

## Your Trusted Partner in Automation

Moxa is a leading provider of edge connectivity, industrial computing, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things (IIoT). With over 30 years of industry experience, Moxa has connected more than 57 million devices worldwide and has a distribution and service network that reaches customers in more than 70 countries. Moxa delivers lasting business value by empowering industries with reliable networks and sincere service. Information about Moxa's solutions is available at [www.moxa.com](http://www.moxa.com).

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**See the IIoT in Action**  
Explore Our Worldwide IIoT Case Studies



Industrial Network  
Infrastructure



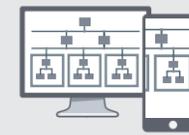
Industrial Edge  
Connectivity



Industrial  
Computing

# Enabling IIoT Connectivity to Pave the Way for Intelligent Solutions

The value of the Industrial Internet of Things (IIoT) to manufacturers is indisputable as it helps them improve their operations, drive productivity, and stay competitive. According to a recent Capgemini study, 62% of industrial manufacturers are already implementing IIoT initiatives. The IIoT is enabling digital transformation by connecting OT (Operational Technology) machines and devices to IT (Information Technology) systems. With connectivity, manufacturing intelligence can be realized in three areas: (1) viewing productivity performance in real time, (2) forecasting production quality, and (3) transforming your business.



## Connect to Visualize

Remote Monitoring is an application that allows you to view data that was often held in decentralized silos. With the combination of existing data sources and sensors on the shop floor, significant benefits can be realized, such as real-time KPIs and dashboards that assist production managers with adjusting their production planning.



## Connect to Predict

With the number of sensors being deployed increasing by leaps and bounds, managers now have ready access to large amounts of data for predicting the performance of their machines with greater accuracy. This trend allows managers to make better informed decisions about maintenance and take action earlier to avoid downtime. While certain measures may still have to be carried out manually with longer lead times, using edge computers is an efficient strategy to automatically prevent adverse events, such as shutting down machines because of the possibility of imminent production failures.



## Connect to Transform

By connecting internal and external systems you can make informed decisions and adapt quickly to changing business environments to transform your business. In smart manufacturing, mass customization is achieved through connected smart production lines/sites to support both standardized and customized production. An increasing number of manufacturers today connect manufacturing and ERP systems to external customers' systems and logistics systems to streamline the production process. A resilient and reliable network is critical to ensure data integrity along the way.

Table of Contents

page. **03** Use AIoT to **Boost SMB Performance**



page. **09** Achieving Centralized Asset Management With **Simplified Edge-to-cloud Connectivity**



page. **15** Smarter Shop Floor With **Cloud-based Monitoring**



page. **21** True Material Traceability to **Improve Logistics and Production in Industry 4.0**



## Find Out How Moxa's Edge-to-cloud connectivity Solutions Grow Your Business

Connecting all of your industrial equipment allows you to unleash its intelligent possibilities. Moxa's edge-to-cloud solutions simplify IIoT connectivity, thereby enabling you to gain real-time insight from machines, prepare properly for the future, and even achieve higher-level business transformation.

Be inspired by these successful IIoT connectivity solutions and optimize your business.

page. **27** Mass Customization Within an **Interconnected Factory**



page. **29** Let There Be Light: **Changing Rural Livelihoods**



page. **35** Enabling a New Service Model for **Home Solar Energy Systems**



# Use AIoT to **Boost SMB Performance**

**P**erformance-driven KPMG helps small and medium businesses migrate to the cloud with AI and IoT applications



## KPMG

**Industry:** Audit, tax and advisory services

**Global Headquarters:** Amstelveen, Netherlands

**Number of employees worldwide:** 200,000

## Challenges

- Average production cycle increased from 30 days to 40 days
- Decline in order arrival rate
- Overall Equipment Effectiveness (OEE) is too low

## Solutions

- IIoT controller to acquire OT data, upper and lower wheel current (4 to 20 ma AI) and ON/OFF (I/O)
- Industrial Ethernet switch and wireless AP to ensure data reliability and transparency
- AOPC UA Server for IT-OT data consolidation

## Results

- Using IoT to Improve OEE from 70% to 83%
- Using AI + IoT to Increase Production Yield

**KPMG**, a distinguished global firm providing audit, tax, and advisory services, leverages AIoT (the artificial intelligence of things) technologies by combining developments in the Internet of Things (IoT) and artificial intelligence (AI) to help small and medium businesses improve equipment utilization rate, increase yield, build predictive maintenance, and migrate to the cloud, with the intent to enhance return on investment (ROI).



**Chi-Zhan Kao, associate director, advisory service department, KPMG thinks it is more practical for small and medium businesses to incorporate IoT applications based on ROI considerations.**

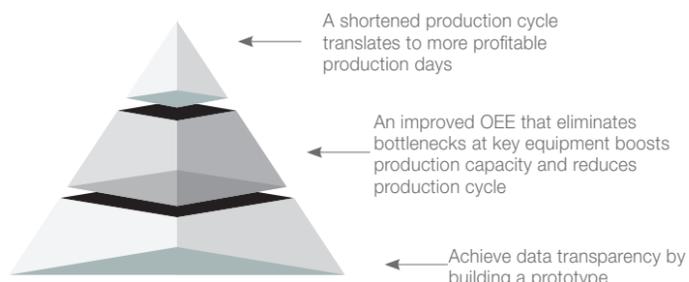
“Our clients attach great importance to ROI. When we pitch our IoT, machine learning, and AI services, the first question that they ask is about the use of collecting data the manufacturing execution system (MES),” says Chi-Zhan Kao, associate director, advisory service department, KPMG, drawing on his experience to help a Japanese-Taiwanese joint venture firm that manufactures engine parts.

Although Industry 4.0 technologies such as the IoT and machine learning are the major trends in the global manufacturing industry, most efforts are made toward improvement on functionality and intelligence. Financial benefits such as ROI, which are the most practical and meaningful to business owners, are rarely talked about.

“Clients generally want to raise their capacity utilization (UT). From MES data, we found their UT is low, mostly around 70%. If a large-scale manufacturer has such a low UT, it makes almost no profit. It is also particularly painful for business owners when they have to pay employees overtime.”

When Kao began working on this project two years ago, he found the client’s UT was too low, resulting in a long production cycle, a low order fill rate, and high overtime costs. He decided to help the client resolve its operation bottleneck from the perspective of overall equipment effectiveness (OEE), which is closely related to UT. The first step was to make use of the IoT to enhance visualization of data management.

### Benefits of IoT Technologies



## First Stage: Use IoT to Improve OEE

“For the client, we wrote a software program to monitor information collected from IoT devices. We discovered a couple of problems. First, MES data and IoT data of equipment uptime were inconsistent. Second, data gathered by IoT devices indicated that equipment utilization was indeed low, especially during night shifts.”

After looking further into the client’s operations, Kao found, from the client’s MES data, they were still relying on a manual clocking system. OEE during night shifts was low because employees were slacking off. Now through the newly gathered data, production managers can have a clearer picture of uptime, tunning, idle, and downtime hours within the day, and can thereby improve the night shift OEE in real time. Upper management can also use the data to regularly keep track of the weekly and monthly progress.

OEE Monthly Report

	Production	Total Working Hours	Running Hours	Idle Hours	Downtime Hours	Labor Hours	OEE
2018	Aug.	0.00	26718	19739	4575	16152.00	73.8%
	Sep.	172140.00	21105	14886	1809	16942.00	70.53%
	Oct.	380921.00	26649	15368	1098	27956.000	57.67%
	Nov.	710179.00	28609	22083	960	21046.00	77.19%
	Dec.	306167.00	18041	14979	1082	12150.00	80.03%

From the gathered data, the problem of a low OEE is identified and resolved.

After 18 months of implementation and testing, the engine part manufacturer boosted its OEE from 70% to 82%-85%, which was a significant improvement. Not only was the production cycle shortened, but overtime costs were also reduced considerably.

“If we translate the savings in overtime costs into the ROI for the IoT implementation, it is actually a good deal for the client.”

Kao showed the client the real value that IoT data can create, so the client asked him to initiate the next stage of the process improvement plan.

