



Innovative Technologies Enabling Digital Transformation

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Introduction

New Global Models of Enterprise Digital Innovation

Progress in digital technology is largely driven forward by a combination of invention and innovation, but the two terms should not be automatically conflated. In the context of technology, innovation is most often about improving invention, and ensuring that those improvements are demonstrable and quantifiable. If, as the proverb has it, necessity is the mother of invention, then it's arguable that a drive to greater efficiency is parent to greater innovation.

Introduction

New Global Models of Enterprise Digital Innovation

Progress in digital technology is largely driven forward by a combination of invention and innovation, but the two terms should not be automatically conflated. In the context of technology, innovation is most often about improving invention, and ensuring that those improvements are demonstrable and quantifiable. If, as the proverb has it, necessity is the mother of invention, then it's arguable that a drive to greater efficiency is parent to greater innovation.

This assertion is especially true as the world strives to recover from the multiple impacts of the Coronavirus pandemic – a crisis that has, nonetheless, accelerated both the pace of digital innovation and the speed at which it has been implemented across projects. Major technology migrations and upgrades that prior to March 2020 might have been scheduled over months or years are now rolled-out in weeks. Such change is being facilitated by Digital Transformation programmes now customarily set to fast-forward. But received notions of what Digital Transformation really means are also being updated. Across a range of vertical sectors, they are evolving toward new models of business value generation through technological innovation that's customized to the operational needs of a specific enterprise.

As this whitepaper reveals, organizations' ongoing drive to create their own stack of emergent technologies that will enable them to improve efficiency and make qualitative gains – even while digitally transformative projects are still unfolding – provides highly-tuned opportunities for innovative applications and practices. These opportunities are equally about the identification and riddance of incumbent methods and outdated tech that the pandemic experience has shown to be retrograde, wasteful and evidently unfit for purpose.

Digital Transformation can also facilitate best-practice sharing across sectors on a scale that's unprecedented: smart buildings borrow techniques from environmental monitoring; environmental sensors learn from construction methods; transportation learns from logistics ops; and every sector wants to derive actionable insights from AI and Machine Learning.

'Innovative Technologies Enabling Digital Transformation' casts perspective on these achievements as well as hearing directly from the professionals and practitioners who are both leading and gaining from their respective programmes of Digital Transformation. The whitepaper reports on innovation exemplars, digital change experts, and enterprise leaders. It tells the stories behind real-world use-cases where Digital Transformation is helping us to build more productive business processes, reduce environmental harm, and lead healthier, more fulfilled lives.



Innovative Tech 1

NGK Insulators: powering and empowering the IoT

The Internet of Things supports an ever-extending range of applications, from control of the world's newest smart buildings like Dubai's Al Shera'a, to the collection of personalized data via wearable fitness trackers. This growth will drive the global IoT market value to reach \$1463.19 billion by 2027, with a CAGR of 24.9 percent over the forecast period, reports Fortune Business Insights.

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However, each IoT deployment must be supplied with power, and conventional batteries – even those designed especially for IoT devices – are often not suited to emergent IoT applications. For such applications to succeed, new battery power sources are required – batteries that are ultra-thin, ultra-lightweight, have high heat-resistance, and do not have to be recharged from mains electricity.

Engineers at NGK Insulators managed to tick each of those boxes with the company's EnerCera Li-ion rechargeable batteries, which since their launch have established a leadership position in the IoT battery market. The EnerCera battery is intended specifically for operating integrated circuits (ICs), sensors, and wireless communication systems which need wide current range, such as several 10 mA to several 100 mA.

There are two EnerCera models: EnerCera Pouch, an ultra-thin 0.45 mm bendable cell for embedding in a card; and EnerCera Coin, a coin-type cell, 1 mm to 2 mm thick, for mounting on a circuit board. Both options are creating many innovative opportunities for the latest self-powered IoT and wearable connected devices, says Iwao Ohwada, Vice President at NGK.

"In addition to applications such as medical, healthcare and elderly care, we also intend our EnerCera batteries to be used for 'smart shoes' for various sports," Ohwada explains.

For the healthcare sector, NGK has collaborated with semiconductor manufacturer Renesas Electronics to develop a low-cost, slimline medical patch that enables patients' vital signs to be monitored remotely.

As the COVID pandemic continues, doctors recommend infected patients' vital signs be monitored, so that caregivers are aware of any changes in their condition. However, attaching multiple sensors can cause stress for patients – and heightens the risk of exposing health workers to the virus.

Renesas has developed a slimline medical patch that can be attached to various points on the body, like the forehead, arm and wrist, to enable real-time monitoring of body temperature. To monitor continuously, a temperature sensor is mounted on the bottom of the device, which makes contact with the patient's skin.

When the patient places their finger on the biosensing IC on the top of the patch, the patch also measures heart rate, respiratory rate, and oxygen saturation. Furthermore, the patch can transmit data to a smartphone over Bluetooth Low Energy 5.0.

Energizing the patch required a battery that is equally compact and slimline, and powerful enough to support wireless communication. It would also have to withstand bending moments, so that it would remain attached to the patient's arm when they bent or moved it. And the battery had to be reusable.

NGK's EnerCera Pouch battery is a good match for Renesas's patch. It's powerful, supports Bluetooth, and can be made to fit snugly to the body; the EnerCera battery is also rechargeable and reusable. By incorporating the EnerCera Pouch battery into its slimline medical patch, Renesas has solved its power supply issues, and delivers the ideal unobtrusive, wearable medical patch.

Another innovative use-case for NGK's star battery is a wireless power transmission/transfer (WPT) power receiver development kit that uses a combination of the EnerCera battery, low-current-consumption power supply ICs from TOREX Semiconductor, and WPT solutions from Ossia.

Announced in November 2021, the WPT power receiver development kit comprises the Ossia Antenna that extracts radio frequency as power, EnerCera batteries that store the power, and a power supply IC that stably supplies the stored power at an optimal voltage to a microcontroller unit (MCU) or sensor. Connecting this kit to any MCU or sensor enables a device with WPT as a power source to be developed.

