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SUMMER 2024

2024 Industrial digitalization report: Private wireless, edge infrastructure and applications

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Introduction – the age of private wireless has begun



“Our newest facility is being built with private wireless as an integral part of the design process.”

Director of IT, Processor Manufacturer, USA

Nokia first partnered with leading market data and intelligence firm GlobalData in 2022 to understand why the early adopters of private wireless network (PWN) solutions had made the decision to adopt the technology and the benefits they had experienced. The results were overwhelmingly positive. 79% of companies experienced a return on their investment in less than six months. Over 50% had already seen total cost of ownership (TCO) reductions of 6% or more from their investments, with 29% experiencing a more than 10% reduction.



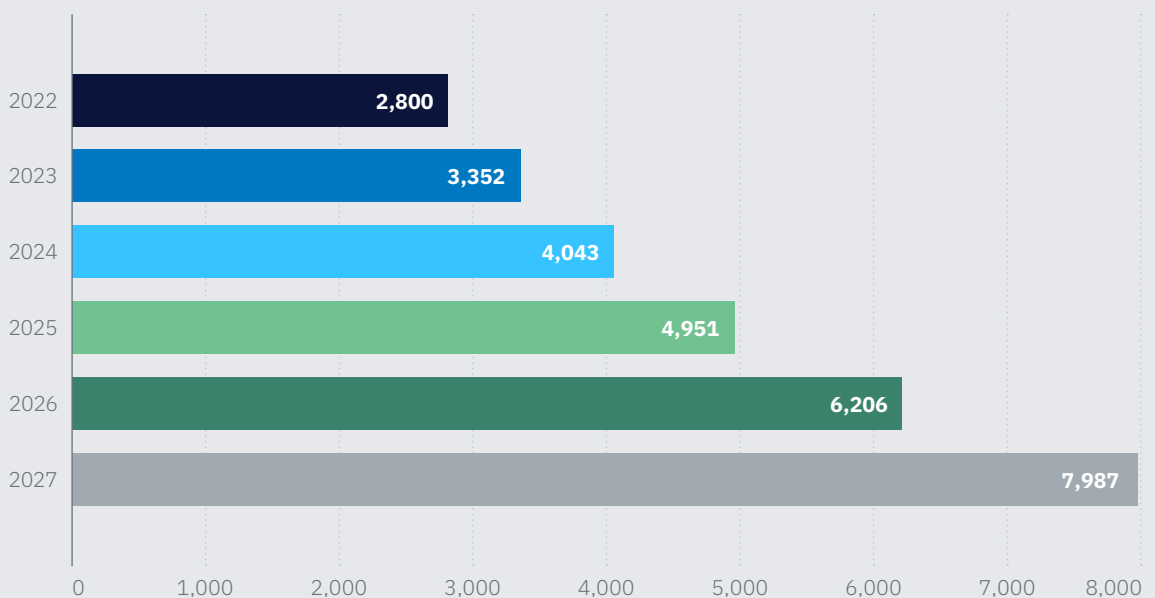
The executives are very pleased with the results.

Director of IT, Heavy Equipment Manufacturer, Japan

These powerful numbers explain why private wireless deployment numbers are growing at an increasing rate. GlobalData’s Private Wireless Networks Market Opportunity Forecast indicates that by the end of 2024 the size of the global private wireless market will have grown by 49% compared to 2022. By 2027 the private wireless market will have grown by almost 100% versus 2024 to almost \$8 billion USD at a Compound Annual Growth Rate of 23.3%.

Nokia has again partnered with GlobalData to understand why so many more businesses are now turning to private wireless network solutions. GlobalData conducted surveys and interviews with more than 100 enterprises, in industrial verticals such as manufacturing, transport and logistics, mining, oil and gas, and energy, who have deployed PWN technology. The results underline that the technology is continuing to deliver meaningful business benefits and ROI returns.

Private Wireless Network Market Size 2022-2027 (USD M)



Source:
GlobalData Private Wireless Survey Q1 2024

How has the market evolved?

While private wireless networks remain a relatively new technology area to many enterprises, it is clear that the technology has reached a new level of maturity. When GlobalData spoke to enterprises in 2022, many were still at the stage of evaluating private wireless. Of those who had actually deployed the technology, many were at the proof of concept (PoC) or pilot stage. These PoCs were usually in a single location and for a single use case.



“From a single PoC at one location, 70% of our sites are now using private wireless”

CIO, Automotive Manufacturing, USA

In 2024, the picture is different. Enterprises interviewed by GlobalData have all run PoCs and pilots, and all have found them to be successful in meeting the business needs required. Further, all have begun the process of rolling out PWN to more locations, and to expand the use of PWNs at the original locations – e.g., by utilizing the PWN for additional purposes and/or by deploying additional antennae to expand coverage at the original site.