OEE Trend Chart



Capacity utilization (UT) is critical to the profitability of small and medium manufacturers



**The IoT combined with precise management improved equipment OEE from 70% to 82%-85 % and shortened the production cycle.**

## Second Stage: Using AI to Increase Yield and Improve Processes

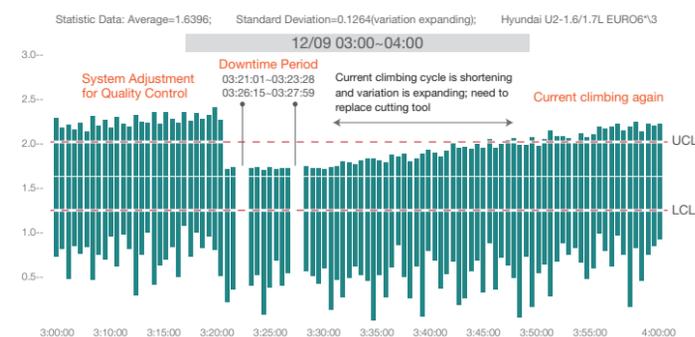
**“An increase by one percentage point in yield translates to an increase by one percentage point in profit margin. If the rework process on the rejects encounters more problems, there will be additional waste of material and labor.”**

**Chi-Zhan Kao**

Associate Director, Advisory Service Department

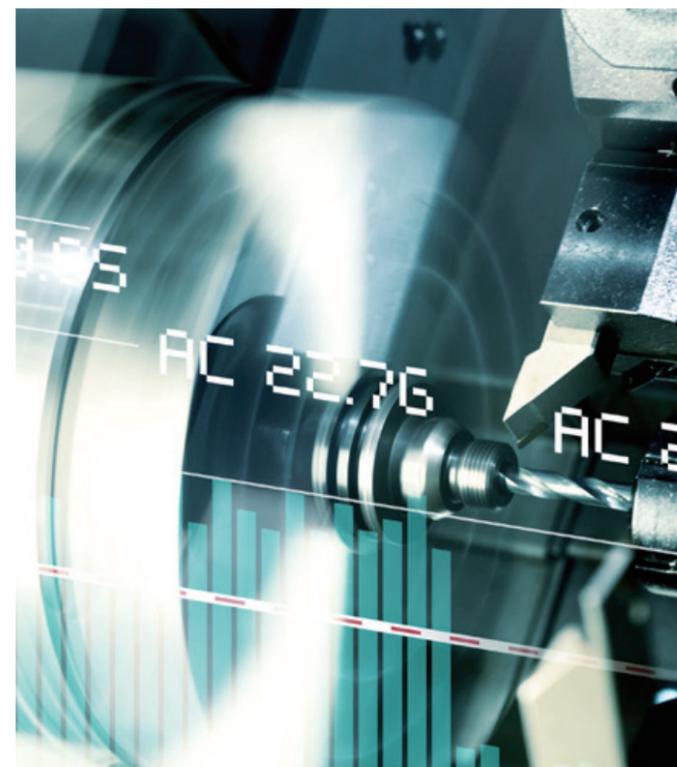
“An increase by one percentage point in yield translates to an increase by one percentage point in profit margin. If the rework process on the rejects encounters more problems, there will be additional waste of material and labor.” noted Kao. Since the beginning of 2017, the client has been dealing with the issue of poor yield, causing the entire production pattern to deviate from the norm. The client has no idea what the root cause may be.

To avoid an abnormality from occurring, Kao thinks it is crucial to effectively control production variation. By adding more sensors to existing IoT devices to collect additional data on vibration, temperature, rotating speed, and electric current, and sending them to a back-end AI platform for analysis, variation control standards can be established and preventive maintenance can be conducted before variation becomes a big problem in order to avoid the production of defective products.



When process variation becomes larger and larger, early replacement of parts is necessary to avoid the production of defective products

For example, when a machine's cutting tool shows an overly high current frequency, there may be tooling damage. An early replacement of potentially damaged tooling can prevent unexpected downtime or accidents, thereby improving production yield and process stability while reducing equipment maintenance and repair costs.



## Leverage Cost-effective Cloud

Industry 4.0 presents a tremendous opportunity for the manufacturing industry to transform itself. Kao thinks cloud-based applications, AI, and big data analytics are the focus of market attention. However, to small and medium businesses, the ROI on IT hardware investment may be less than optimal, especially during early-stage implementation when the benefits have yet to manifest themselves. As such, a cloud-based platform may be a more secure, reliable, and cost-effective choice.

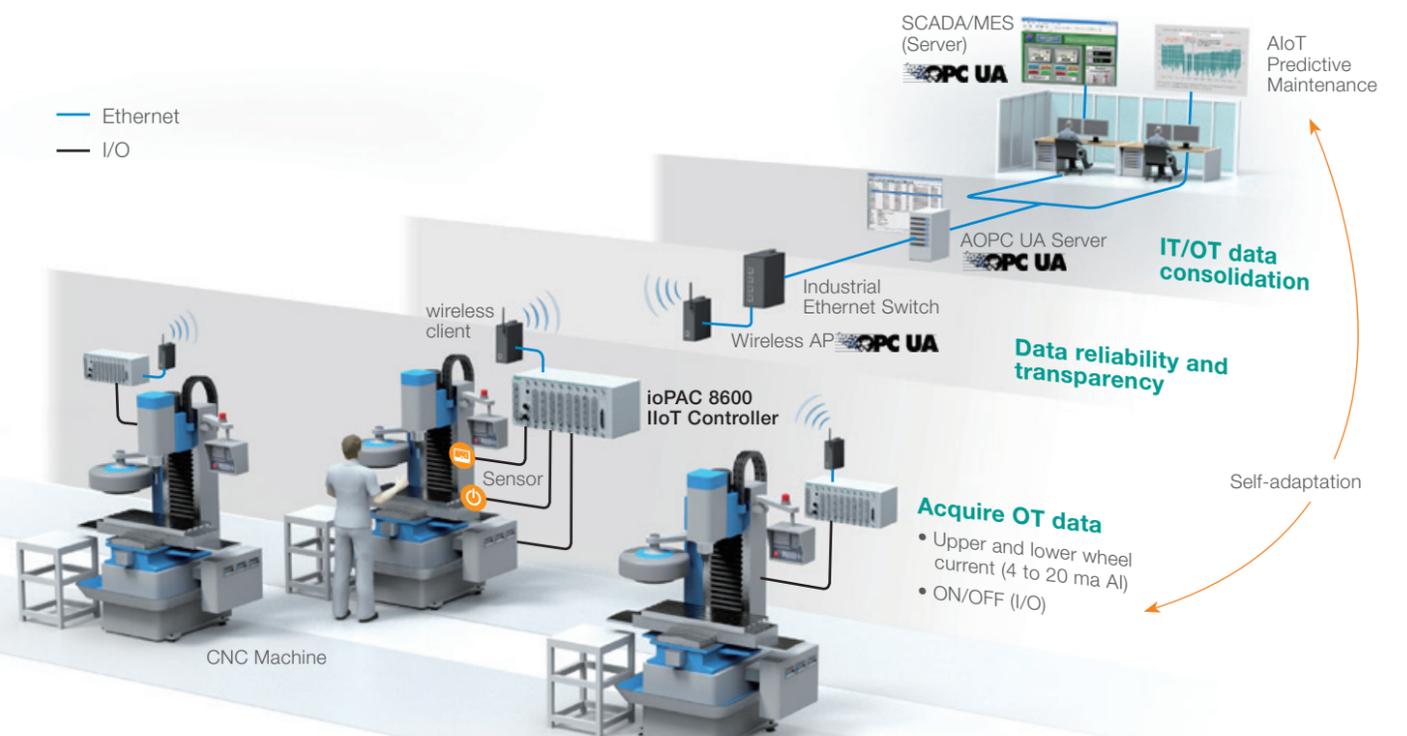
“Our IoT services can help clients build a cloud-based big data analytics model, wherein data is directly forwarded to public or private cloud platforms for analysis.” Kao also noted that at the initial stage, it is not easy to reliably collect data and uncover useful and accurate information, so working with a good IoT partner is essential.

“We surveyed a number of IoT partners and discussed with clients. Upon evaluation of their credentials, we selected Moxa. Our practical experiences working with Moxa indicate that Moxa provides reliable IoT software and hardware products and services, which indeed play a critical role in helping our clients bring Industry 4.0 implementations to reality.”

**“Moxa’s reliable IIoT software and hardware products and services indeed play a critical role in helping our clients bring Industry 4.0 implementations to reality.”**

**Chi-Zhan Kao**

Associate Director, Advisory Service Department



# Achieving Centralized Asset Management With Simplified Edge-to-cloud Connectivity

**A** very large producer of air separation equipment and supplier of industrial gases in Russia used the IIoT to monitor their air separator equipment in the field and track energy consumption. A dashboard that can be accessed from anywhere provides real-time reports from the field by the second.



## Softline

**Industry:** IT

**Global Headquarters:** Moscow, Russia

**Number of employees worldwide:** 4,800

## Challenges

- A limitation in the legacy SCADA system means that collecting real-time data is very expensive
- Upgrade the system without changing existing platforms or encountering costly budget overruns.

## Solutions

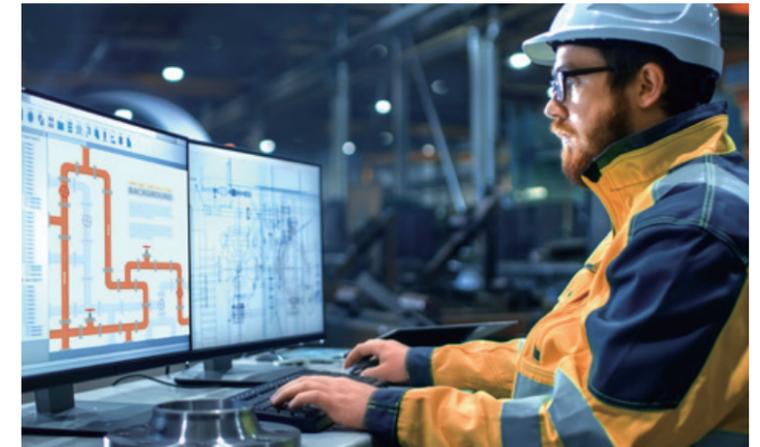
- Moxa's IIoT Gateway with ThingsPro support requires zero programming efforts, which simplifies OT data acquisition
- Moxa's IIoT Gateway uses MQTT protocol and a built-in client for Azure services to deliver OT data directly from the edge to cloud platforms
- Microsoft Azure Cloud Services offer flexible tools for application development and secure communications via the Azure IoT hub

## Results

- Real-time monitoring of sensors and acquisition of energy consumption data
- Analysis of equipment performance and error protection to boost productivity

The company needed a service for remote monitoring of an air separation plant and collection of data with a specific set of metrics. The project objective was to develop a mathematical model to optimize the process of maintaining equipment and a number of related business processes including: procurement, supply, client relationship management, financial services, and production planning. The service should collect, transform, and store data for further analysis, as well as for further solutions:

- For remote diagnostic maintenance (the service ensures real-time integration of telemetric data into the mathematical model for predicting the outage of air separation units).
- For prognostic services (to help predict the time that pump maintenance should be performed on remote pump stations to avoid unplanned equipment failures and stoppages).
- To determine the production function (to search for various combinations of production factors to maximize production output).
- To analyze the impact of temperature, humidity, and ambient air composition on performance.



