DATA defines DevOps as a combination of culture, practices, and tools that increase an organisation's ability to deliver systems at high velocity. Its purpose is clear – to deliver innovation quickly and securely. It is the key to enabling a faster delivery of innovation and the future technologies required.

DevOps is sometimes considered more an aspiration rather than a set destination. It gives us the capacity to deliver software at scale and is fundamental to our ability to innovate while incorporating continuous improvement. The DevOps of a decade ago focused on IT services alone. It now spans the entire enterprise seeking ever higher output and operational efficiencies.

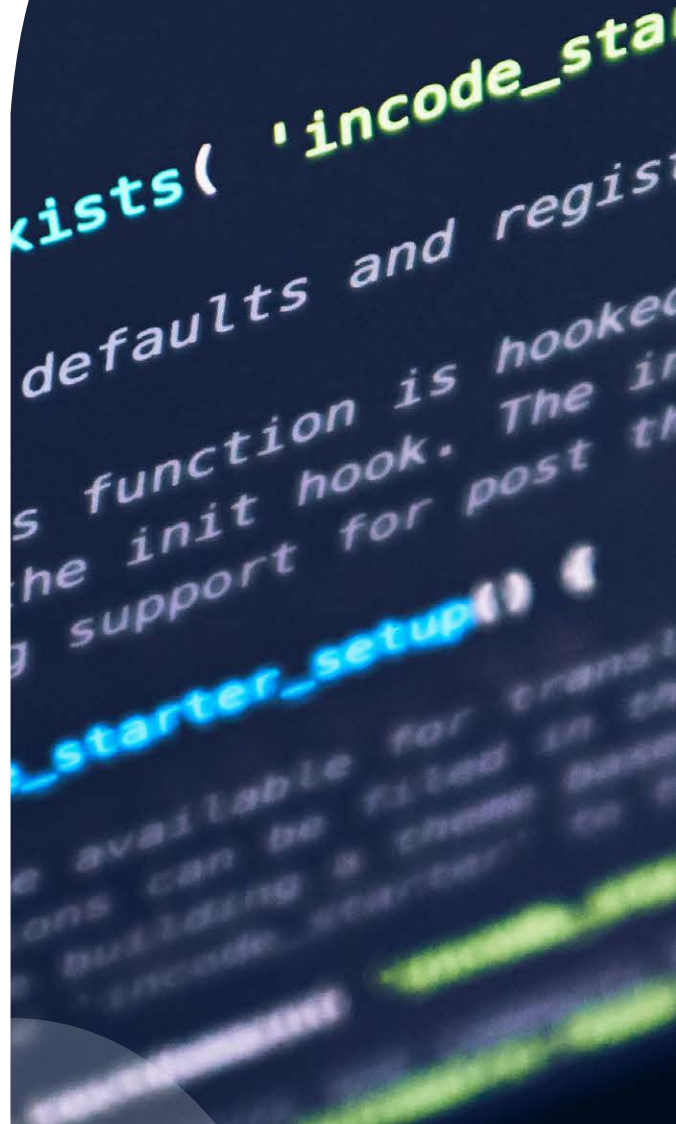
We are also seeing a change in how we think about the development lifecycle, evolving from the fixed projects of the past through to product centric thinking. We are transitioning from the idea of temporary projects to something more permanent in organisations: products.

DevOps and Time To Learn

Speed-to-market is an important business metric, and DevOps certainly helps to increase speed. Minimum viable products can be created very quickly and iterated to the point of value. However, there is a further, lesser considered, but arguably more important business metric: time to learn.

Well-organised agile teams can learn quickly, and this enables them to react to and learn from changing consumer expectations and associated market disruption. In 2020, the global health pandemic forced companies around the world to become digitally conversant in a matter of weeks. They were forced to adapt to new processes that were entirely digital, and some had to find new routes to market very quickly. Companies that succeeded were those which were able to learn quickly.