Most initial requirements for PWNs were focused on connectivity – primarily achieving connectivity where other technologies had failed or were not possible to install. Early movers in PWN are now being more ambitious, accompanying their PWNs with additional edge capabilities to support complimentary technologies such as AI and analytics, or adding drones or critical communication systems to the mix of devices connected to the PWN.

On-premise edge technology is playing a foundational role in enabling these more advanced use cases that go beyond connectivity. Scenarios that require ultra-low latency, particularly when combined with AI systems are powered by edge technology. Edge solutions are also helping businesses to move clunky technology stacks away from active areas of their sites with private wireless access to an edge server able to maintain the consistent high-speed connectivity required. This is why 39% of the businesses surveyed have already deployed industrial or on-premises edge technology with their PWN and a further 52% are planning to do so.



Reliable, pervasive and secure connectivity that scales with your needs

Private wireless networks exist among a range of wireless technologies from WiFi and IoT, to public LTE/5G networks and network slicing deliver over public mobile networks. Why are more and more industrial enterprises choosing PWNs even when they already have WiFi and IoT installed?

Latency can be one answer. Private wireless networks offer ultra-low latency capabilities in the low single digit millisecond range that can support the most demanding of use cases. But the reality is that use cases requiring this remain few. In many instances, latency of around 50ms is entirely sufficient.

Where private wireless technology excels in providing consistent connectivity over large areas with a significantly reduced need for cabling. A single private wireless cell can potentially deliver connectivity across an area the size of a football field. Furthermore, the spectrum used by PWNs provides better, secure, and more consistent signal penetration in challenging environments such as factories and underground.



“The down the line consequences of connectivity interruptions are catastrophic – these are lifesaving drugs and without them people could die.”

Director of ERP and Technology Solutions,
Pharmaceuticals, UK

Covering a similar area with WiFi would take a large number of access points (APs) - each one having to be bought and installed – including power and data cabling. Even with all these access points, there are likely to be black spots. Furthermore, even when signal is consistent, WiFi’s limited range means that there is a frequent need for handover between APs which increases latency and causes potential for interruption. This consistency is crucial for scenarios such as using automated vehicles and machinery and drones.



“Connectivity downtime stopped everything in our manufacturing processes”

CIO, Manufacturing Company, USA

Private wireless networks can also be configured to adjust upload and download speeds. Public 5G spectrum is designed to support consumer users downloading from the internet. Private systems can be altered to support cameras uploading high quality video at tens of Mbps for situations such as video analytics, compliance monitoring, or security.

PWN’s are also housed entirely on premises using privately owned and operated radio and edge infrastructure. The data is natively encrypted at a high level and never leaves the control of the enterprise creating certainty for data that is sensitive for commercial and/or compliance reasons.



“Once a Private Wireless solution is installed it is easy to operate and expand”

(European Aviation Company)

Installation of a PWN is likely to require the support of a technology partner or partners from the PoC stage though to deploying a full-scale solution. However, the enterprises interviewed by GlobalData indicate that ongoing management of PWNs is comparable to managing a WiFi network. Scaling solutions can also be done at a rate to suit the needs of the business with the addition of further radio equipment much easier than initial deployment.

It should also be remembered that PWN is designed to work alongside and compliment other wireless technologies. It operates of different spectrum from WiFi and IoT and does not preclude the use of public LTE/5G spectrum for devices such as mobile phones. The platforms for managing PWN can also be used to manage other wireless solutions, and multi-wireless protocol solutions can be used to increase resiliency and redundancy.

ROI and TCO survives scale

One of the most consistent messages from organizations that have deployed private wireless solutions is the rapid return on investment. Some market observers have speculated that as PWN technology matures and is used for more complex deployments, a return on investment may be harder to achieve. However, the survey data suggests that results continue to be highly impressive.