**“It is one of the pioneering IIoT projects in Russia” said Sergey Belyaev, Project Director at the Strategic Project Management Division at Softline, who oversaw the pilot. “The company will widely adopt this technology within the next three years. Together with Moxa, we are already able to offer it right now.”**

## Limitations of the Legacy SCADA System

The legacy SCADA system was capable of running their equipment, but subject to severe limitations. It lacked the capacity to collect real-time data, or transfer it to remote locations. Moreover, the information that was gathered could be stored for only 30 days, making long-term observation and predictive monitoring impossible. The SCADA system lacked the capability to automatically track the output values from the air separator units.

This meant that, in order to provide their integrated services to customers, the specialists at the company had to travel on-site both for standard maintenance and to address equipment malfunction. The frequency was dependent on the conditions in which the units were housed, and the rate of utilization. On the other hand, the end-users were forced to keep a full-time operational engineer to run the system. They were also at a competitive disadvantage, because they did not have an up-to-date picture of their gas production values, which had to be measured manually just once every shift.

# Simplicity of Development and Implementation

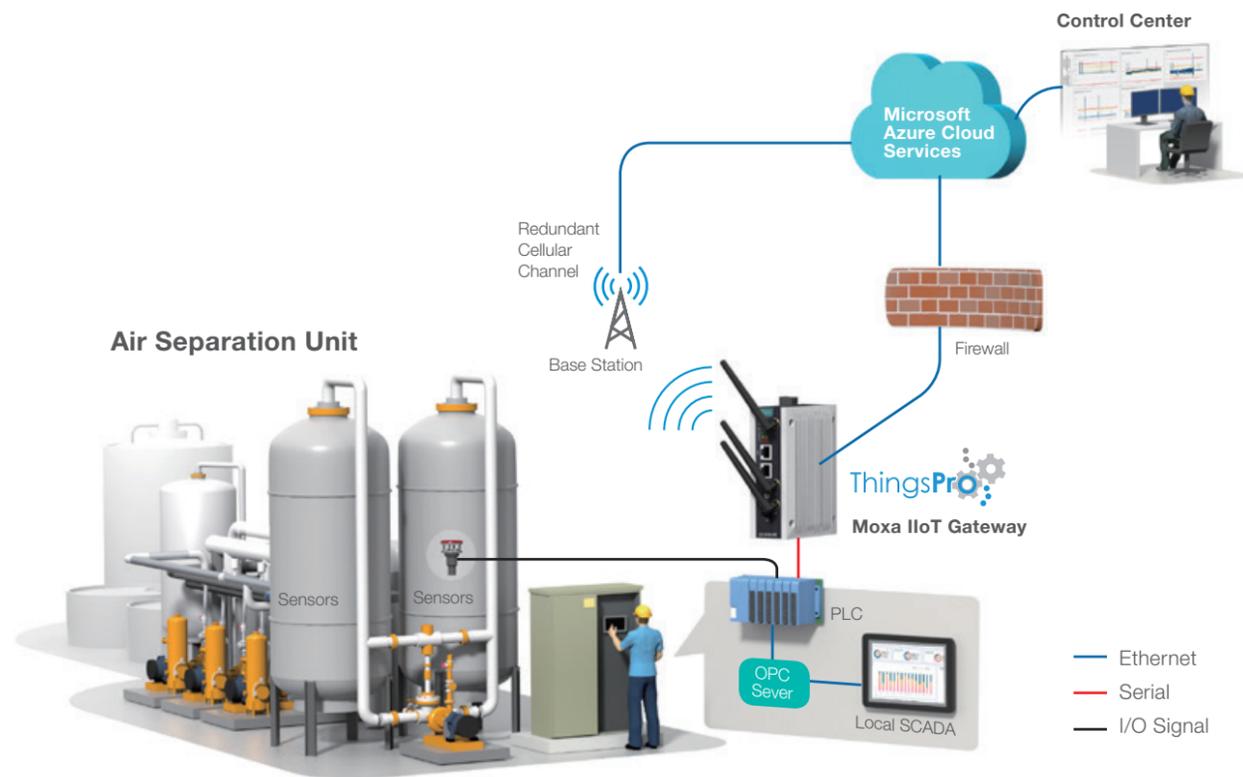
It was noted that the challenge was not just the new technology and how to implement it but also about getting the buy-in from the companies management and convincing them that the system can be implemented without costly budget overruns. Softline opted for an IIoT solution that incorporates a Moxa IIoT edge gateway and Microsoft Azure Cloud Service. Azure IoT Hub enabled development of a workable proposal in just two weeks using existing templates.

For the software part, Moxa's IIoT edge gateway features ThingsPro Gateway, which enables easy acquisition of OT data and delivers it directly from edge to cloud platforms using MQTT protocol and built-in clients for Azure. ThingsPro Gateway not only provides IIoT connectivity without requiring additional programming efforts, but also helps implement edge intelligence and centralized asset management. For the hardware part, Moxa's IIoT edge gateway is an embedded computer for industrial applications. It can work in unfavorable conditions and use traditional RS-422/485 interfaces to connect to a PLC and wire-based Ethernet or LTE are used for Internet access.

"We needed to offer them a comprehensible implementation of an Industrial IoT system. And we were able to do that." says Sever Sudakov, a Senior Field Application Engineer at Moxa, who was part of the project.

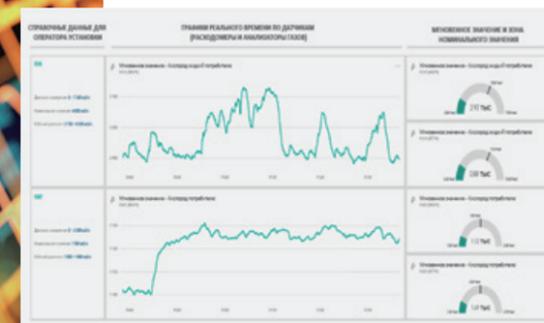
Initial resistance came from those furthest away from the functional part of the solution.

"The most difficult part was convincing the client's security department that providing external internet access would not make them vulnerable. They were scared that access to the cloud could result in their confidential data and trade secrets being compromised," says Belyaev. "Though, of course, thanks to end-to-end encryption, their risks are minimized. "But once the prototype was in place and could be demonstrated first-hand, the benefits were self-evident.



# Real-time Online Dashboard Accessed From Anywhere

The company is now able to remotely monitor 11 different production values for its air separators, such as oxygen, nitrogen, and argon, and the quantities that are available for a potential customer. In addition to this, existing energy consumption sensors collect 44 individual measures of electricity usage throughout the unit, which is key for a power-intensive production process, where electricity is the main operating cost. Reports can be viewed



through a real-time online dashboard that can be accessed from anywhere. A reporting software compiles the information collected from the field by the second and produce reports for any period of time.

The company now has a better understanding of its equipment, which has allowed them to boost productivity. Maintenance costs have been lowered manifold, staff time has been freed up, while transparency has increased between the head office and the St. Petersburg plant, leaving less room for potential issues.

The project has received official recognition, winning the Microsoft Inspire Partner of the Year prize in the Manufacturing category in 2018.

In the future, in addition to expanding the number of real-time indicators, Softline and Moxa plan to roll out the solution to all air separation units. There is also a plan to use the invaluable information that is already being added to the company's database to introduce the ambitious predictive maintenance functionality that could bring high financial returns.

"This is a signature project for us and we want to use this experience to replicate and export this solution worldwide. Moxa can enable clients to build data-driven connected plants, and Softline can assist clients to turn their data into value. By working together, we can realize the vision of digital transformation and fundamentally change our customer's business model" says Sudakov.

# Smarter Shop Floor With Cloud-based Monitoring

**T**ech Manufacturing, a long-time manufacturer of machined metal parts for aerospace clients such as Boeing, Lockheed Martin, and Bombardier, needed to raise production capacity and reduce lead times for their clients' largest and most urgent orders.