DevOps is at the heart of NTT DATA's approach to software delivery. Our DevOps centre of excellence is world-leading, and our Altemista cloud platform speeds up deployment by automating much of the manual effort when starting projects. It may come as a surprise, but DevOps can trace its roots to Japan having been influenced by the principles of Lean Manufacturing employed by Toyota - a Japanese company with whom NTT DATA often partners.



Mark Masterson,
Head of R&D at NTT DATA UK

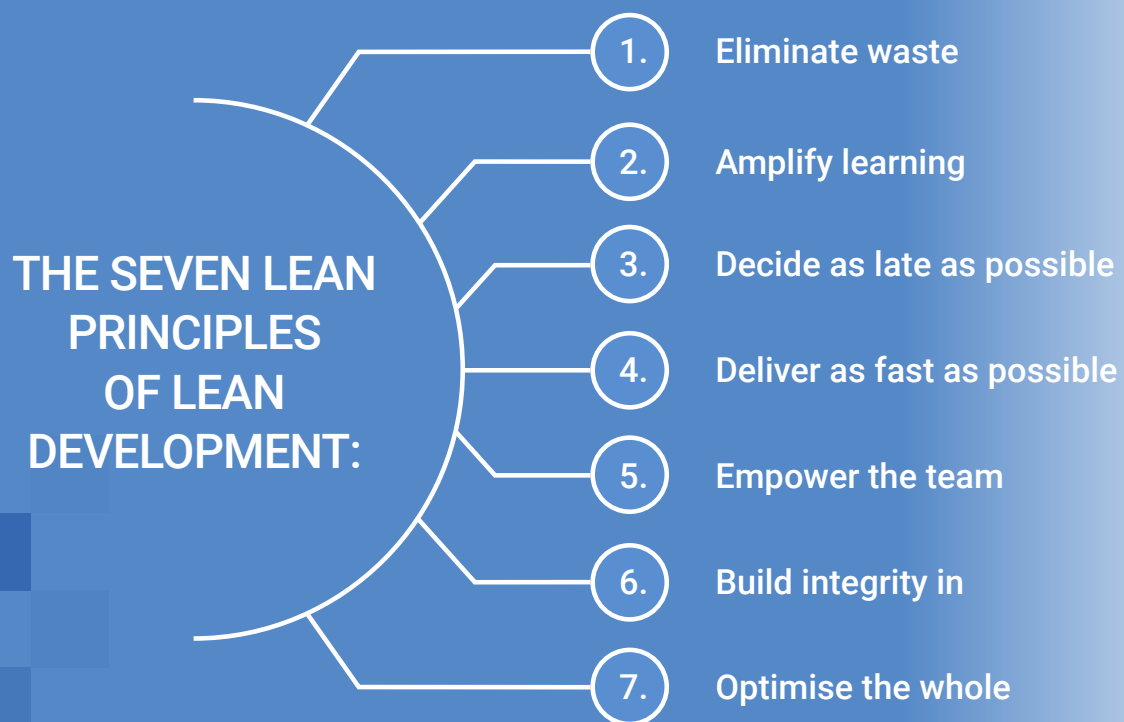
“ The most important business metric right now is time to learn. A black swan event forces us to review everything, and those that learn fastest will be the first to succeed.”



From Automotive Manufacturing to Lean Software Development

The core systems thinking principles that inform modern approaches to software development originated from Japanese automotive manufacturing, and the ideas they developed to make the process more efficient and sustainable.

The Toyota Production System was developed between 1948 and 1975. It was the first example of “just in time production” with the goals of designing out overburden, inconsistency, and to eliminate waste. It was called lean manufacturing and was a big influencer of the lean software development movement of the early 2000s.



In the early 2000s the concept of ‘Agile’ became widely used. ‘DevOps’ as a term was coined in 2009 when two Flickr employees spoke at a conference on a topic titled, ‘10+ Deploys per Day: Dev and Ops Cooperation at Flickr’ which explained how

improved collaboration increased the speed of software releases. An engineer called Patrick Debois, who had been following the event remotely, created a shortened term ‘DevOps’ in his postings and thus the new ‘DevOps’ was born.