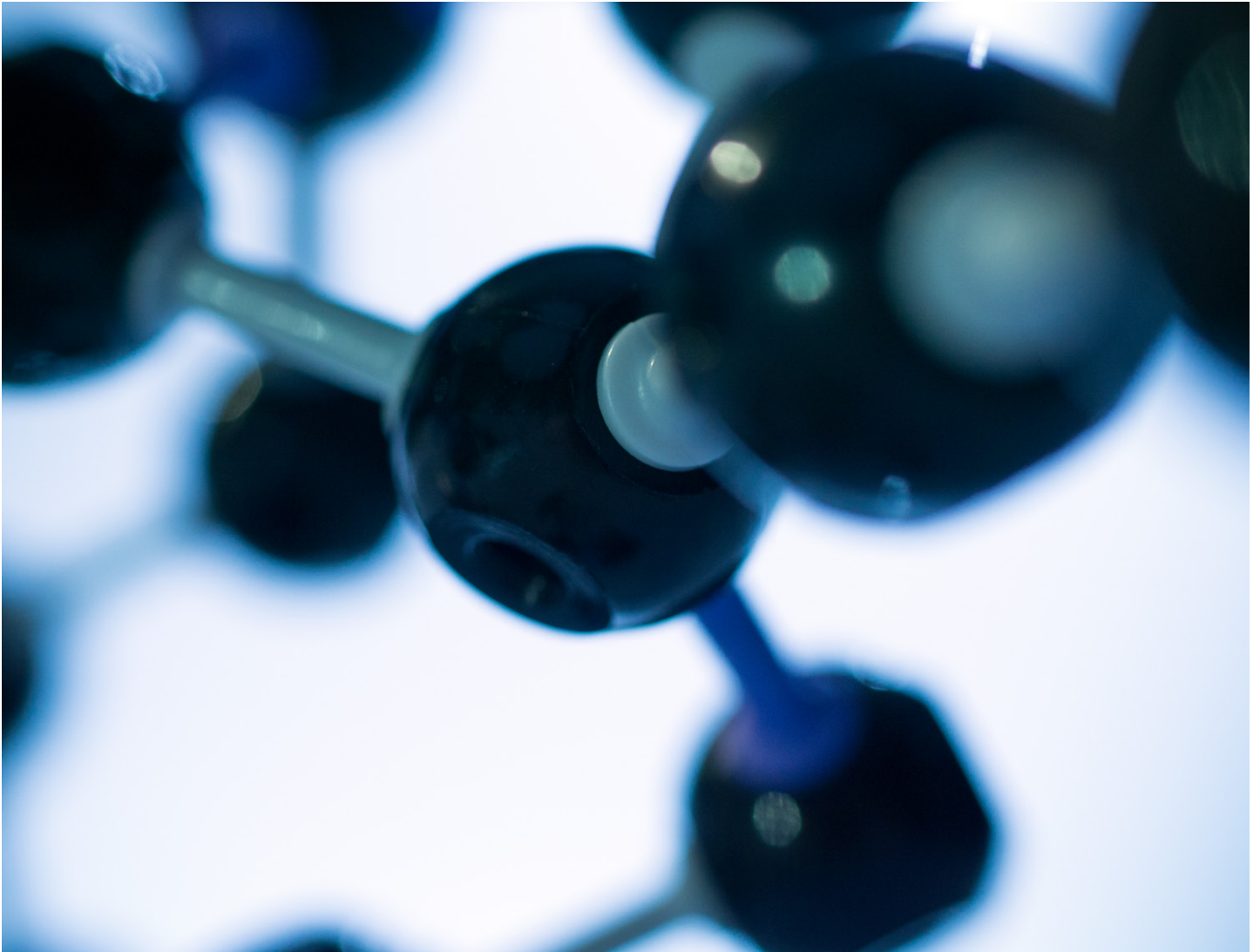
“With features such as low resistance, high capacity, and long life, EnerCera batteries are an ideal energy storage device for WPT,” says Iwao Ohwada at NGK, “because it can efficiently charge the power transmitted via WPT and store it for long periods of time and provide high enough output to power MCUs and sensors.”

Ossia’s Cota WPT using the 5.8 GHz band is expected to be used in a wide range of applications, including power supplies for sensors installed in locations such as enterprise environments, retail outlets, factories and warehouses.

At the higher frequency of 5.8 GHz, it enables smaller receivers and more precise control of power supply. NGK, Ossia and TOREX will work together to spread the use of 5.8 GHz band WPT, the companies say.

“With the products and systems using our unique technologies, we will contribute by promoting open innovation with a wide range of industry partners,” NGK’s Iwao Ohwada adds. “EnerCera batteries will contribute not only to the development of maintenance-free IoT devices, but also to the carbon neutrality of our increasingly digitalized societies.”

* EnerCera is a trademark of NGK Insulators, Ltd., registered in the U.S. and other countries.



Innovative Tech 2

Bupa: global healthcare experience transformed

According to Gartner, the Coronavirus emergency has caused some healthcare delivery organizations to accelerate their Digital Transformation programmes by more than five years. There's been additional pressure for digitalisation to speed-up as it became acutely evident that digitalisation could play a critical role in delivering safer treatments to COVID and non-COVID patients, as well as help protect frontline health workers.

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Healthcare provider Bupa's Digital Transformation programme was already well under way as Coronavirus spread around the world, but toward the end of 2020 Bupa experts realised that progress would have to be rapidly reviewed to take account of growing pandemics exigencies.

Recruited to lead this task was Bupa's Chief Technology & Architecture Officer Diana Kennedy. "Incoming Bupa Group CEO Iñaki Ereño recognises the intrinsic importance of digital, and made Digital Transformation a greater priority for 2021," Kennedy says. "His vision is for Bupa to be the world's most customer-centric healthcare company. It's achievable only through digital technologies and the transformative power of cloud."

Kennedy works closely with Bupa's Digital Transformation team and business unit CIOs around the world, and advises leadership on how to drive digital capability improvement across the health insurance and healthcare group's global network of businesses. Kennedy's remit also includes the development of the organisation's technology partnerships, from majors like Microsoft to healthtech startups.