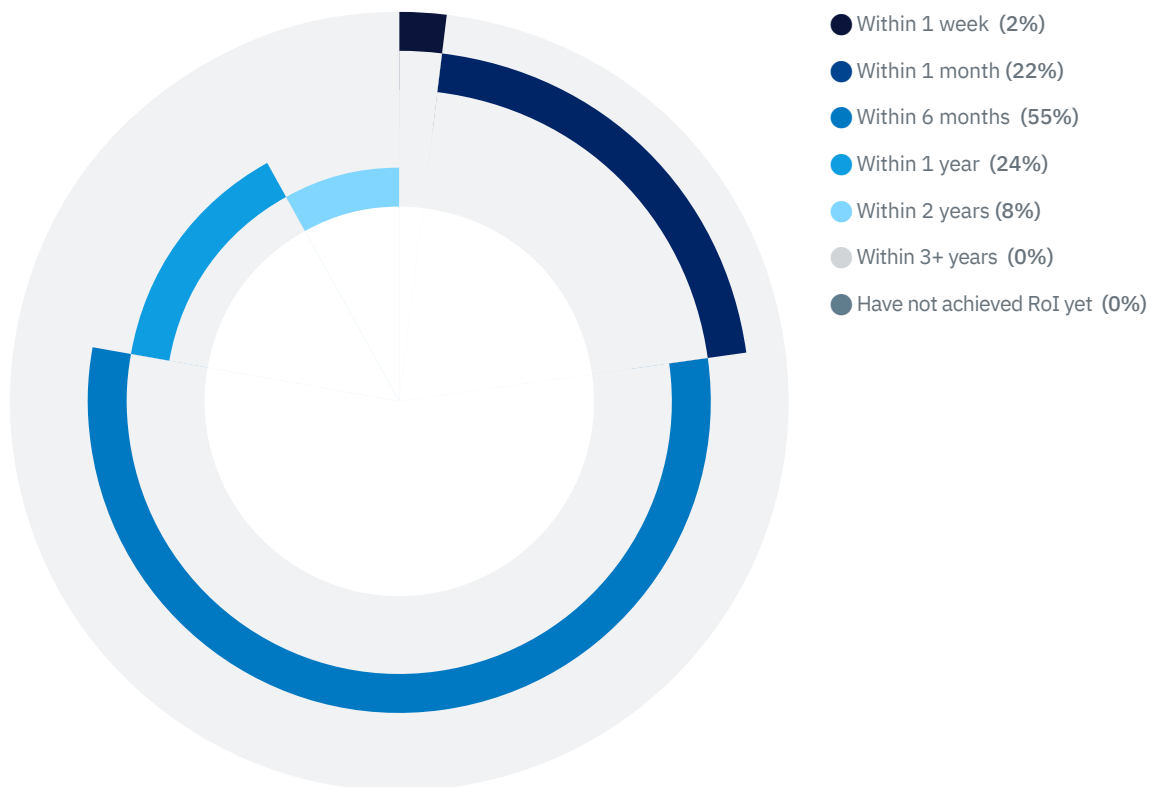
Not a single respondent indicated that they had failed to achieve a return on their investment in private wireless technology, with 92% achieving a return within 12 months and 78% achieving a positive result within six months. In fact, almost a quarter of respondents (23%) achieved their ROI target within one month, and two businesses surveyed stated that their PWN had paid for itself within a single week.



“We are seeing a favorable cost benefit – the efficiency is better than we thought”

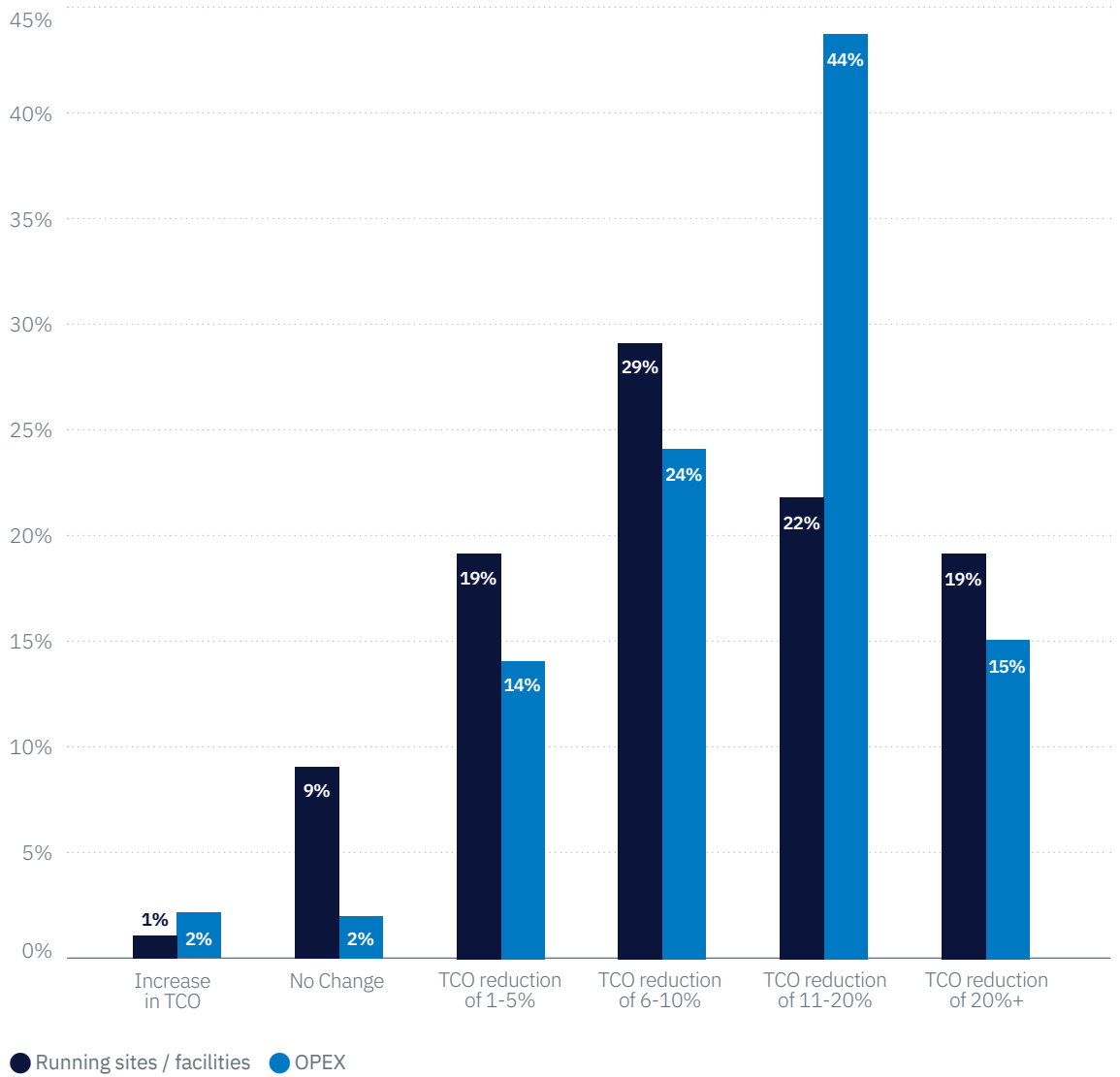
Director of IT, Heavy Equipment Manufacturer, Japan