Companies who are **design-led** outperform those who are not by 211%.

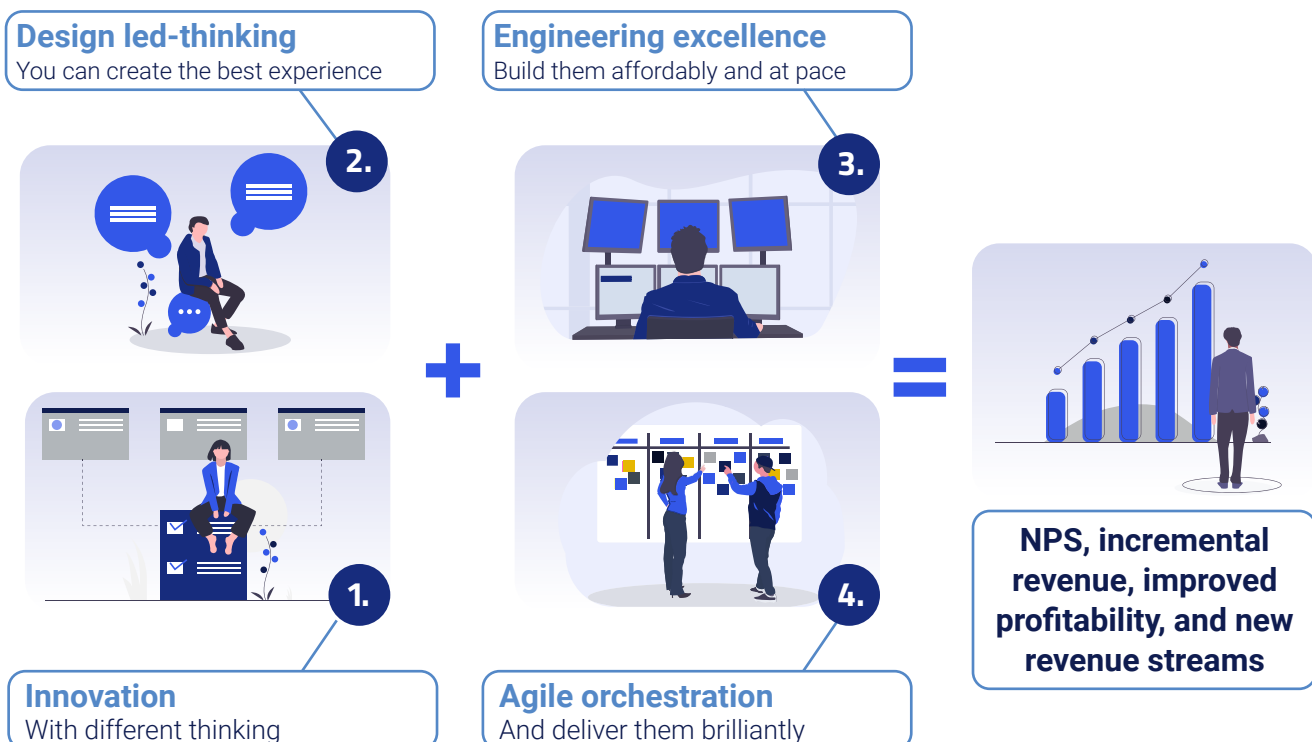
Using **agile techniques** to deliver software development projects promises a 62% higher likelihood of success compared to conventional, sequential or waterfall delivery methods

Companies who have the skills and techniques associated with **engineering excellence** (DevOps as standard, optimising system-wide flow etc.) are twice as likely to exceed cost reduction targets and twice as likely to exceed targets for the quantity and quality of products delivered than those who don't