## Tech Manufacturing

**Founded:** 1956  
**Headquarters:** Pennsylvania, U.S.A  
**Industry:** Aerospace machining  
**Number of Employees:** 70  
**Website:** techmanufacturing.com

## Challenges

- Live dashboard with alerts based on historical and target performance metrics
- Easy to use with existing CNC machines that may not have a built-in Ethernet interface
- Does not require investment or expertise in specialized IT infrastructure, servers, or software
- Knowledgeable and experienced integration and vendor support team

## Solutions

- Data collection from CNC machines, PLCs, or manual machines
- Collect from Ethernet or RS-232-based devices
- Track multiple types of cycle time
- Real-time equipment dashboard with automatic updating
- Designed and built to evolve, integrate, and grow

## Results

- Setup completed in less than a day
- No additional IT infrastructure or maintenance effort
- Visual dashboard with rich performance data on each cell and machine
- Significantly improved productivity

# Gaining Real-time Insights From People and Equipment

With their 5-axis CNC machines already running 24 hours a day up to 7 days a week, Tech Manufacturing, looked towards smarter operation and real-time performance data to increase the productivity and useful life of their existing machines.

"We needed a better understanding of how our machines were actually performing for us in real-time. Live and historical machine performance data would also help us identify technical or process issues that were detrimental to productivity," said Halley.

**" We needed a better understanding of how our machines were actually performing for us in real-time."**

**Jerry Halley**

Chief Engineer, Tech Manufacturing



# Maximizing Productivity With Minimum Investment

With a combination of hardware and software, a CNC monitoring system would collect, analyze, and visualize the necessary performance metrics. However, Halley needed to weigh the productivity gains of such a system against the cost and effort of deployment, especially if it involved a new and unfamiliar server-based IT infrastructure.

The ideal system would be easily deployed without specialized IT equipment, knowledge, or effort, and would not require repeated software installation, updates, or configuration.

## System Requirement

- Data collection from CNC machines, PLCs, or manual machines
- Collect from Ethernet or RS-232-based devices
- Track multiple types of cycle time
- Real-time equipment dashboard with automatic updating
- Designed and built to evolve, integrate, and grow

## Challenges

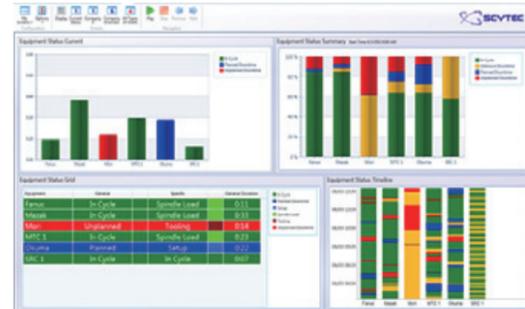
- Live dashboard with alerts based on historical and target performance metrics
- Easy to use with existing CNC machines that may not have a built-in Ethernet interface
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- Knowledgeable and experienced integration and vendor support team



## Giving New Life to Older Machines

Tech Manufacturing selected Shop Floor Automations, one of the most prominent systems integrators in North America specializing in CNC monitoring systems, to assist with cloud-based monitoring. Each CNC machine was connected to the existing local area network, so no additional IT infrastructure was required. For legacy machines that did not have a readily available Ethernet port, Shop Floor Automations provided an easy-to-deploy solution that was developed with Moxa.

With the local network connected to the Internet, machine performance data was easily viewed and analyzed by cloud-based software such as Scytec DataXchange or Predator Machine Data Collection. Key performance metrics were organized on a visual dashboard so owners and machine operators were able to see exactly how productive each cell was, down to the machine level.



**Moxa Partner**  
Shop Floor Automations

**Moxa Solution**  
Serial Device Server

**“Getting our CNC machines connected and monitored has made it much easier for us to deliver on our clients’ build to print orders with maximum efficiency and minimum lead time. It is a lot easier to get connected than a lot of people may realize.”**

**Jerry Halley**  
Chief Engineer, Tech Manufacturing



## Getting Connected to Higher Productivity and Better Service

With a cloud-based monitoring system, Tech Manufacturing was able to minimize their upfront cost and deployment effort. “Many clients perceive it to be difficult and expensive to set up a CNC monitoring system,” according to Mercurio. “However, with today’s cloud-based solutions, you can be set up in less than a day, with almost zero additional IT infrastructure or maintenance effort.”

The live dashboard made it easy for Tech Manufacturing to identify critical productivity issues. One immediate finding was that set-up times on certain machines were unnecessarily long, leading to hours of lost productivity every day. By rearranging setup sequence and on/off times, Halley quickly achieved significant productivity gains with those machines.

Having comprehensive machine performance data on hand provided an additional benefit: better service from CNC manufacturers. Service calls were now backed by a rich set of historical data, making it easier to identify and troubleshoot potential hardware issues. “Manufacturers became more willing and able to provide support when we needed it because we had the data to show abnormal operation,” noted Halley.

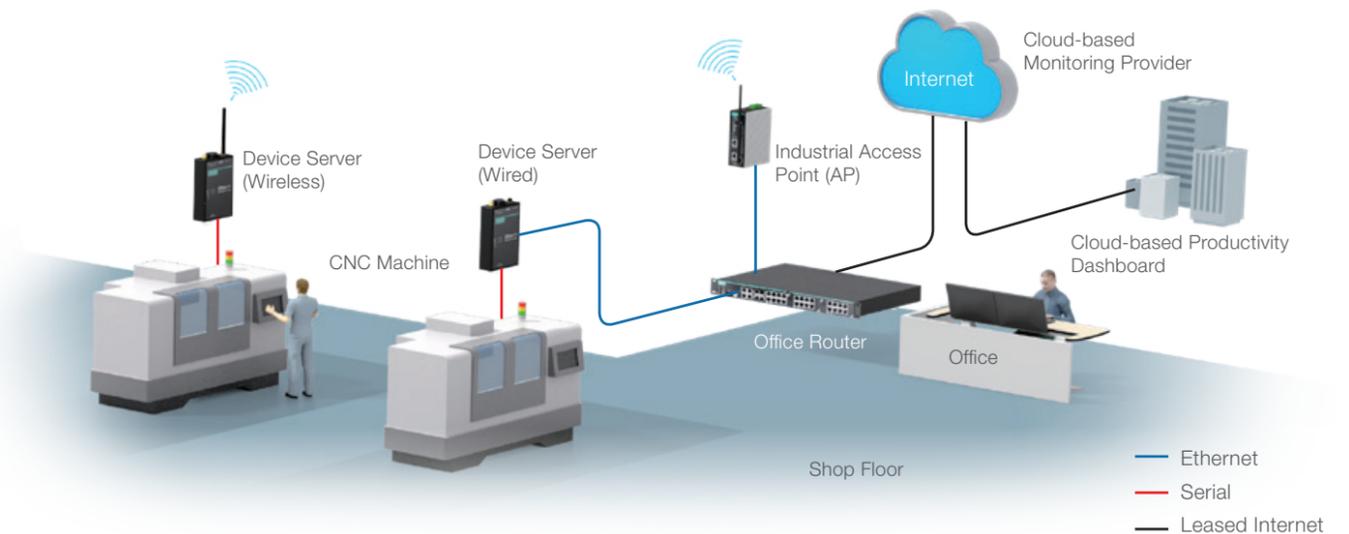
### Benefits

- Setup completed in less than a day
- No additional IT infrastructure or maintenance effort
- Visual dashboard with rich performance data on each cell and machine
- Significantly improved productivity

### Moxa Product



**NPort W2000 plus series**



# True Material Traceability to Improve Logistics and Production in Industry 4.0

**A** leading optoelectronics manufacturer in Taiwan introduced ECON's Automated Guided Vehicle (AGV) system to replace manual processes, which were considered too time consuming and labor intensive. The AGV system was integrated with the MES (Manufacturing Execution System) and WMS (Warehouse Management System) in order to achieve clearer visibility of logistics and production processes.



## ECON

**Founded:** 2000  
**Industry:** Machine ODM  
**Headquarters:** Taiwan  
**Number of Employees:** 60

## Challenges

- AGV system to replace manual processes, which were considered too time consuming and labor intensive.
- The complexity and diversity of AGV application scenarios makes it very difficult to find a set of powerful wireless network devices that are suitable for all scenarios.

## Solutions

- AGV path planning and design tools that are easy to use and do not require programming.
- Wireless communication technology that allows remote monitoring and scheduling of vehicles.
- Path maps on the cloud improve the scheduling flexibility.

## Results

- True traceability: Integration of AGV, MES, WMS, and elevator systems.
- 50% labor saving.
- 20% space saving.



## Reduce Labor Costs and Boost Production Efficiency

The Liquid Crystal Module (LCM) process involves dozens of assembling stations and contains the majority of the company's workforce, which means that this department has to spend a significant amount of money on labor. The assembly operators have to spend a lot of time collecting raw materials and bringing them to their work stations, even though this is not the role they were employed to perform. Previously, when operators had to move away from their stations to collect raw materials or bring semi-finished products to the conveyor belt, it resulted in them being temporarily unavailable to attend to their designated tasks, which resulted in low overall production efficiency. To solve these problems, the optoelectronics manufacturer decided to use ECON's AGV to upgrade their material handling processes, so that operators can concentrate on performing assembly tasks.