Within how long did you achieve a Return on Investment (ROI) on your private wireless solution (including industrial applications)?



Source:
GlobalData Private Wireless
Survey Q1 2024

Impact on Total Cost of Ownership (TCO) through deploying private wireless and/or industrial edge technology



Source:
GlobalData Private Wireless Survey Q1 2024

One of the businesses interviewed by GlobalData highlighted that the cost of a two-day outage caused by poor connectivity – a situation they had experienced using WiFi – was 200% of the cost of deploying their entire private wireless solution.

Private wireless solutions have helped businesses to achieve such returns by fixing broken processes and reducing the overall cost of doing business. Of the enterprises surveyed, 97% had achieved an overall reduction in their OPEX expenditure as a result of deploying a PWN solution, with 59% achieving a reduction of 10% or more. 89% experienced a reduction in the cost of running industrial sites and facilities, with 41% experiencing a reduction of more than 10%.



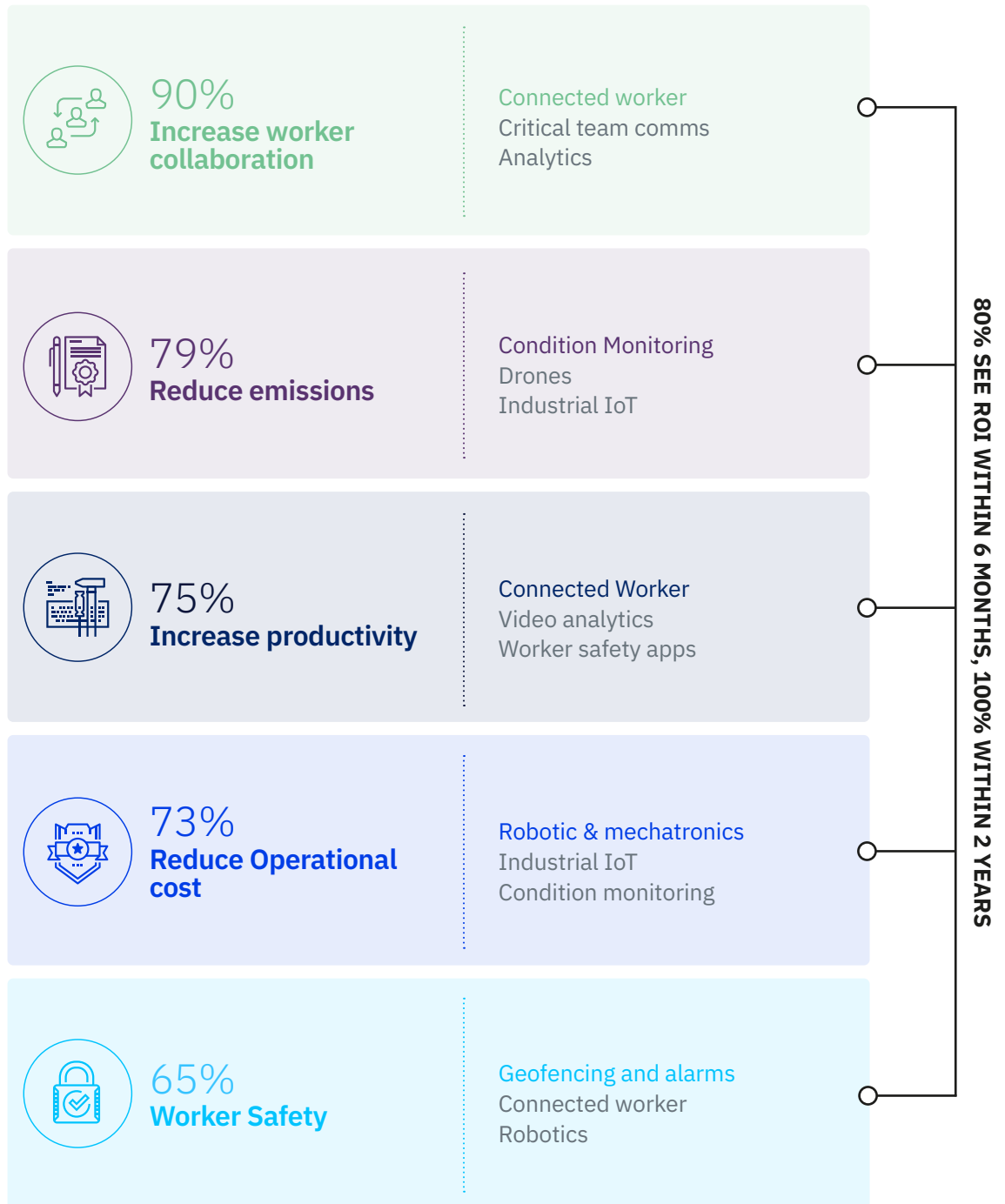
“It was cheaper than deploying WiFi”