Truly global in its operations, the Bupa Group employs 85,000 people based in the UK, with businesses in countries including Australia, Spain, Chile, Poland, New Zealand, Hong Kong, Turkey, Brazil, Mexico, and the Middle East. Health insurance accounts for the majority of Bupa's 31 million customer business, but in some markets it operates clinics, dental centres, hospitals and care homes.

"Bupa wanted to do a better job in using its considerable scale to leverage the technology that could help it achieve better global collaboration," says Kennedy. "It had deployed enterprise

collaboration platforms, but they had not been set-up across the entire organization to exploit their true potential and enable knowledge sharing, collaboration and innovation across the organisation."

One of Kennedy's initial transformative objectives was to maximise value and efficiency where opportunities exist to standardise on common digital platforms and solutions.

"Much of Bupa's IT has been configured by geographic region, rather than as part of a truly global infrastructure," Kennedy explains, "and this creates small barriers for collaboration between internal teams – so fixing that is bringing quantifiable gains."

Kennedy adds: "Also at an enterprise-wide scale, Bupa has set up the concept of Global Centres of Enablement. These facilitate communities of practice in three tech areas: Cloud, Data and Digital. Bupa experts come together in these Centres and both share best practice and create reusable artefacts, from cloud engineering and solutions implementation to DevOps and Agile deployment."

All fully cloud-enabled, these centres constitute the foundations of Bupa's wider Digital Transformation because they "bring together those responsible for making it happen", says Kennedy. "The real magic comes from the people who use those tools and 'fabric'. Digitalisation also makes it easier to capture insights and knowhow. Everyone's schedule is under pressure – without a digital-first environment there's the risk that knowledge gained could slip through gaps between systems and be lost."

In the area of analytics, Bupa uses scaled datasets to drive predictive models for planning better patient care outcomes. "We have Healthcare Analytics teams sat in our core market geographies," Kennedy explains. "We use advanced analytics to develop new care pathways to support those with chronic conditions. We also invest in AI-led digital wellness services, mostly from third-parties, that provide vital signs diagnostics trained on a scaled dataset, for example."

In June 2021 Bupa consolidated its partnership with Microsoft by announcing its intention to migrate key applications in its leading markets onto the Azure cloud platform. Business applications suite Dynamics 365 has also been rolled-out to Bupa teams in Australia and the UK. Combining these with applications based in Azure enables Bupa to offer more personalised, insight-led healthcare, Kennedy reports. Bupa is also developing a partnership with Google to adopt and exploit cloud services and advanced analytics capabilities as part of its transformation.

Bupa has been able to achieve two strategic benefits through its cloud strategy, Kennedy explained. First, it can exploit cloud-based services that are already in place and ready to deploy. Second, it can orchestrate those resources into applications that are 'local' to each country-specific business.

Kennedy adds: "If each Bupa business around the world was tasked with developing its own capability using the previous ICT model – building software, provisioning infrastructure – that would have been a minimum of 12 months for each build-out. A cloud-led approach has saved us hundreds – probably thousands – of work hours and reduced the solutions delivery timeline from years to weeks and months."



Innovative Tech 3

Strava: an exercise in digitalizing athletic lives

‘Digital Transformation’ is an adaptable concept. With apps and wearable tech, the pursuit of fitness goals can also be digitally transformed – to gain better health, efficiency and focus for body and mind.

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The high exemplar of this ideal is Strava, the subscription-based digital platform that combines exercise tracking with social network-style features that let its athlete-users report their endeavors, share experiences and facilitate competitive interaction. When founded in 2009, Strava focused on cycling and running, but now the platform is open to over 30 different activity types, like swimming, skiing and hiking.

Basic Strava services like GPS tracking, activity uploads and following friends are free, but to access the platform's full feature set requires a subscription. The company has over 90 million athletes currently on its platform, and continually reviews its feature set for ways to enhance the Strava value proposition.

"At core, our mission is to connect Strava athletes to the experiences and people that motivate them, and to help them achieve their personal best in ways that keep them driven and inspired," says Co-Founder & Executive Chairman Mark Gainey.

Strava records data for a user's activities which can then be shared with that user's followers or publicly. If an activity is shared publicly, Strava groups activities that occur at the same time/place (like a marathon or sportive ride).

An athlete's tracked information can include a route summary, elevation, speed, duration, and heart rate. Activity can be captured using the Strava app or third-party connected devices, or entered via Strava.com.

"At Strava we have a thesis: being active makes us better people – not just physically, but emotionally, socially and other ways too," says Gainey. "Also, we realise that people keep people active. So that ability for our users to interconnect and encourage each other has been critical."

Innovation at Strava is not predicated solely on technological advances. It can also be about discovering innovative ways to exploit a usage trend. "Early on, Strava focused just on cycling – we had many conversations with cyclists," Gainey says. "We learned that regardless of whether they were on a five- or 100-mile ride, there was an important moment in their journey – when they were cycling up a challenging hill, say – and that hill became the iconic moment within their ride that they most focused on."

He continues: "We thought, 'How can we help those users characterize that hill and the effort they expended there?' And that became a 'Strava Segment'. These gave cyclists context and showed them how hard they were working and trending on successive climbs."

This feature led to another user request: 'Can you show me how my friends are doing on that same climb?', Gainey adds: "So we thought about how we could show this on leaderboards and create opportunities for competitions, based around Strava Segments." Tens of millions of Segments have been created, Gainey reports: "It's become integral to the Strava experience. From it users can create camaraderie, motivation – and yet it's not a super-sophisticated idea!"

Having over 90 million athletes is a colossal endorsement of Strava's popularity, but presents scale challenges for Gainey and his teams. Strava user feedback includes many suggestions for new features – so how does Strava decide which ideas to act on?

"Prioritizing new features is a challenge," Gainey feels. "We don't always go with something that might meet the biggest 'ask' constituency. Sometimes it's better to prioritize personalisation tools so that users can create their own features."

Wearable connected devices are integral to Strava. "Strava's been turned into the data hub of the connected fitness market," Gainey says. "Over 500 devices connect into Strava, with 70,000 API partners. Two trends fascinate us. First, the definition of a 'wearable device' is changing rapidly. Strava users now capture health

information on their finger, inside footwear and clothing.”