Delivering Digital Success With NTT DATA's Idea Model

DevOps and Digital Transformation go hand in hand, and NTT DATA R&D has been working to develop a repeatable approach that leads to digital success. By combining three key ingredients companies can successfully create the digital products that their customers want at the time they need them, driving profitability and revenue. The key ingredients of a successful digital business can be summarised as follows:

The NTT DATA IDEA model is based on our deep experience of guiding clients to success. It brings together Innovation, Design-led thinking, Engineering excellence, and Agile orchestration:



Innovating in DevOps at NTT DATA

The desire to improve software development has led to constant innovation in DevOps. The ecosystem around hyperscale clouds such as GCP, AWS and Azure has put DevOps front and centre for businesses looking to accelerate their digitisation process – and lead to some very innovative approaches.

Jason Ford,
VP of Digital Practice,
NTT DATA UK



“The way that applications are architected now, it would be crazy to write something that’s not cloud-native. You’d be building in potential obsolescence.”

NTT DATA has created its own cloud platform called Altemista, developed by R&D teams in Spain and Germany. Altemista leverages best-in-class cloud offerings from hyper scalers, which auto-generates a complete workspace on demand. It selects the application lifecycle management tools required, as well as creating the necessary testing and deployment environments. The result is a best-in-class end-to-end toolset that means projects can get going fast with the best tools available.

Samantha Evans,
DevOps Practice Lead -
NTT DATA UK



“Complexity is increasingly hidden from developers. Provisioning a server used to take days, now it is one line of code. We are taking away the noise for developers and automating in sophisticated ways.”



The Rise of Low Code

As platforms and frameworks become more advanced, the amount of manual effort required is much reduced. We can spin up an environment in a click, we can test in a click, we can release in a click.

This has led to the rise of low code. A study by Gartner predicts low code will be responsible for 65% of application development activity by 2025. Low code is a natural partner for a DevOps approach. It is a solution that can further streamline the DevOps lifecycle, greatly reducing the development timeline.

Both can be complimented further when combined with the use of containers. NTT DATA uses everis Dedalow, a low-code development platform (LCDP), machine learning, and test automation technology to visually design (modelling) applications such as screens, data, and logic using a graphical user interface (GUI), generate and construct source code from the defined model in an instant, and deploy it in a cloud environment. This way developers can write one line of code, enter it into a centralised code repository, and then apply it across an entire piece of software. The testing process can now be done in minutes.



Jason Ford,
VP of Digital Practice,
NTT DATA UK

“ DevOps is like the oil in the pipe, it reduces friction in bringing features to market – not just increasing speed but reducing error rates and detects.”

Digital Twins From Smart Connected Products

NTT DATA is working with digital technologies such as cloud, IoT and AI to create connectivity across products and software functions, converting them into smart connected products. These products will be the precursor to digital twin computing.

Smart Connected Products create a continuous feedback loop, enabling product development that constantly adjusts in response to customer feedback and product use. Smart Products not only deliver operational efficiency but help companies improve strategic positioning by leveraging cross and up-sell opportunities.

Starting from digital twins of Smart Products as we know them today, our parent company NTT envisages a world where all the digital twins are interconnected to resemble broader ecosystems

like entire facilities, supply chains or customer populations. Based on this interconnection of digital twins, new business opportunities can be identified and then proven in complex simulations, taking into account not only the individual customer or product but the whole ecosystem in which they operate. As products become smarter and more connected, incorporating next-generation networking technology like IOWN, we are able to model them more accurately in order to enhance functionality, improve maintenance, and optimise the usage of the product.

While photonics is key to the IOWN revolution, continuous integration and consistent development of the software will be required to ensure the evolution of product-centric design.

Water Management Using Smart Products

Water is one of the most critical resources on our planet. It is a basic requirement for survival and yet often overlooked as a precious, life-sustaining force. It is our oceans that control the climate of the earth, cooling the earth when it heats up and vice-versa.