CIO, Automotive Manufacturing, USA

These benefits were achieved through a number of factors. For example, 93% of those surveyed were able to reduce costs through switching off legacy infrastructure and network services as a result of using private wireless connectivity. Private wireless infrastructure itself can be cheaper and more energy efficient than using alternative wireless technologies such as WiFi or the cost of trying to support wired connections in challenging environments. 95% of businesses surveyed found that private wireless reduced equipment costs, with 40% seeing a reduction of more than 10%.

Use cases making a difference

Percentage of early adopters that see 10%+ improvement



Source:
GlobalData Private Wireless
Survey Q1 2024

Deploying private wireless solutions is not merely about cost reduction. Indeed, while most providers were able to achieve a demonstrable ROI, often the primary motive

for choosing private wireless connectivity was about solving a specific problem. GlobalData asked enterprises about a range of use cases that can be enhanced by the use of PWNs.

Connected workers are safer and more efficient

While private wireless networks are often targeted at connecting devices, connecting people is an equally important part of their capability. In large and busy industrial sites, worker communications can be next to impossible leading to reduced efficiency and potentially risk to life if workers are not alerted to potentially hazardous situations.

90% of enterprises found that they were able to improve worker collaboration by more than 10% using connected worker solutions and analytics tools. Combining critical team communications solutions with private wireless connectivity led to an improvement in solution performance and managers being able to stay in contact with workers more easily across large sites.

Layering analytics tools on top of this using edge technology also enabled enterprises to better understand working patterns, identifying best practice as well as behavior that may be in breach of regulations.



“We need to reduce the number of human touches in hazardous environments.”

Director of ERP and Technology Solutions,
Pharmaceuticals, UK

The enterprises surveyed also stated that they saw clear worker safety benefits, with 65% stating that they realized a more than 10% improvement. Connected services such as geo fencing and automated alarms reduce instances of workers accidentally moving into dangerous locations, as well as improving site security. The use of robotics and automated vehicles connected to PWNs also makes it easier for businesses to take their workers away from the most hazardous environments.



Productivity gains

Deploying the above-mentioned connected worker tools with video analytics, and industrial IoT devices connected over a private wireless network allowed 75% of businesses to improve efficiency more than 10%. But, as well as connecting people, PWNs also make it easier to monitor and manage industrial processes.



“The machine operators have advocated for the use of private wireless connectivity.”

Director of IT, Heavy Equipment Manufacturer, Japan

Maintaining a consistent and reliable throughput from sites and facilities was one of the biggest challenges highlighted by the businesses GlobalData spoke to. Video analytics tools deployed alongside on-premise edge compute resources were cited by manufacturing companies interviewed by GlobalData as crucial for delivering improvements in quality control, predictive maintenance, and compliance.



“Connecting our AGVs [automated guided vehicles] would not be possible without private wireless”

CIO, Automotive Manufacturing, USA

In locations such as ports, warehouses, mines, and factories, enterprises have repeatedly experienced interruptions in operations due to WiFi either being unable to provide coverage in all corners of a plant, or due to failures caused during handover between wireless access points. 83% of businesses found that PWN connectivity delivered a more than 10% performance improvement.



Sustainable industry 4.0

Efficiency and sustainability go hand-in-hand and private wireless has also been a significant boon to those seeking to meet carbon reduction targets and improve their sustainability reporting processes. 79% of organizations surveyed experienced significant improvement to their sustainability efforts after installing a PWN.