**“Throughout the journey from raw material to finished products, at least 70% of time was spent on internal logistics.”**

**He Zhiwei**  
Vice President, ECON



## The Ideal Wireless Technology for AGVs to Communicate

**“The complexity and diversity of AGV application scenarios makes it very difficult to find a set of powerful wireless network devices that are suitable for all scenarios.”**

**He Zhiwei**  
Vice President, ECON

A few years ago, AGVs did not have strong communication capabilities, so vehicle routes had to be defined in advance in order for material handling to be performed as expected. However, as the system developed over time, the AGVs started to utilize wireless communication technology. This allowed the AGVs to interact with the dispatching system located in the central control room and relay the position of the vehicle to the dispatching system in real time. This greatly enhanced the efficiency of production line management as well as the AGVs. ECON's Vice President, He Zhiwei, emphasized that the key to successful AGV transportation management was the quality and reliability of the wireless communications. For this reason, ECON felt it was necessary to enforce a robust selection process when purchasing wireless APs (Access Points) and clients. As there are many complex and diverse AGV application scenarios, it is difficult to find a set of powerful wireless network devices that are suitable for all scenarios. In order to meet the above requirements, ECON needed to work closely with the wireless device manufacturers to help them overcome any challenges that arose.



# Efficient and Dependable AGV Solutions Integrated With the MES

The optoelectronics manufacturer planned to integrate the AGV and MES in order to combine logistics and production processes to enhance operational efficiency. The company chose ECON's AGV for its strong communication capability, ability to integrate with the MES, and a variety of software tools that are intuitive to use. One of the advantages of the vehicle map software is that it allows engineers to quickly utilize map navigation operation procedures after viewing the plant layout, and the path simulation software enables users to quickly execute the route path simulation without relying on mechanical engineers to produce CAD diagrams that can be very time consuming. All of these features significantly helped to minimize programming efforts, which was a problem with the previous solutions deployed.

In order to ensure the AGV operates safely and smoothly, the solution needs to work reliably at every intersection and T junction within the plant, where there is a higher chance of interference. Any disruptions to communications between the vehicle and the wireless AP may result in the location of the vehicle not being sent to the central control room. This will significantly impact the ability to control the AGV or even result in a collision between the AGV and other vehicles or objects. In short, it is impossible to underestimate the importance of the reliability of the wireless network components. He Zhiwei said that ECON had previously purchased wireless networking devices from different manufacturers, but sooner or later their wireless signals suffered from interference that resulted in errors occurring on the AGV. Moxa's AWK Series industrial wireless network products have excellent signal strength and much higher levels of reliability than the products that were previously used. More importantly, Moxa has a clear advantage over other providers as they are able to facilitate real-time services. All of these factors contributed to ECON's decision to choose Moxa's products.

**Moxa has an obvious advantage over other providers in terms of provision of real-time services.**

**He Zhiwei**  
Vice President, ECON



## Flexible AGV Scheduling via a Cloud-based Path Map

Although path maps can be built into AGVs, considering the large number of stations and path maps in the plant, it is not efficient to modify the route for every vehicle in the event that there is a production process change or an area that needs to be avoided. As ECON has the ability to build AGV path maps in the cloud, it allows users to distribute up-to-date map codes to the designated vehicles each time a user modifies the maps in the cloud, thus improving scheduling flexibility.

- Seamless integration of software and hardware: Integration of AGV, MES, and WMS.
- AGV path planning and design tools that are easy to use and do not require programming.
- A vehicle map software suite can meet the needs of a wide range of customers.
- Wireless communication technology that allows remote monitoring and scheduling of vehicles.
- Path maps on the cloud improve the scheduling flexibility.

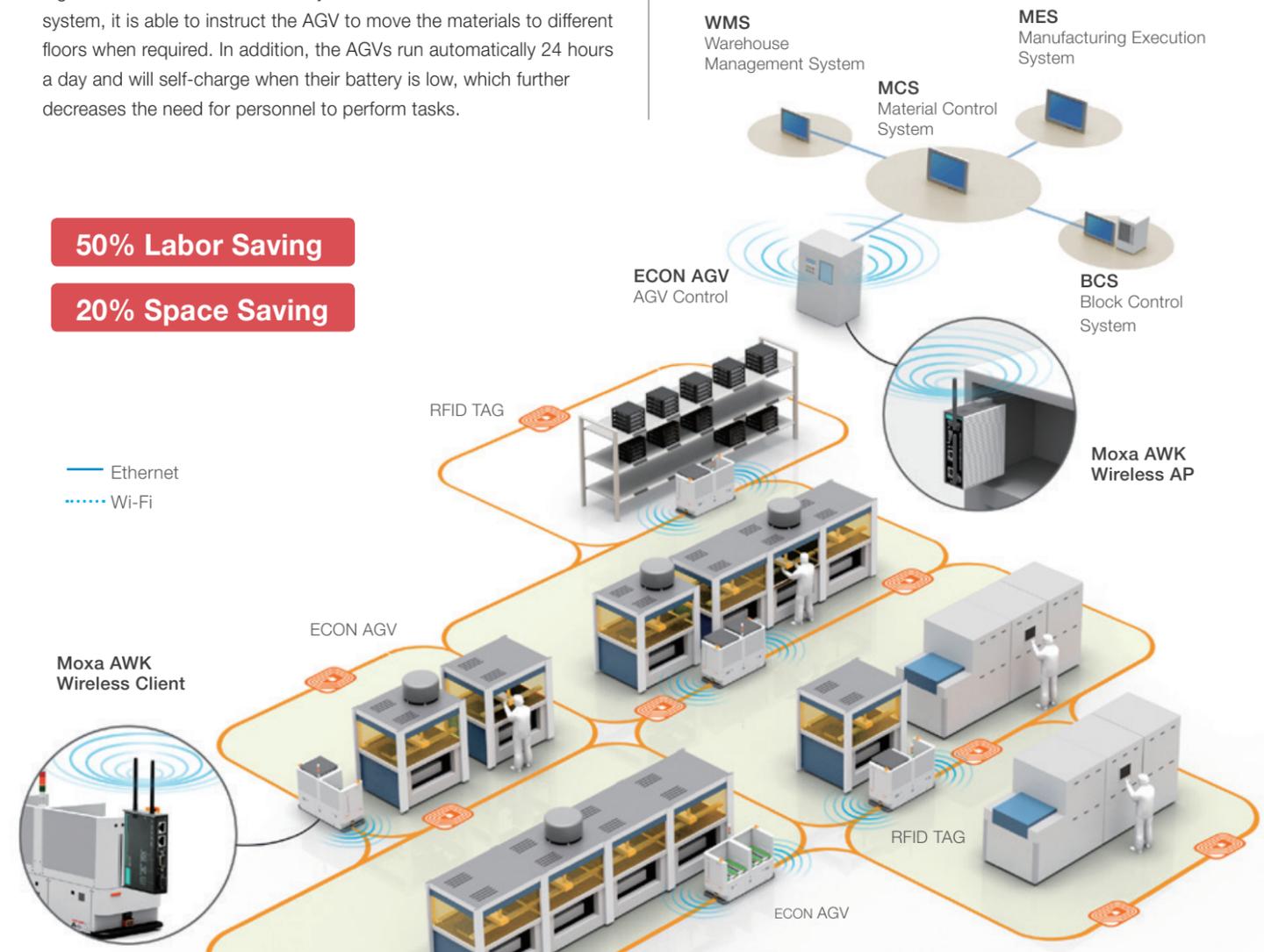
# Increased Transparency and Efficiency in Logistics and Production

By integrating the information flow of the production lines and logistics, the MES can keep track of the materials at each station in real time and in case of a material shortage, send an instruction to dispatch materials to the AGV controller, which then ensures that the AGV that is most suitable for the current transportation task performs it. The updated AGV system has greatly improved the working conditions of station operators, allowing them to focus on their own work and remove the need for them to leave their stations to handle logistics. As the elevator control system is linked with the AGV control system, it is able to instruct the AGV to move the materials to different floors when required. In addition, the AGVs run automatically 24 hours a day and will self-charge when their battery is low, which further decreases the need for personnel to perform tasks.

- True traceability: Integration of AGV, MES, WMS, and elevator systems.
- Labor saving: The cost of labor is reduced by 50% and the working efficiency is improved.
- Space saving: The areas used for temporary storage are no longer required, which means that the size of the site can be reduced by 20%.

**50% Labor Saving**

**20% Space Saving**





Smart Manufacturing

**Country:**  
China

**Products:**

**IKS-6728A Series**

24+4G-port Gigabit modular managed PoE+ Ethernet switches

**IKS-G6824A Series**

24G-port Layer 3 full Gigabit managed Ethernet switches

**NPort 5100 Series**

1-port RS-232/422/485 serial device servers

**MXview Series**

Industrial network management software designed for converged automation networks