NTT DATA has implemented a Smart Products end-to-end solution which combines a multi-protocol gateway with a vendor-agnostic smart cloud platform that handles core functionalities like device registration, software updates and data analytics. The project is called HOTSPOT, and it uses narrowband IoT on water meters, in order to monitor and forecast water usage through IoT and AI solutions, control drinking water quality and model water demand and consumption.

HOT interacts as multiprotocol device sources and exposes them to SPOT – a platform that solves specific IoT problems, including digital twin, configuration and device management.



Putting The Sec In DevSecOps - Developing Secure Systems

Security is now a fundamental part of the software development process. DevOps used to be viewed as an additional risk by InfoSec Teams, with the increased frequency of software releases seen as a threat to governance and security. However, enterprises have since found that DevOps practises actually mitigate potential security problems. Building secure-by-design systems has become a standard in DevOps to the point that it is often described as 'DevSecOps.'

By building in more automation and reducing the volume of change in each release, DevOps frameworks are more secure than previous

processes that required more manual involvement. This speeds up the release cycle and ensures any issues discovered are addressed much more quickly.

Increased connectivity further adds to the pressure on companies to instil robust security practices and governance. NTT DATA's Cyber Security division maintains partnerships with key vendors for security components and provides blueprints for solutions like secure software development while working closely with NTT Ltd's global network of security operating centres (SOCs).





Automotive Security and how to design a Secure Car

Cars are becoming increasingly complex. Subsystems control everything from the infotainment system to the windscreen wipers. The CAN Bus protocol, developed in the 1980s, is a low-level protocol that offers little security against malicious interference.

To address this issue, NTT developed and designed the Vehicle Security Operation Centre (VSOC).

The VSOC in Tokyo monitors the security status of connected cars, detecting and analysing cyber-attacks. NTT R&D went a step further, developing an in-house, intrusion detection system in cars, augmented by existing SOC solutions provided by NTT Security. The solution was designed to be compatible across global vehicle products. Working with automotive components manufacturer, Denso,

NTT has been leveraging expertise from across its global network to continue meeting the threats of cyber-attacks on smart vehicles.

An example of the system in action is when facing “fuzzing attacks”, an automated process flooding a system with random data in a bid to uncover exploitable weaknesses. The vehicle is installed with a gateway, a piece of hardware able to transmit and receive messages. This is triggered when a threat or issue is uncovered and transmits an alert through a network to VSOC. A VSOC operator then sends a command to the in-car gateway instructing it to isolate the affected area or component that is under attack. This countermeasure ensures a real-time response to cyber security threats.

In February 2020 the Security division of NTT Ltd announced that it was forming an alliance with ESCRYPT in response to the rise of cybersecurity incidents on automotive connectivity and digitised vehicle functions and services. The two companies are now offering joint solutions specially designed to enable the cyber resilience of vehicle fleets.



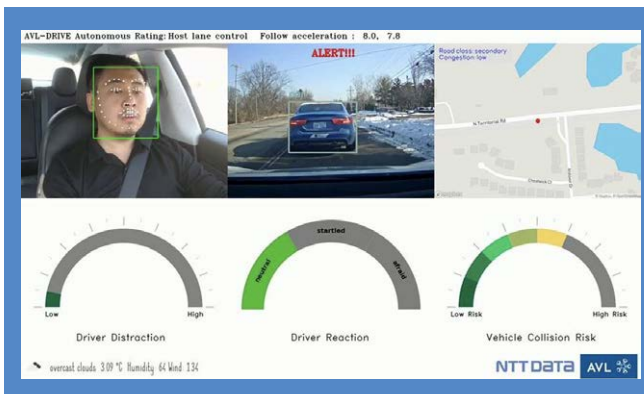
Cars are becoming increasingly complex and ever more so as the automotive industry races ahead to develop and produce autonomous vehicles. Subsystems control everything from the infotainment system to the windscreen but many consumers remain hesitant to embrace the technology.