“Our PWN solutions are important for our sustainability strategy”

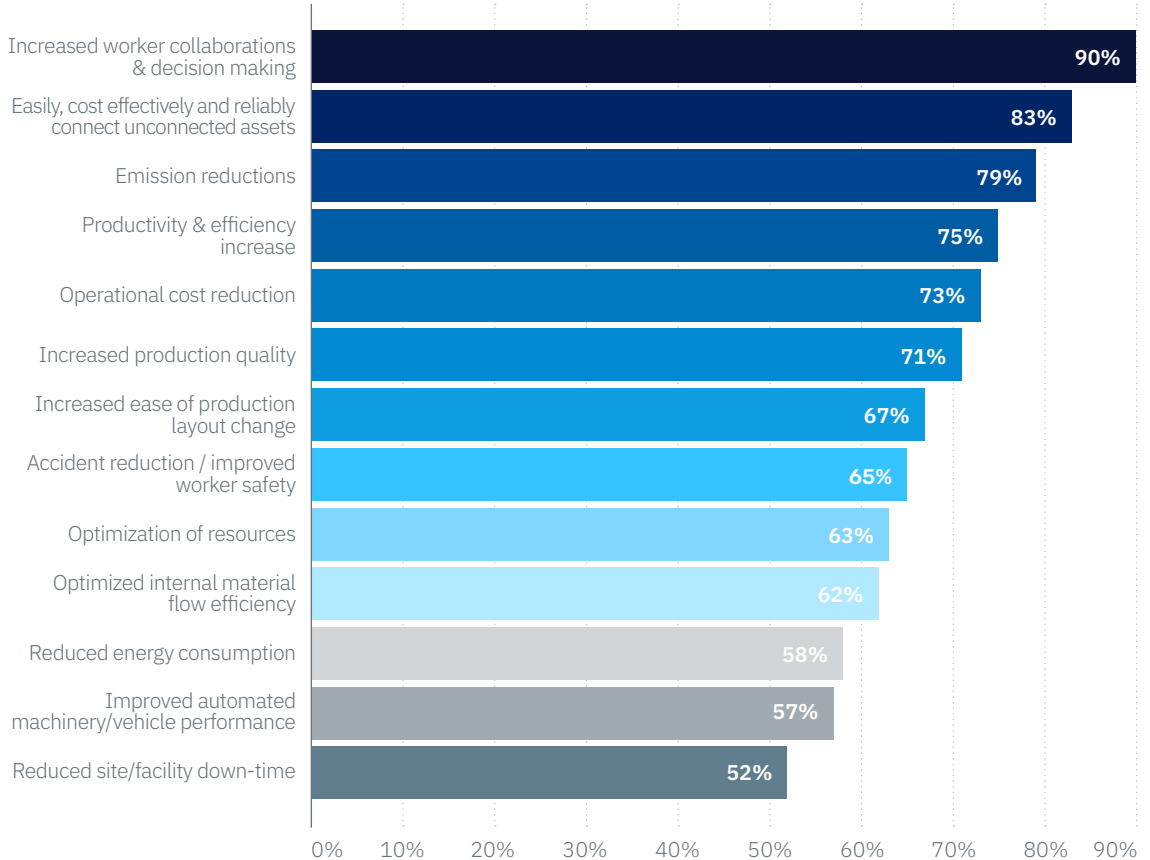
CIO, Automotive Manufacturing, USA

Tracking and monitoring carbon emissions is increasingly required both by national and regional regulators and authorities, and also by investors and customers. The enhanced connectivity provided by PWNs increased the ability of those surveyed to connect industrial

IoT devices and sensors as part of their condition monitoring processes. Using these sensors together with edge and AI capabilities has made it easier to automatically collect emissions data, with near real-time tracking possible, and to analyze where improvements can be made.

PWNs can also reduce carbon footprints by removing the need for workers to travel – either between locations or across single sites. Reduced need for in-person monitoring of processes has reduced travel requirements for engineers and quality control personnel. In large sites such as mines and utilities sites, the use of drones connected to private wireless has improved companies’ ability to safely monitor large areas without the need for workers travelling in petrol-powered vehicles until a problem is identified.

% of respondents who have achieved a benefit of 11% or greater for priority use cases



Source:
GlobalData Private Wireless
Survey Q1 2024

Growth through transformation



“Private wireless is enabling the next stage of our transformation process.”

Director of ERP and Technology Solutions,
Pharmaceuticals, UK

All of the enterprises spoken to stated that their private wireless network was part of a wider transformation process – a process that is designed to develop new revenue generation opportunities as well as better ways of doing business. Furthermore, the majority of respondents expected to see a growth in the benefits experienced from the use of private wireless networks.



“I wouldn’t even have thought of this use case when we started”

CISO, Manufacturing Company, USA

Enterprises often deploy private wireless networks with the intention of addressing a single business use case, such as connecting automated equipment, improving quality and/or compliance control, or deploying enhanced worker safety solutions. The success that businesses have experienced from these initial use cases is driving innovation and 45% of those organizations who have deployed a private wireless solution have already used it to support additional use cases beyond those envisaged at the time the solution was initially bought.

One manufacturing business cited the example of a PWN being deployed to connect hand scanners in its warehouse environment had expanded to include automation and maintenance solutions. These processes include using employees wearing Google Glass devices connected to the PWN. The video can be viewed remotely by equipment

manufacturers allowing them to diagnose faults and send out engineers who know the problem and have the right replacement components and tools with them.