Second, says Gainey, the data types are expanding to include sleep and nutritional data, glucose levels, etc. “We’re excited about how we can process that data to help users interpret it to achieve their goals – whether that’s a marathon or just a healthier lifestyle.”

Strava’s influence has also entered the urban planning and smart city space. In October 2020 the company made Strava Metro, its active travel dataset, freely available to metropolitan government and infrastructure planners. Strava Metro aggregates and de-identifies data uploaded by Strava users about their activities before making it available to qualified third-parties.

“Strava Metro provides cities with access to mobility insights that inform smarter urban planning and infrastructure decision-making,” Gainey explains. “It can, for example, assist departments of transportation and city planning groups to understand changing commute patterns in the Coronavirus pandemic, to improve safety and evaluate infrastructure projects.”



Innovative Tech 4

XPO Logistics: moving efficiently with the technology

Logistics describes itself as a 'highly integrated network of people, technology and physical assets'. The Connecticut, US-headquartered company's commitment to being digital is evidenced by a yearly \$300 million investment and an ethos that gives its 50,000 customers direct reach into its core ICT platforms.

Operating in 744 locations with some 40,000 employees, supply chain solutions specialist XPO Logistics describes itself as a 'highly integrated network of people, technology and physical assets'. The Connecticut, US-headquartered company's commitment to being digital is evidenced by a yearly \$300 million investment and an ethos that gives its 50,000 customers direct reach into its core ICT platforms.

"Since the start, technology has been central to everything XPO does," says its CIO Mario Harik. "We've believed that proprietary platforms and systems, propelled by scale, drive innovation and efficiency in transportation services. Our 900 technologists are embedded throughout our operations, focused on four areas of innovation: automation and intelligent machines, visibility and customer service, our digital freight marketplace and dynamic data science."

Broadly, XPO Logistics has a two-line model. First, there's its 'less-than-truckload' (LTL) business, where it collects goods from a customer site and moves the consignment between its distribution terminals. It then fulfills a local delivery of the goods via its own LTL fleet of physical assets (i.e., trucks) and drivers.

XPO's truck brokerage business has no physical assets. On this side of the company's operations its sales and carrier procurement teams manage customer shipments on XPO's digital platforms – principally XPO Connect, working in conjunction with its Drive XPO app. Behind those platforms, the organization has access to a huge amount of truckload capacity, provided by independent third-party carriers, to move these goods on behalf of XPO's customers – with XPO's own tech platforms enabling that fulfillment from start to completion.

"Think of XPO Connect as a digital freight marketplace that allows our customers and carriers to interact electronically," Harik explains. "A customer on the Connect platform can quote, they can book, and can manage their shipments. They get full end-to-end visibility on where the freight is at any point. If they have systems that they want us to integrate with ours, we use APIs for back-and-forth integration to manage transportation."

On the third-party carrier side, meanwhile, XPO Connect allows the company to manage tens of thousands of carriers and find the right match for each load. "They can negotiate with us electronically on Connect, and the platform enables us to procure transportation with the benefit of deep visibility into the market conditions," says Harik. Drive XPO is XPO Logistics' Apple iOS/Google Android app that drivers and carriers use as part of the XPO Connect platform. Carriers can interact with XPO Logistics through Drive XPO with the same functions they get using the platform online. "They can book specific shipments, they can put in bids, they can 'buy it now' or negotiate with us," Harik says.

The third component that gives XPO Logistics its digital edge is XPO Smart: this is a proprietary labor resource optimization system that leverages data science and Machine Learning to forecast demand in individual cross-dock facilities in XPO Logistics' LTL network. XPO Connect and Smart have embedded Machine Learning functionality, and get 'smarter' as more data flows through the systems, allowing the algorithms to function more and more effectively.

With XPO Smart, XPO analysts look at historical information and time as being the predominant factors of how the system can 'forecast' the future. "However, when we look at time, we put a much higher weight on recent time periods than we do on, say, the same day or same week a year ago," explains Mario. "Effectively, this allows the algorithms to reflect more recent trends with a higher level of accuracy than they would when the data dates from an earlier timeframe."

“Many of our customers and carriers have their own transport management and/or supply chain system, so XPO Logistics tech support offers integration with our platform through Electronic Data Interchange (a generic term for methods of electronic business communication), APIs and web-based access,” says Mario.

“Approximately 60 percent of all the shipments coming through our truck brokerage business are coming in electronically through EDI, API, on the app, and through shippers booking digitally via Connect as well. And all of this goes back to the usage of the platform – and how we’re focused on driving that usage.”

XPO Logistics recently reported that it had been able to grow the number of customers registered on the platform by six times year-on-year in Q2/2021. “The global freight industry is evolving, and customers want to de-risk their supply chains with more intelligent automation and better visibility into the movement of their goods,” Mario says. “Because we prioritized digitalization and visibility early in our technological development, we’re already in a leading position to meet this demand.”



Innovative Tech 5

Nippon Express with Intel Japan: extra care for cargo tracking

The global logistics services sector is rebounding after an 18 month period that saw it contract by 3.3 percent, according to Research and Markets, which also reports that within four years the market will be 24 percent larger than before the Coronavirus pandemic.

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The latest growth is being driven by an escalation in cargo volumes caused in part by post-pandemic recovery, but also because Digital Transformation has introduced efficiencies that bring higher levels of customer engagement.

One aspect of logistics services where digitalization has introduced direct improvement concerns goods that require strict quality control during shipment, such as precision machinery and pharmaceutical supplies.

Such consignments transported across ground, air and sea have to be monitored continually to check that they stay at the right temperature and orientation, for instance, and haven't been damaged en route.

This is an estimable challenge, especially because these categories of cargo show high market growth rates that logistics services providers want to leverage. It's a challenge that leading logistics services provider Nippon Express has accepted with fervour.

Nippon Express operates a global network that comprises some 735 locations and 30 different lines of business, ranging from freight and transportation to warehousing and packaging.

The Tokyo-headquartered company is renowned for its embrace of advanced digital technologies that enable it to address both customer demand trends and wider legislative requirements of the territories in which it operates: it's been characterized as a company that constantly adds value to change.