# Mass Customization Within an Interconnected Factory

## Introduction

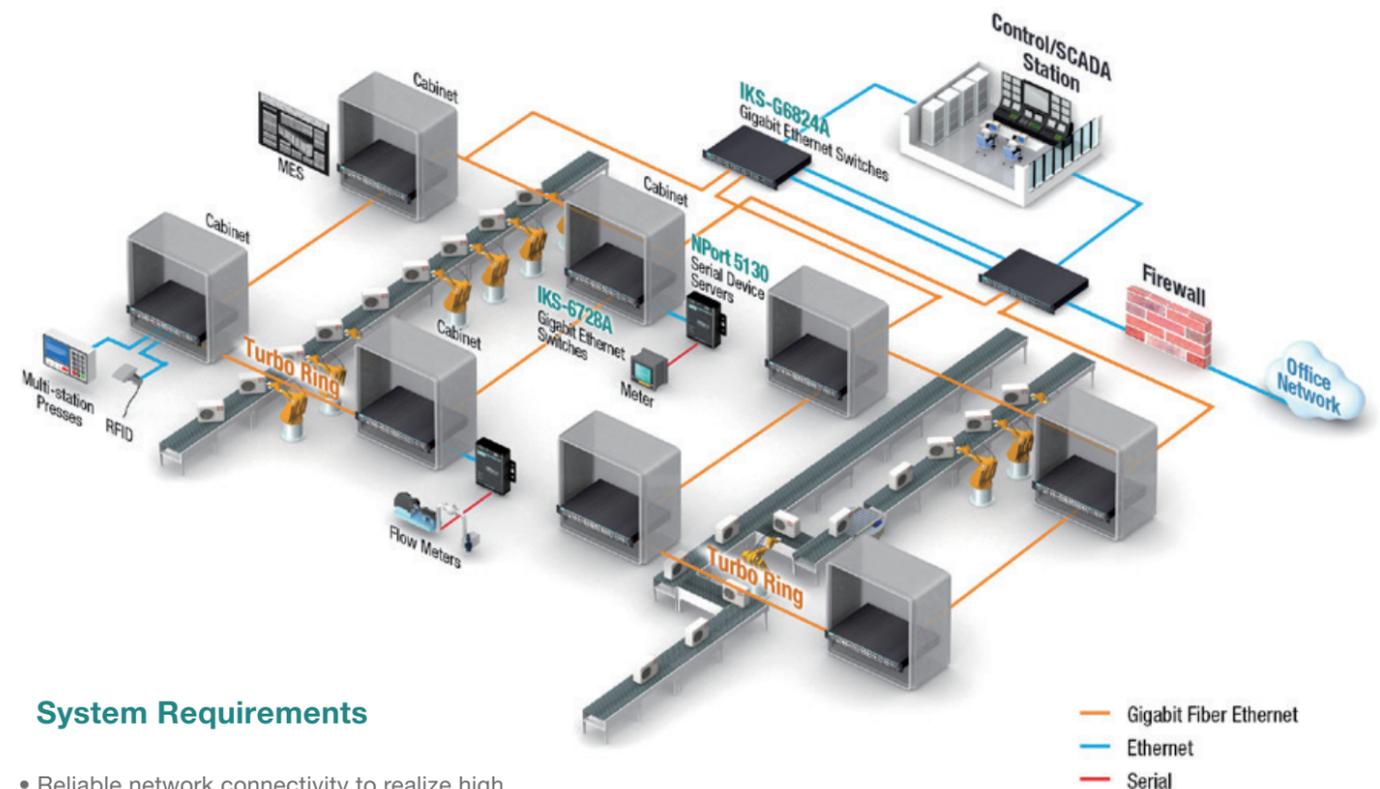
### An Interconnected Factory Helps Provide a Better Service to Customers

More and more modern-day consumers want products that are customized and available on demand. In order to create these types of customized products with the agility and responsiveness to sustain profitability, a leading home appliance manufacturer wants to achieve precise and efficient mass customization by building an interconnected factory, which involves a multitude of connections between smart machines and production lines in both the physical and cyber world. These connections allow the manufacturer to enhance the customer's experience by transitioning from a supply-centric service to a user-centric service.

**The following example illustrates how production is driven by customer needs:**

Customers can design their own appliances that incorporate their style, color, and function preferences. Based on the customized order, the interconnected factory set in motion its manufacturing process automatically, conveying the information to the production line of each process, module makers, and logistic carriers to schedule the equipment, materials, and modules for each production line. Each customized order has to be synchronized with the schedule of each production line. At the same time, customers can check the status of their customized appliances directly.

To enable mass customization, the interconnected factory needed to transmit data seamlessly from the Manufacturing Execution System (MES) to the production line. For the MES to control an accurate manufacturing process, it has to know the production operation of each customized order, meaning that it has to know which part is where, where what part has to go next, and what has to happen once the part is there. However, the home appliance manufacturer experienced high packet loss for almost a year, which caused a discrepancy between their planned production process and actual production process, so the product did not know which process to go to next. It took a heavy toll on their labor force to address this problem, which ultimately impacted the customer experience negatively.



## System Requirements

- Reliable network connectivity to realize high precision machine-to-human interaction for personalized customization
- A solution that allows operators to pinpoint network failures

## Moxa Solution

### Reliable Data Transmission to Ensure Data Completeness

The high packet loss happened because of a high number of environment interferences and extreme temperatures, which the customer's existing commercial-grade solution could not withstand. As the application required data completeness in order to optimize production, losing communications for a few seconds was not acceptable. Moxa's industrial Ethernet switches are designed with -40 to 75°C wide operating temperatures and are EMI/EMC certified. In addition, Moxa's redundancy technologies are designed to protect networks against transmission failures. Moxa's Turbo Ring provides an efficient way to build a reliable and flexible network to ensure high availability and support unlimited redundant network expansion. Ring topology is a very popular and cost-efficient way to build a network and is recognized within the industry as being one of the most effective solutions to avoid network downtime. Also, Moxa's Turbo

Ring technology guarantees Gigabit Ethernet networks a recovery time of under 50 ms.

In order to eliminate network failures easily, Moxa's industrial network management software (MXview) provides an integrated management platform, which makes it easy to discover and visualize the physical network topology, and therefore helps to reduce administrators' stress levels with regard to the possible mishandling of device status or interconnectivity in the network. MXview can discover networking devices and SNMP/IP devices installed on subnets, and the live-view topology map and historical event database let you check the health of your network and identify problems when troubleshooting—anytime and anywhere via web browsers such as Internet Explorer and Firefox.

# Let There Be Light: Changing Rural Livelihoods

The government of South Africa came up with a revolutionary way of dealing with the country's erratic power supply issues. Naledi Trust in South Africa has become the world's first village powered entirely by fuel cells. The cells need only water, methanol, and a catalyst to produce clean energy. It opens up the possibilities of clean and cost-effective power for more off-grid communities, as well as a new business model for CHEM's ME2Power fuel cell systems.



## Chung-Hsin Electric & Machinery Mfg. Corp

**Founded:** 1956  
**Headquarters:** New Taipei, Taiwan  
**Industry:** Energy, Manufacturing  
**Number of Employees:** 2,000  
**Website:** [www.chem.com.tw](http://www.chem.com.tw)

## Challenges

- High and recurring operational expenditure for maintaining equipment at remote areas
- Wired network is unavailable for data transmission
- Harsh environments in rough rural terrains

## Solutions

- Remote I/O with a built-in cellular function collects and transmits data status through 3G communication
- Click&Go Plus™ control logic for event alert setting for optimized bandwidth utilization

## Results

- Transforming a traditional machine-selling model to Machine-as-a-service and increasing sales revenue
- Enabling live monitoring of the system through reliable cellular communications
- Saving 50% manpower cost on maintenance

## Fuel Cell System Helps Channel Electricity to Rural Community

Like many developing countries, South Africa faces an acute power shortage. The lack of reliable access to electricity is an impediment on economic growth, investment, and development.

Originally designed as a backup power system for telecommunication stations at remote places, the ME2Power fuel cell transforms its role into the main power generator for small communities. Chung-Hsin Electric & Machinery Mfg. Corp's (CHEM) fuel cell mini-grid system uses platinum as a catalyst and is fueled by methanol. It generates mostly water as a by-product.

This approach has now become an alternative sustainable energy solution for more off-grid communities after completing a two-year pilot run in Naledi Trust community in South Africa. "The government of South Africa is considering to roll out similar plans in rural areas where the cost of electrification via an expansion of the national power grid is too costly or technically prohibited," said Amy Liao, Director of CHEM's Hydrogen Department.

**"Access to reliable, low cost and clean electricity is vital. The Naledi Trust project can make a tremendous difference in the lives of hundreds of rural communities."**

**Amy Liao**

Director of Hydrogen Department, CHEM

## Improving Remote Maintenance Cost and Metrics

CHEM's 5kW ME2 fuel cell system is integrated into a complete hybrid off-grid energy solution. It includes a battery bank and inverter operating within a micro-grid. A mixture of water and liquid methanol is piped through to these fuel cells where an electrochemical process converts it into hydrogen gas which is used to generate electricity.

"The theft of the solar PV panels is a common phenomenon in South Africa," said Liao. "The government of South Africa was eager to find an alternative solution to the problem." Weighing 295 Kgs, the ME2Power system makes itself a hard target.

The system provides a total of 15 kW of generated electric power and generates a peak power of 70 kW with the support of batteries. It is sufficient to power the 34 households in the Naledi Trust community. Monthly delivery of liquid methanol fuel to an external storage tank enables uninterrupted primary power to these homes.

"It takes a lot of manpower to conduct inspections and manage the logistic of fuel delivery," said Liao. "All systems are located at remote places, it was a challenge for us to improve our maintenance metrics without a network."

## Challenges

- High and recurring operational expenditure for maintaining equipment at remote areas
- Wired network is unavailable for data transmission
- Harsh environments in rough rural terrains



# 3G Helps Gain Real-time Insights from Equipment Anywhere

To solve this problem, CHEM integrated Moxa's cellular remote I/O into the fuel cell system. The cellular I/O features dynamic IP access that provides reliable 3G cellular connectivity. CHEM's fuel cell system is currently the only one that offers a remote monitoring function.