Enterprises have also begun to use PWNs as part of their training processes. Apprentices and new employees can be remotely monitored. Processes that need improving can be identified while hours of experience needed to achieve certifications can be validated.

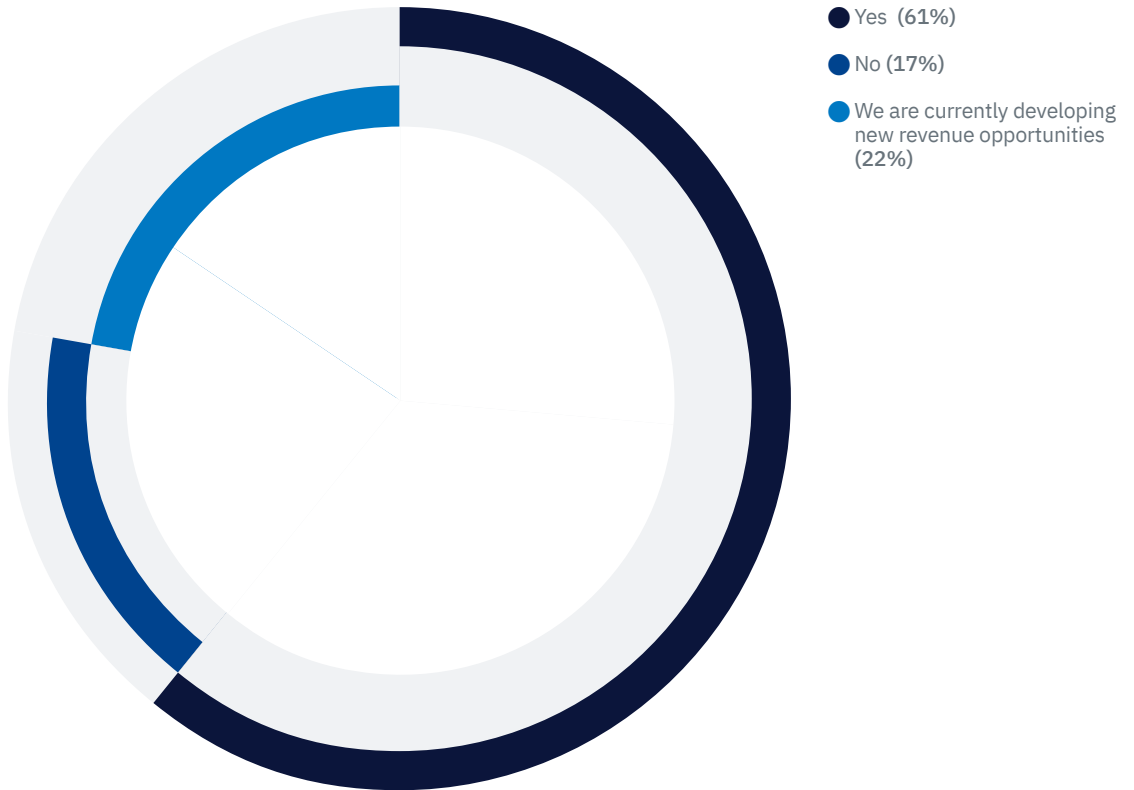
The pervasive and reliable connectivity delivered by private wireless is also allowing enterprises to be more creative and address more market opportunities. 61% of respondents stated that their PWN solution has already enabled new revenue opportunities with a further 22% currently developing new opportunities.



“Private wireless is helping our transformation processes across three key areas: customer facing, supply chain, and manufacturing.”

Director of IT, Heavy Equipment Manufacturer, Japan

Has your private wireless solution enabled new revenue opportunities for your business?



Source:
GlobalData Private Wireless
Survey Q1 2024



Lufthansa Industry Solutions



“Private 5G gives you a stable, reliable, and secure connection across a very wide area with only a small number of radio access points.”

Dr Claudius Noack, IT Consultant, Lufthansa Industry Solutions



BRINGING ADVANCED SOLUTIONS TO THE LUFTHANSA GROUP

Lufthansa Industry Solutions is an IT consultancy within the Lufthansa Group, one of the world's largest aviation companies. The company's mission is to understand how advanced new technologies can benefit the Lufthansa Group and other industries - determining the best ways to implement these technologies and addressing the business needs they can fulfil.

Lufthansa Industry Solutions has collaborated with Lufthansa Technik (also part of the Lufthansa Group), Nokia and other vendors as part of its mission to integrate technology with tangible business benefits, providing wireless connectivity in intricate environments.



COVERAGE OVER LARGE AREAS

Delivering connectivity in challenging environments in airports and aircraft facilities is a mission-critical challenge for Lufthansa Group. These facilities are often extremely large – airports the size of small cities and hangars covering tens if not hundreds of thousands of square meters.