Integral to this is Nippon Express's Global Cargo Watcher Advance (GCWA) service – a cloud-based freight tracking service that enables both Nippon Express and its customers to keep a real-time check on the transport status of shipments. It achieves this via compact digital

sensor tags affixed to cargo to measure temperature, humidity, vibration, tilt, illuminance, location and other conditions. GCWA updates and uploads this data to a cloud-based backend system via reader gateways installed in vehicles and warehouses.

Measurement data cannot be uploaded while cargo is onboard aircraft in flight, in areas outside of designated communications network coverage, or in other locations where communications between readers and sensors may become disrupted. (Once communications are re-established, the measurement data collected during the break period is uploaded and the backend updated.) Accumulating shipment information data also gives Nippon Express the opportunity to propose new solutions to customers. Data on how cargoes are being transported around the world is continually collected and analysed. Sharing such data can help detect trends and reduce delivery times.

GCWA also offers predictive analytics to identify demand, supply chain optimization, and risk management. The mitigation of risk helps Nippon Express's customers boost productivity and optimize their business processes.

Critical to the GCWA service is the Intel Connected Logistics Platform (ICLP). Developed to offer near-real-time asset tracking solutions for the logistics industry, ICLP is an IoT-enabled platform that uses battery-operated smart wireless sensor devices that, working with a proprietary wireless sensor network, provide greater visibility into location, condition and security of cargoes.

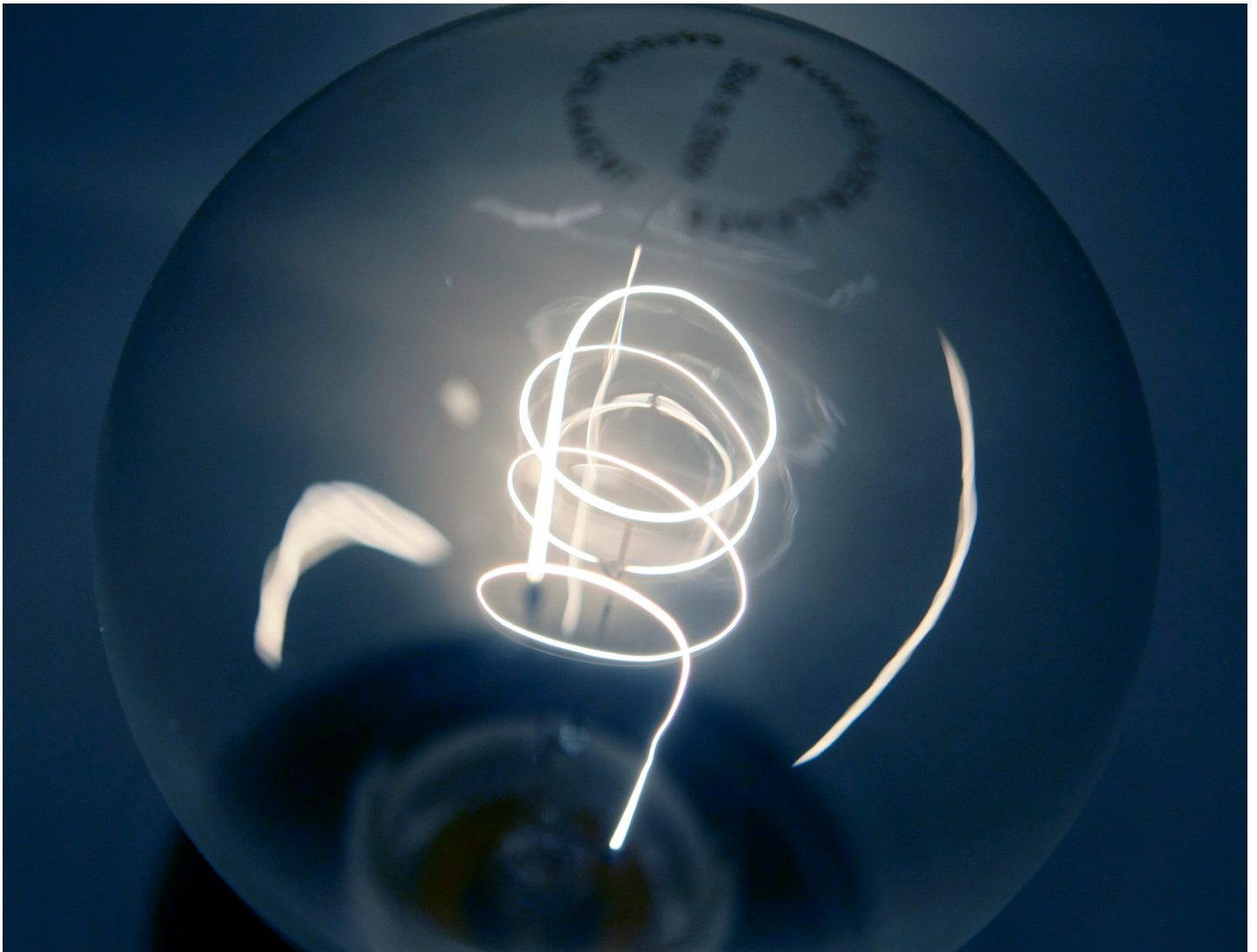
"Essentially, ICLP is a reference platform that involves both hardware and software," says Ray Zhang, Executive Director, Business Consumption at Intel Japan. "For deployment as part of a commercial solution such as Nippon Express's, the platform is customized to meet with specific operational requirements, and configured to deal with the different types of cargo it might monitor." Zhang adds: "When you put the platform into the field, various unexpected challenges will likely arise. An example is support for diverse network connections. The GCWA is running across the world in different areas and different operational environments, so we need

to ensure that it connects to different wireless networks – 3G, LTE and along to 5G – correctly.”

Research and Market’s believes that with the emergence of 5G network connectivity, the logistics industry will shift towards a significant transformation in order to build an even more cost-effective ‘autonomous ecosystem’.

Forecasts for medium-term value growth of the global logistics market vary between analysts. According to a report from Allied Market Research, it’s worth will reach \$12.97 billion by 2027, registering a CAGR of 6.5 percent over the same period. Another report by IMARC Group, however, projects market value to reach \$6.9 trillion by 2026, but with a CAGR of 4.6 percent during the forecast period (2021-2026).