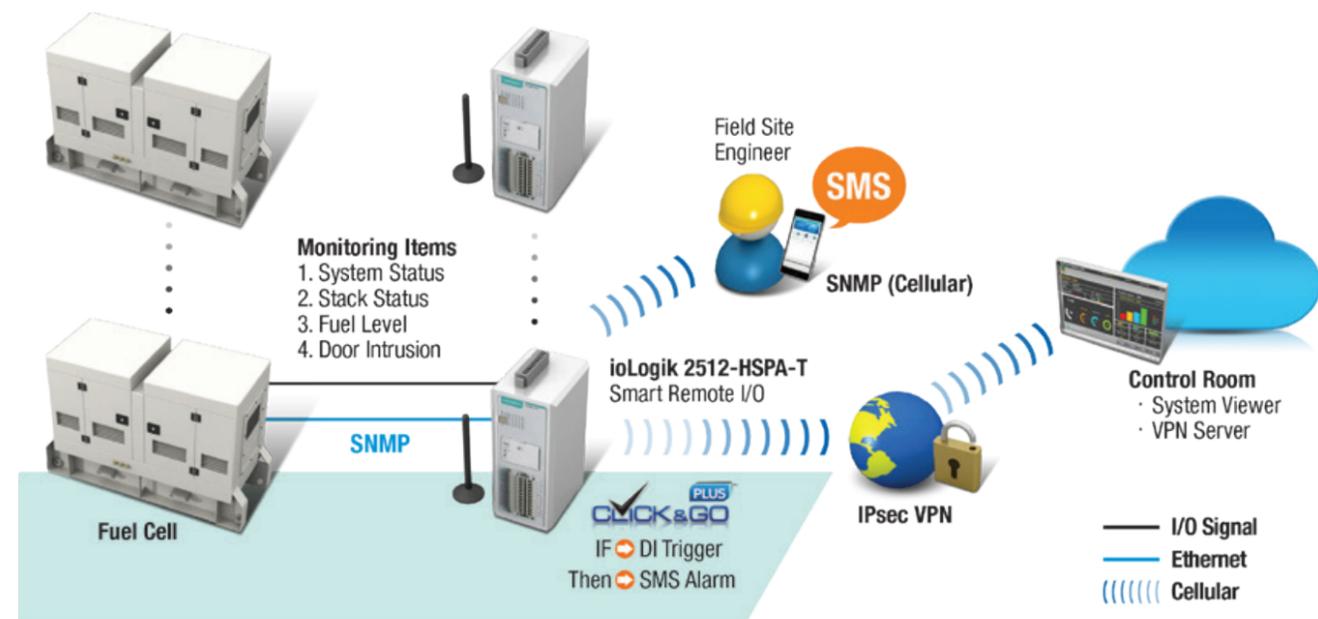
"Deploying the technology of IIoT, CHEM's fuel cell systems distributed at scattered locations can be fully monitored via a mobile phone. Control sites can check the conditions of systems, including power consumption, voltage, power supply time, methanol level, and unit sensors anytime."

In addition to collecting data from sensors at remote sites, Moxa's patented Click&Go Plus IF-THEN-ELSE control logic allows CHEM to configure SMS alarms to deliver real-time notifications for handling issues as soon as they arise. "This report-by-exception approach requires far less bandwidth than traditional polling methods." Joseph said.

**"We can gain quick response time and reduce machine downtime utilizing the advantage of real-time monitoring."**  
**Joseph Chang**  
Special Assistant of Chairman Office, CHEM

## Solutions

- Remote I/O with a built-in cellular function collects and transmits data status through 3G communication
- Click&Go Plus™ control logic for event alert setting for optimize bandwidth utilization



# The IIoT Gives Rise to Machine-as-a-service

In addition to time and cost saving on inspection manpower, CHEM can organize the logistics of fuel delivery and on-site troubleshooting more efficiently. Data from field sites are collected and transmitted to the SCADA-based control and monitoring center located in Taiwan. "We are able to work more efficiently with our local service provider. When the SCADA system receives an abnormal status report, we can immediately inform the local service providers via SMS to dispatch maintenance personnel for instant on-site troubleshooting," explained Chang.

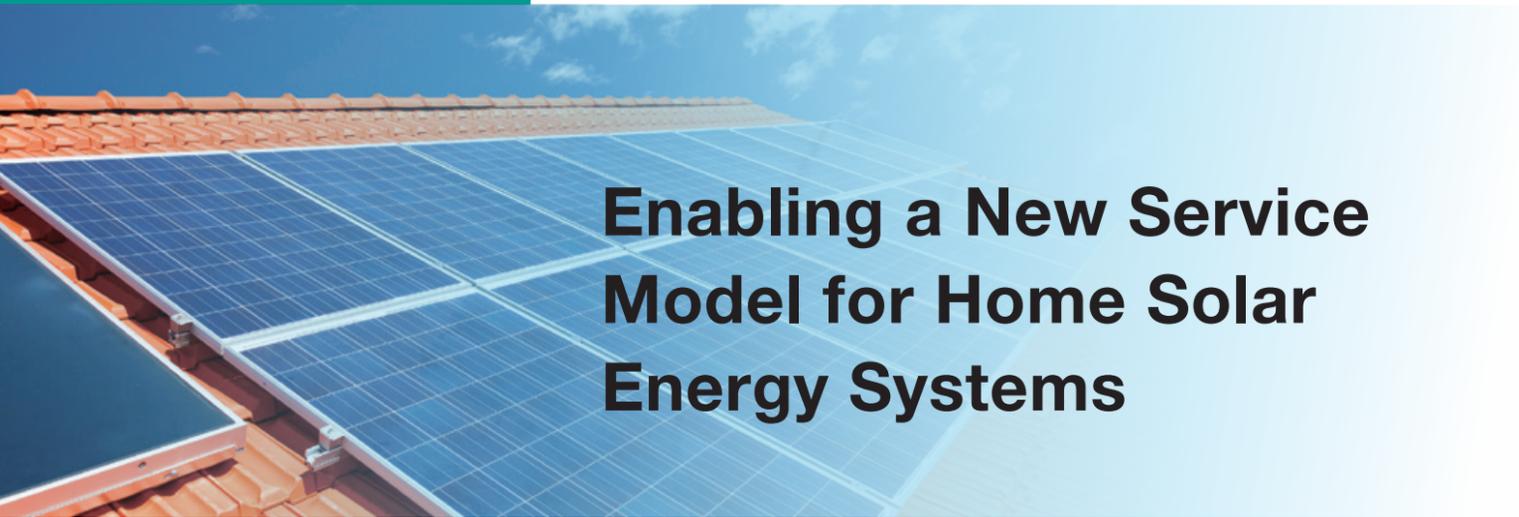
A fuel cell system costs much higher comparing to a diesel power generator. Customers facing budget restrictions will not consider purchasing the fuel cell system. "IIoT is transforming our business model. We are transitioning from selling a product to offering Machine-as-a-service. Rather than relying on a one-time sale, we are charging customers based on machine use and service." explained Liao.

"The business transformation helps us to untapped goldmines in aftermarket services by strengthening our core business in parts, repair, and maintenance. By analyzing the collected data, we can help customers improve the efficiency and stability of operation, and provide predictive maintenance service," she said.

IIoT technology is also helping our customers to measure their energy usage and manage their budget. The consumers can pay accordingly to the actual power generated and consumed.

"We will continue to enhance our remote monitoring and control system to improve our service quality for our customers," Liao said. As a member of Moxa's Solution Partner Alliance program, CHEM is working closely with Moxa to integrate GPS into their next generation fuel cell system.





# Enabling a New Service Model for Home Solar Energy Systems

## Smart Energy

**Country:**  
U.S.A.

**Products:**

**UC-8100 Series**

Arm-based wireless-enabled DIN-rail industrial computer with 2 serial ports and 2 LAN ports