Driver Sentiment

NTT DATA has developed a driver sentiment solution in co-creation with AVL. By simultaneously processing three dimensions the solution can evaluate:

- 1. ENVIRONMENTAL CHARACTERISTICS** – road conditions achieved through assessment of online navigation systems, real time processing from the frontal camera and integrating data from the online weather forecast service
- 2. HUMAN EMOTIONS** – recognising facial expressions in critical situations, estimating attention levels and detecting drowsiness (see graphic below)
- 3. VEHICLE DYNAMICS** that use CAN data signals to predict an event before it happens, such as sudden braking

The solution relies on multiple machine learning algorithms, parallelised and optimised for running in real-time on embedded devices. By recognising critical events that are likely to result in driving incidents, the technology can take precautionary action about 500msec to 1 second earlier. Through this technology, NTT DATA hopes to reduce the number of accidents and create safer roads for drivers in the future.



DISTRACTION MEASUREMENT LIVE EXAMPLE

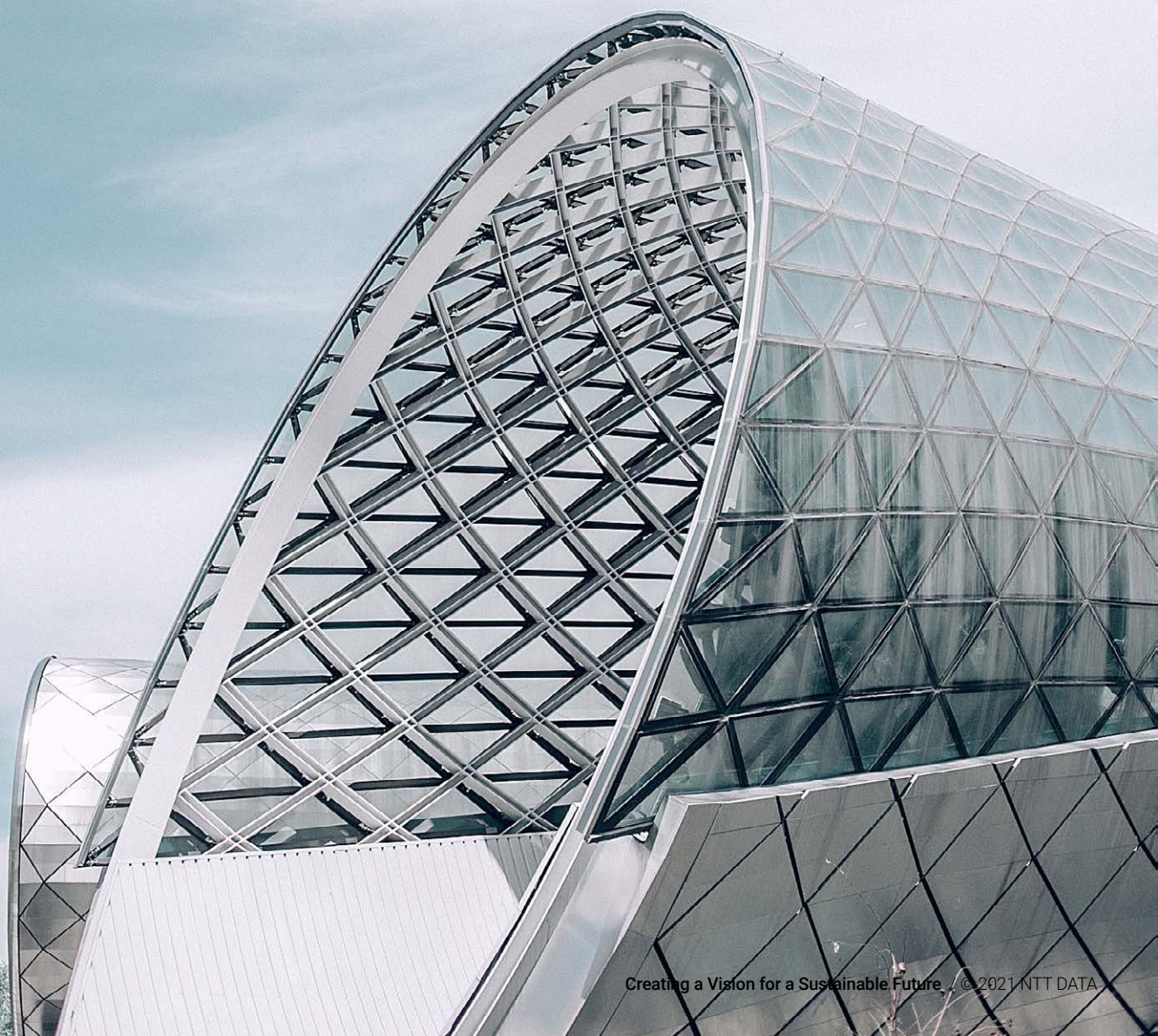
Conclusion

DevOps: It's about delivering the future

DevOps is a culture, an ethos, a set of techniques, and above all, it's collaboration. It's a coming together of ideas, design-led thinking, and engineering excellence that results in innovation. It's tools, processes and practises that enable change at scale, while minimising friction.

It's all these things and more. DevOps is the enabler to delivering the future and the technologies upon which it depends.

Software unpins our lives. We interact with it every day. It has the ability to frustrate and delight us. Through continuous delivery, we can improve it one line of code at a time – and that is the real beauty of DevOps.



References

1. Tollefson, J., Nautre, 15 January 2021, Covid curbed carbon emissions in 2020 – but not by much, <https://www.nature.com/articles/d41586-021-00090-3>