Whichever estimate proves correct, what is assured is that Digital Transformation is key to achieving these margins. Meanwhile, Intel Japan’s Ray Zhang is in no doubt that, at whatever pace digitalization progresses, the world’s logistic service providers now have to decide whether to be disruptive – or disrupted.



Innovative Tech 6

SMK Corporation: harvesting energy to beat the IoT battery drain

The battery industry was a pioneer of the product recycling ethos, yet each year a huge quantity of primary batteries – estimates range from 9 billion to 15 billion – get discarded, likely destined for landfill.

The battery industry was a pioneer of the product recycling ethos, yet each year a huge quantity of primary batteries – estimates range from 9 billion to 15 billion – get discarded, likely destined for landfill. Meanwhile demand for batteries gets higher around the world – and it's an increase driven in part by the burgeoning Internet of Things: the global battery market for the IoT overall is estimated to grow from \$9.2 billion in 2020 to \$15.9 billion in 2025 (a CAGR of 11.6 percent), according to researcher MarketsandMarkets.

Even long-life batteries to power remote devices that make up the IoT and other connected device applications have to be replaced every three-to-ten years – and that's on the assumption that they survive that long.

This means that as IoTs build out globally across multiple millions of devices, the task of replacing the batteries that power all those devices and sensors will become a major challenge – especially where those devices serve industrial and safety critical systems and infrastructure.

This dilemma, however, looks set to provide significant opportunities for innovators like SMK Corporation, the global designer and manufacturer of OEM electronic components. Its declared aim is to be a company that develops innovative and original solutions to the challenges that face both its customers and the wider societies in which they operate – especially the challenges of more efficient methods of connectivity.

SMK believes that energy harvesting and Wireless Power Transfer technology are the true final jigsaw pieces that will signal the decline of the era of battery dependence for many technological use-cases, and so enable the IoT to attain its fullest potential for the long term. "Billions of batteries are thrown away each year, and to make matters worse it takes much more than a battery's power output to actually manufacture it," says Toshihiro Morita, Technical Sales Manager at SMK Electronics. Morita and his colleagues set about the development of a better alternative solution to the battery conundrum.

Earlier this year SMK announced what it believes is the first hybrid technology that combines two different types of non-battery power supply systems – combining energy harvesting and Wireless Power Transfer.

In brief, energy harvesting technology converts renewable energy (such as indoor light, temperature, vibration, etc.) into electricity. Far-field Wireless Power Transfer (WPT) Technology, meanwhile, is the transmission of electrical energy without wires as a physical link. Far-field WPT differs from the proximity (near-field) WPT systems that are already in practical use for charging mobile devices, for instance. Far-field systems enable power transmission to a distant location – up to 10 meters, SMK says – using sub-GHz microwaves. Its new solution will enable battery-free sensors and other IoT devices, as well as remote controls product – thereby obviating IoT battery replacement costs and end-of-life battery disposal, SMK says.

The new solution promises a range of additional benefits. Without conventional dry batteries devices can be thinner, Morita points out. They have better drop impact resistance due to weight reduction and because there no need for a cover to fit a battery, water resistance and robustness are improved.

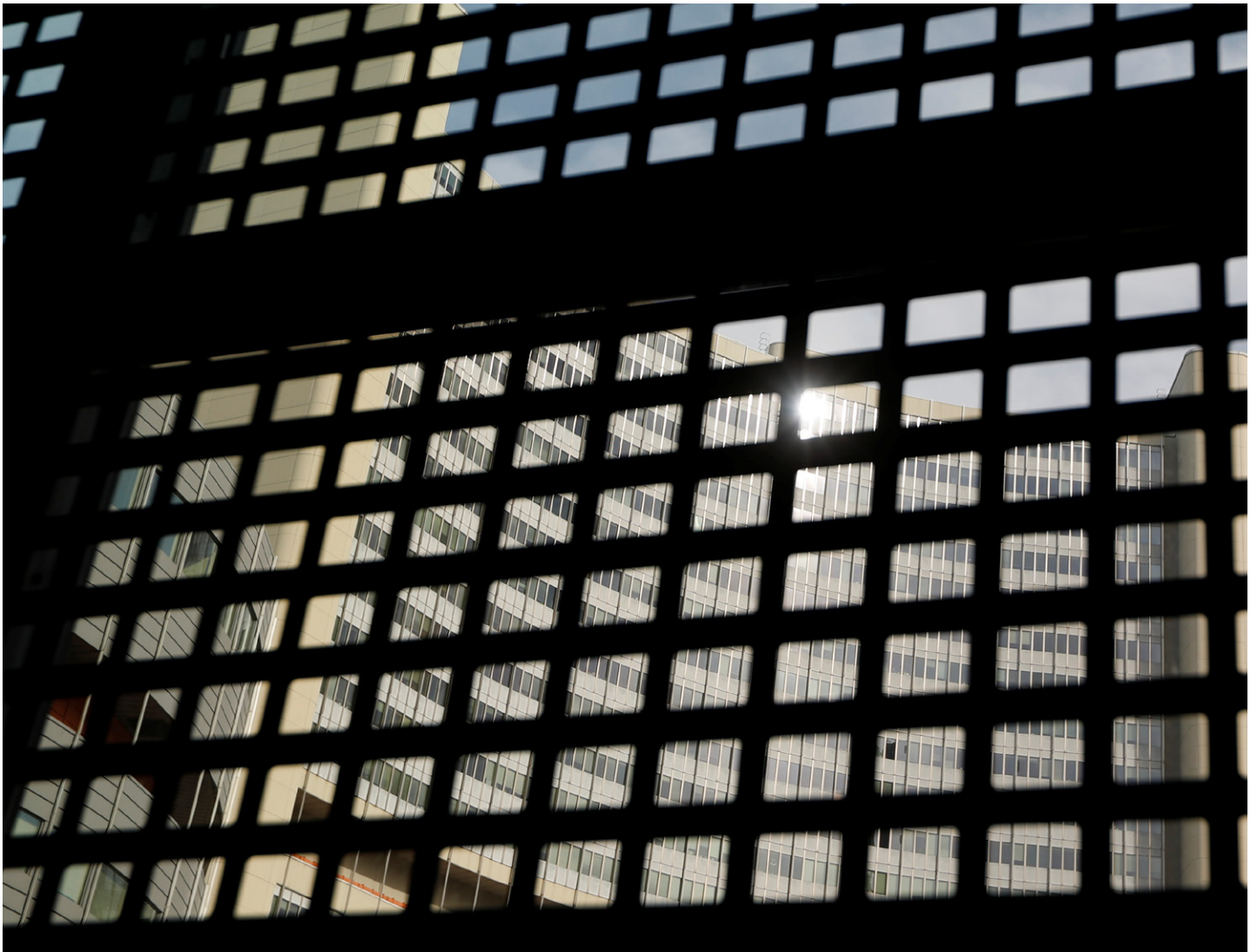
"The new solution is initially aimed at business and industrial use-cases," says Morita. "For instance, the monitoring of facilities equipment such as the kind installed at large plants, factories and national infrastructure, often calls for batteries to be replaced on a regular basis. This task can be costly and hazardous work because it means human engineers must get to places that are risky to access. Once deployed at scale in the field, SMK's solution would greatly reduce that requirement."