**ThingsPro**

ThingsPro Gateway data-acquisition software

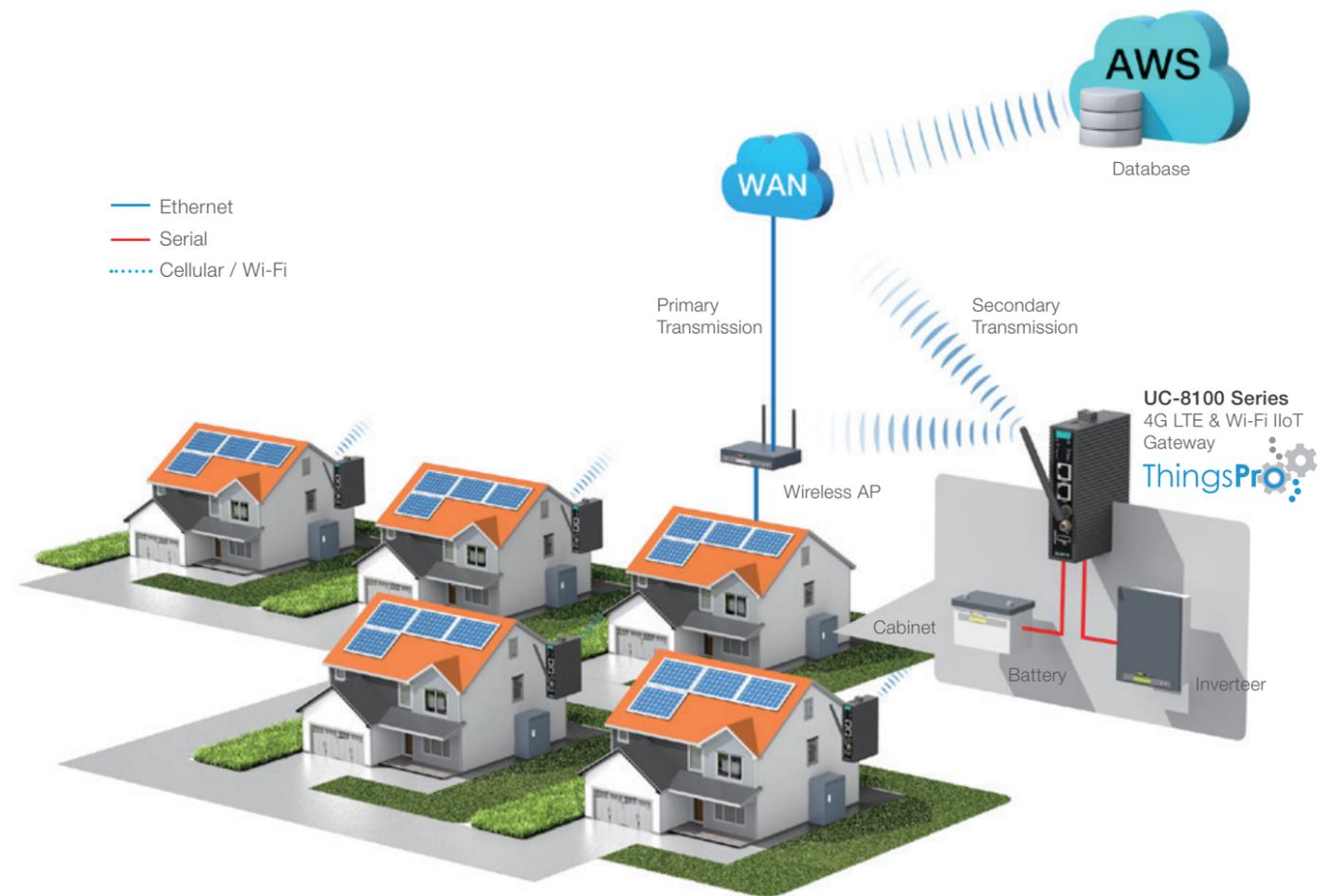
## Introduction

### Turning Big Data Into New Income Streams

In the pre-IIoT era, solar panels were often purchased outright or loaned to end users. The upside was that the homeowner kept all the tax credits, but the downside was that the upfront costs were high. An American solar energy company wanted to leverage big data, cloud storage, and reliable wireless communication to make home solar energy systems easier to use and more affordable to the public. They came up with a new solar energy offering: a power purchase agreement (PPA). This contract between the solar energy company and a homeowner allows the solar energy company to install a solar power system on the homeowner's roof. In exchange, the homeowner agrees to purchase the electricity that is generated by the solar panels from the solar energy company at a fixed rate. This business model benefits homeowners in that they do not have any upfront costs or maintenance responsibilities. For the solar energy company, the PPA model brings in a new revenue stream. In order for this agreement to work efficiently, the solar energy company required real-time and accurate data to ensure the billing information is correct; otherwise, unreliable data transmission will cause them to lose revenue. To enable the PPA business model, the solar energy company required an edge-to-cloud solution.

## System Requirements

- The ability to collect power generation and consumption data from 50,000 sites over a wide geographic area, and send this information to the cloud for billing and operational purposes.
- A failover mechanism to switch between Wi-Fi and cellular communication for a high-availability network.



## Moxa Solutions

### Accurate Data Means Accurate Billing. Always Connected with Failover Transmission.

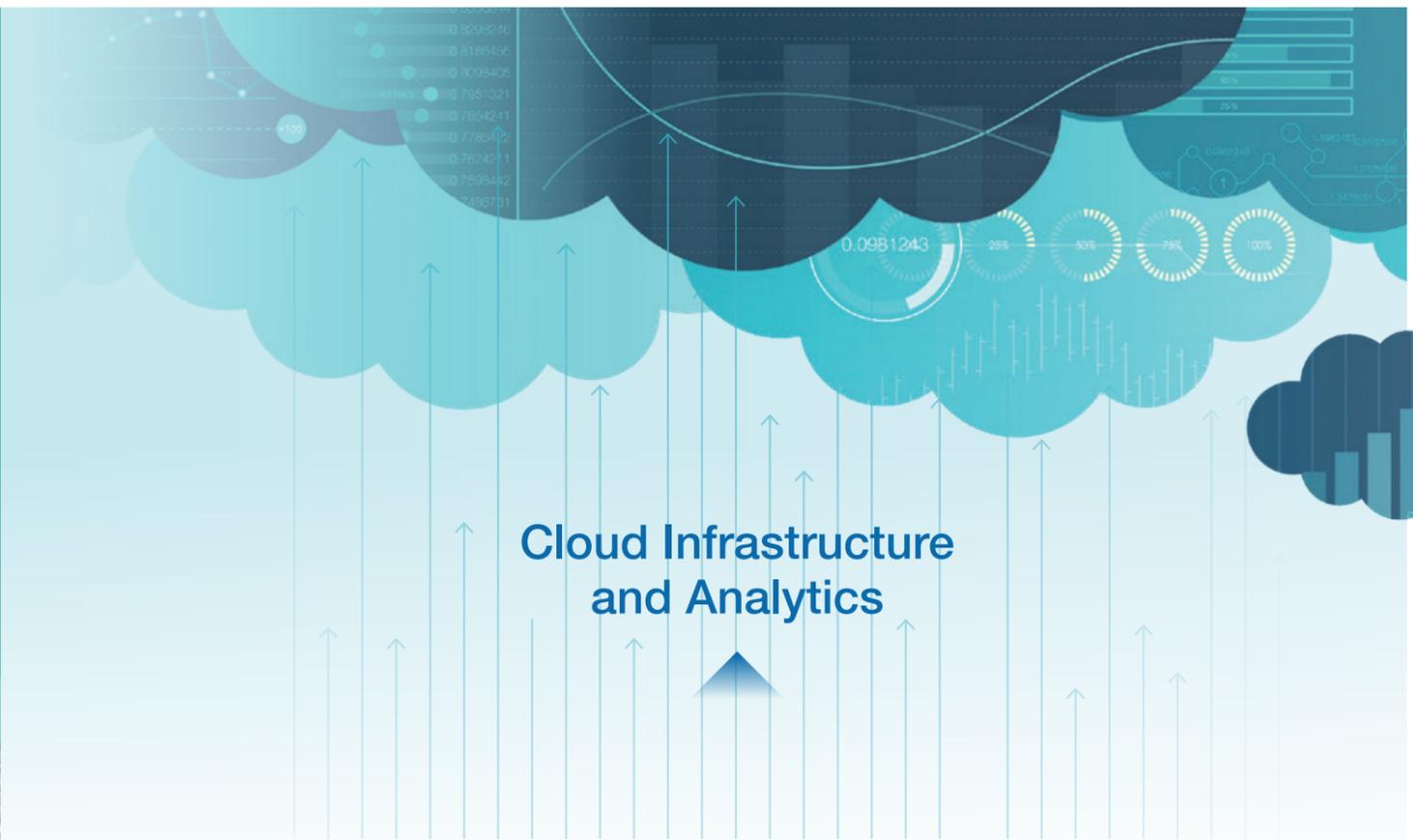
For this PPA business model, a reliable networking system is important to ensure the solar energy company has real-time monitoring of the end users' energy consumption to ensure accurate data billing. Furthermore, the solar energy company needs the real-time monitoring to balance demand against supply through flexible pricing and other options. IIoT gateways installed in the solar energy system play an important role in this project, as they acquire energy production and consumption data from batteries and inverters via Modbus communication, and then transmit the data to AWS Cloud with a ready-to-run data acquisition platform via wireless networks. In real time, the IIoT gateways enable the solar energy company to retrieve data related to solar energy storage and consumption from sites spread over a large geographical area.

In order to prevent loss of data, the IIoT gateways are designed with a failover mechanism whereby the network communication will switch automatically to the secondary transmission method (cellular) if the primary transmission method (Wi-Fi) fails. When a failure occurs, the solar energy company can fix and update the Wi-Fi settings remotely via their self-developed maintenance applications by leveraging RESTful APIs, which means operators can do all of the maintenance via their mobile devices.

# Enabling IIoT Connectivity From **Edge** to **Cloud**

With rapid globalization and information digitalization, industrial operators have begun to adopt Industrial Internet of Things (IIoT) applications to enhance operational efficiency. Moxa is here to provide you with practical technologies to optimize network infrastructure and simplify industrial edge-to-cloud connectivity for accelerating OT/IT convergence. You also have our strong commitment to protecting connectivity from edge to cloud.

- We take care of interoperability** >
- So you can keep your legacy machines** >
- And also interconnect with various platforms**
- We take care to keep it simple** >
- So you can set up devices easily** >
- And also reduce maintenance costs**
- We take care of device security** >
- So you can operate without concerns** >
- And also identify threats to your assets**
- We take care of reliability** >
- So you can operate at -40°C** >
- Or even at 75°C**



## Connectivity

Optimizing network infrastructure

Unifying connectivity of diverse OT and IT interfaces

Integrating OT data to IT platforms with ease



Industrial Network Infrastructure



Industrial Edge Connectivity



Industrial Computing

## Devices