2. Jones, N., Nature, 12 September 2018, How to stop data centres from gobbling up the world's electricity <https://www.nature.com/articles/d41586-018-06610-y>
3. Bischoff, P., 22 July 2020, Comparitech, Surveillance camera statistics: which cities have the most CCTV cameras? <https://www.comparitech.com/vpn-privacy/the-worlds-most-surveilled-cities/>
4. Sparrow, C. et al, 30 May 2018, nature, Simulating the vibrational quantum dynamics of molecules using photonics, <https://www.nature.com/articles/s41586-018-0152-9>
5. Gartner, 25 April 2018, Gartner Says Global Artificial Intelligence Business Value to Reach \$1.2 Trillion in 2018
6. Juniper, 9 May 2017, Chatbots, A Game Changer For Banking & Healthcare, Saving \$8 Billion Annually By 2022
7. Gartner, 13 July 2020, Hype Cycle for Blockchain Technologies, 2020, #G00441585
8. Forrester, 28 October 2020, Predictions 2021: Blockchain Is A Tale Of Two Speeds
9. Gartner, 16 September 2019, Gartner Says Blockchain Deployments Across Financial Services Ecosystems Are At Least Three Years Away
10. Lynkova, D. 8 October 2019, Leftronic, IoT Statistics and Trends to Know in 2020, <https://leftronic.com/internet-of-things-statistics/>
11. G., N., 4 January 2021, techjury, How Many IoT Devices Are There in 200? <https://leftronic.com/internet-of-things-statistics/>
12. Goodness, E. and Velosa, A., 15 December 2020, Emerging Technologies and Trends Impact Radar: Internet of Things- ID G00733494
13. CABI, Global Burden of Crop Loss, 2019-20
14. Mezak, S., 25 January 2018, DevOps.com, The Origins of DevOps: What's in a Name? <https://devops.com/the-origins-of-devops-whats-in-a-name/>
15. Vincent, P. et al, 30 September 2020, Gartner, Magic Quadrant for Enterprise Low-Code Application Platforms, ID-G00450466

NTT DATA EMEA
2 Royal Exchange
3rd Floor, London
EC3V 3DG, United Kingdom
Tel.: +44 2007 2209200
www.nttdata.com/global/en/sustainability