For the present, the new solutions SMK has announced are primarily aimed at deployment into technological and industrial use-cases where there is a compelling justification for that reinvestment, Morita explains: "We expect that deployment of energy harvesting/far-field WPT into consumer products will come into play eventually, but the reality is that for now consumers are disinclined to pay the extra cost

our battery-free solutions would add to the purchase price of devices.”

It is also important to understand that obviating the need for batteries is not just about reducing maintenance costs, continues Morita: in addition to design and durability benefits, it also could help prevent unforeseen equipment failures that are caused by battery reliability issues.

“We are still at a proof-of-concept stage with this solution, and have some way to go before we reach the production stage,” Morita explains, “but we are making good progress toward that. Over the next year we expect it to be introduced to existing applications – after that new applications for the solution will start to emerge.”.



Innovative Tech 7

Ricoh Group: power for sensors in new worlds of operation

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In ways, the Internet of Things is a network of unknowns: no one is sure of how many devices are connected to the internet (20 billion? 26 billion? 30 billion?), nor which of those devices really belongs to the IoT.

What we can be reasonably certain about, however, is that this mass surge to interconnect will present problems when it comes to keeping the IoT powered and charged-up, because there's a disparity looming between the electrical energy required to run all the devices and the energy available to do so.

Making and discarding more batteries is not compatible with many regional environmental policies. For example, according to the 'EU Regulatory Framework for Batteries' (March 2021), the European Union is looking at phasing out non-rechargeable primary batteries by 2030.

These factors add impetus to energy harvesting as a means to transition from battery dependency. Energy harvesting is the conversion of ambient energy present in the immediate environment into electrical energy for use in powering autonomous electronic devices or circuits, such as those used in wireless sensor networks and wearable electronics.

Developments in this field produce energy harvesting solutions robust enough to be used to power sensors and monitors deployed just about anywhere – from the built environment or transport infrastructure to wearable devices and child strollers. Allied Market Research valued the global energy harvesting system market at \$511.6 million in 2020, and forecasts a worth of \$1,057.7 million by 2030 (a CAGR of 7.5 percent).

But energy harvesting is more than a business opportunity; it is a way to reinvent how we source and consume electrical power, and Ricoh Group is at the forefront of that reinvention. For Ricoh, energy harvesting is about the creation of 'A World Without Charging', where people no longer have to recharge or replace batteries. It's also about transitioning toward a world in which many forms of batteries are obsoleted by more efficient and sustainable ways of energy provision.

"At some point in the next decade we should expect a major battery crisis, for which we ought to prepare," says Tetsuya Tanaka, General Manager at Ricoh's Energy Harvesting Business Center. "The IoT is a massive force for change, because it brings the power of the internet to a wide range of remote objects. But most of those objects, such as wirelessly-connected environmental monitors, need a local source of low power in order to function, and so they are equipped with small batteries. But they needn't be."

Earlier this year, Ricoh launched its latest range of self-powering Dye Sensitized Solar Cell (DSSC) environmental sensing devices, the EH Environment Sensors D201 and D202, as successors to the D101, launched in 2020. Due to an improved dye material and hole transfer layer material, power output for the new solutions is increased by 20 percent from the previous model.

"The new solar modules will further eliminate the need to replace batteries used in IoT terminals," explains Tanaka. "Power generation is achieved within a -30°C-to-60°C temperature range, so the sensors can be used in refrigerated, high-temperature and high-humidity indoor settings to acquire environmental information without reliance on replaceable batteries or wired connections."

"Modules are solidified electrolytes – made using only solid materials – and are safe and highly durable, so they eliminate the risk of liquid leakage due to aging that can occur with conventional batteries," Tanaka adds. "Going forward, using this type of technology there is also power generation potential for the walls of offices, warehouses and factories, even under indoor light or other low-light environments."

In August 2021 Ricoh took the energy harvesting ideal further, with the introduction of a physically flexible energy harvesting device – an organic photovoltaic that generates power indoors or semi-indoor areas as a stand-alone power source for the constant operation of a variety of sensors.

Sized 41mm by 47mm, the thin, lightweight, bendable film-based device uses a proprietary photovoltaic material developed by Ricoh in collaboration with Kyushu University. The result is sustained power generation in low-light environments, such as indoors (approximately 200 lx), and medium-light such as shaded outdoor areas (approximately 10,000 lx). The device can also be mounted on variously-shaped IoT devices.

Meanwhile, Ricoh is also working on the development of perovskite solar cells – a type which includes a perovskite-structured compound (most commonly a hybrid organic-inorganic lead or tin halide-based material) as the light-harvesting active layer – for the outdoors use-cases and even for deployment in space, says Tanaka: “We continue to contribute to solving social issues through our business by expanding the applications of independent power sources to reduce environmental impact.”



Innovative Tech 8

Al-Shera'a and Johnson Controls: a smart building that learns from experience

Increasingly, smart buildings are defined in terms of the goals of the organizations that own and occupy them, rather than the intelligent technologies they facilitate. Furthermore, as smart buildings get smarter, they will drive a global market set to grow to \$265.37 billion by 2028 with a CAGR of 21.6 percent (forecasts Fortune Business Insights).

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Much of this investment will emanate from the United Arab Emirates. The nation has a passion for the smart build ideal that applies to both privately- and publicly-funded projects, and the Dubai Energy and Water Authority (DEWA)'s new HQ, Al-Shera'a, is an outstanding exemplar of this.

The 185,800-square-meter structure, scheduled to open in 2022, will serve as a showcase for, and a benchmark of, DEWA's commitment to the Net Zero Energy Building principle (total amount of energy used by the building annually equals, or is less than, the amount of renewable energy created on-site).

The structure will accommodate more than 5,000 people who needn't worry about losing their way as they navigate its 15 floors, basement levels, and four-story car park: there's a 'digital concierge' available to guide occupants and visitors around Al-Shera'a's inner environs.

DEWA commissioned Johnson Controls (working with Microsoft UAE) to deploy the core smart management tech for Al-Shera'a that will enable it to meet its ambitious targets, based on the company's OpenBlue platform. This is a suite of connected function-specific solutions that deliver impactful sustainability, healthy occupant experiences, and safety and security.

OpenBlue also provides customized, AI-powered service solutions such as remote diagnostics, predictive maintenance, compliance monitoring, advance risk assessments. Other features include OpenBlue Digital Twin: a managed service for smart building enablement and mapping by creating a digital replica of assets, processes, people, places, systems and devices.

"OpenBlue applies a set of AI algorithms against data inputs that create optimization opportunities for Al-Shera'a's building operators who can then optimize environmental levels such as air temperature, quality and ventilation," explains Vijay Sankaran, CTO at Johnson Controls. "It can also inform decision-making around space utilization and manage predictive maintenance, automatic service dispatches and service workflow automation."

The operational recommendations OpenBlue provides will be cross-referenced with data about the number of people in the building at a given time and how much energy they are utilizing – either directly (by using a workspace computing device, say) or incidentally, as a result of their use of a particular workspace's environmental services.

Johnson Controls is also implementing innovative OpenBlue features including remote diagnostics, predictive maintenance, compliance monitoring, and advanced risk assessments to monitor the energy efficiency and space performance using central AI to optimize the building's sustainability.

"The range of data types OpenBlue ingests for processing is very wide," says Sankaran. "In addition to environment controls OpenBlue handles inputs from fire and alarm systems, inputs from solar panel arrays, air quality sampling, CCTV feeds, and even the car park's EV charging systems."

He adds: "Al-Shera'a's occupants generate telemetry that impacts the consumption of energy within the building's spaces, whether that is directly through their own activities, or through the choice of the building operators, as they create healthier spaces."

OpenBlue's new Performance Advisor feature uses dashboard-driven data tracking software and AI to follow indoor air quality and energy consumption, and deliver clean air and decarbonization recommendations. The software also supports management of employee health, productivity and tenant experiences.

“Performance Advisor gives operators control over making integrated choices that traverse data silos, rather than following static standard operating procedures,” Sankaran says. “Our algorithm measures parameters such as zone size, occupancy, facemask usage and weather forecasts, and can predict the chances of an infection spread. It provides recommendations to facilities managers that range from deep disinfection to energy minimization, depending on the specific needs of a space at a given time.”

Meanwhile, Al-Shera’a’s system will take time to establish data on patterns of usage that OpenBlue can base its recommendations for action on, reports Sankaran: “When Al-Shera’a opens, we will not be at a point where the building systems can make adjustments autonomously or where we can say the building self-corrects. What it can do is, based on the outputs of the AI and Machine Learning algorithms, make a set of recommendations for the building operators to make a decision.”

However, Sankaran and his team expect that as Al-Shera’a’s control systems continue to ‘learn’, and operators through OpenBlue’s management functions accept more of the optimizations it suggests, the system can register when a recommendation has been accepted 50 times, say, and so codify it as standard procedure thereafter.

Concluding Points:

Key takeaways from 'Innovative Technologies Enabling Digital Transformation'

NGK Insulators

Soon, the Internet of Things will be the 'Internet of Anything', thanks to advanced new power sources like the EnerCera battery. Energy management solutions are the future of battery technology. Innovators are open to working closely with partners who may create new applications – and markets – for your innovations.

BUPA

Digitally transform existing processes to harmonize geographically dispersed operations by leveraging the flexibility of cloud, and build strong relationships with technology partners that add value to their products and services. Cloud can also be used to replicate IT processes and bring digital continuity to the furthest reaches of the enterprise.

Strava

Build on connected technology to build deeper relationships with customers that enable them to invest value into their use of digital services. Be mindful of opportunities for the value of proprietary data assets to be extended into additional applications.

XPO Logistics

Provide service delivery platforms that customers can closely engage with, so that they feel supported by a community of mutual interest. Embrace emergent advanced technologies like AI to increase commercial value from existing IT investments. Be open to integration with customers' preferred technologies.

Nippon Express and Intel Japan

Stay close to customers' specific requirements, and market differentiation will be retained. Prove trustworthiness to customers, and build a robust strategy for risk mitigation. Leverage your technology partners' global strengths, and view disruptive global trends as a positive challenge.

SMK Corporation

Be alert to opportunities to exploit emergent technological trends in ways that leverage established product leadership. Make long term R&D investments that will put you in a market leading position in emerging markets. Embrace ways to contribute to prevailing Net Zero ambitions.

Ricoh Group

In order to transform the world be prepared for a world of innovation-driven transformation. Look for opportunities to provide alternative solutions to long-standing problems in the world of technology – because every technology must evolve through successive cycles of re-invention.

Johnson Controls and Al-Shera'a

The technology it surrounds itself with increasingly defines an organisation's cultural identity. Design technology that can learn from, and be modified to, the world around it. Low energy consumption will be a hallmark of technical excellence in the move to a Net Zero economy. Someday all buildings will be smart buildings.