CHALLENGING ENVIRONMENTS FOR TRADITIONAL WIRELESS SIGNALS

Inside hangars and workshops offered perhaps the biggest challenge as the primarily metal superstructures and busy, multi-technology environments inside leave dead zones when using traditional wireless access services such as WiFi. The scale of the environments also makes cabling for wireless access points or fixed connectivity both difficult and expensive – when it is even possible.



REACHING SIGNAL DEAD ZONES

Public 5G and 4G LTE services also encountered dead spots and low-quality signal areas. Furthermore, public spectrum left security challenges in an industry that is highly security conscious as it handles proprietary technical data as well as the personal data of millions of passengers.



A SPECIFIC NEED

Like many businesses, Lufthansa Technik's journey towards private wireless technology started while trying to develop a specific use case. In this case, Lufthansa Technik was seeking to develop a solution that would allow detailed 'table inspection' of aircraft components as part of regular, industry mandated maintenance processes to happen remotely rather than in person.

Normally, engineers would have to fly to Lufthansa Technik's premises in Germany to inspect components incurring significant costs and creating a large and avoidable carbon footprint. Lufthansa Technik had already received permission in principle from the German regulators for the concept, but the regulator had mandated that remote inspections must be conducted over a high quality and consistent connection to meet the required standards.



“WIFI GAVE BAD VIDEO”

As noted above, WiFi, public mobile, and fixed access technologies often struggle in the kind of environment in which the maintenance processes take place – a fact that had been confirmed with previous trials. The possibility of using a private wireless solution suggested itself after IT consultants from Lufthansa Industry Solutions had observed its successful use supporting autonomous guided vehicles (AGVs) in an industrial plant in Finland.



“ONLY PRIVATE WIRELESS COULD DELIVER AT THE RIGHT LEVEL”

The private wireless solution was able to deliver consistent connectivity over a large area without cumbersome handover between WiFi access points and without areas of low or no signal.

Lufthansa Technik quickly moved to develop a proof of concept using a single private wireless radio deployment. Nokia had been the technology partner for the successful AVG solution and Lufthansa Technik and Nokia began a conversation that would lead to a proof of concept (PoC) trial.

Initial site surveys confirmed that stable bandwidth with a high level of signal strength was available consistently across almost all of the table inspection hangar. Furthermore, the management portals provided enabled Lufthansa Technik to manage bandwidth.



“THIS IS EXACTLY THE CASE WHERE PRIVATE WIRELESS CAN HELP”

Specifically, Lufthansa Technik was able to increase upload speeds to support the high-quality video uploads from multiple cameras. The solution was comfortably able to support the requirement of connecting four cameras each uploading 25Mbps of high-quality video data. This upload capacity was fundamental to making the PoC a success by meeting customer and regulatory demands.



“WE CAN PROGRAM THE C-BAND TO ALLOW MORE UPLOAD – WE HAVE ACHIEVED 400 MBPS”

Reducing the need for highly specialized engineers to be on site for table inspections has improved the speed of inspections while also saving precious time and travel costs per inspection. Furthermore, Lufthansa Technik has a strong sustainability ethos, and it has been able to reduce its carbon footprint by many thousands of tonnes through reduced travel.



ONLY THE BEGINNING

The success of the PoC quickly led to live deployment of remote table inspections as a regular part of aircraft maintenance. Lufthansa Technik has already extended the number of private wireless radio locations at its site – including a kilometre-long, 200-meter-wide concrete ‘apron’ in front of the hangar which is covered by just two radio antennae.

The Nokia-technology-powered private wireless network already connects more than 50 devices, a number that will soon grow into the hundreds, with the ability to ultimately support more than 1,000 connected devices. Trials have also begun at new locations including at sites in the United States.



“IT WAS REALLY CHEAP TO EXPAND ONCE THE INITIAL SYSTEM WAS INSTALLED”

Lufthansa Technik is now using its private wireless solution for additional use cases. Removing scenarios in which human operators had to move tens of meters between WiFi black spots while using scanners has improved efficiency and scanning accuracy leading to significant savings in terms of time and money per scanner.



“IT IS ABOUT SAVING TIME AS WELL AS MONEY”

Similarly, inspection processes for aircraft engines where, traditionally, server stacks supporting data processing and AI analytics systems had to be physically wheeled to the component can now be conducted using private wireless connectivity and edge computing resources. This new capability reduces costs and human error leading to a safer experience for passengers and air crew.



OUTSIDE MAINTENANCE HANGARS

Lufthansa Industry Solutions' customers have expressed a strong interest in working with the company and its partners, such as Nokia, to deploy private wireless networks at their own locations. Lufthansa Industry Solutions is also speaking to airports about extending the use of private wireless to other parts of the air travel ecosystem.

For example, on its 2024 agenda is the use of private wireless connectivity to upload multimedia entertainment data to aircraft. At present, each plane has to have the data uploaded manually by a person physically present at the aircraft. Multiplied across hundreds of planes multiple times per year, the time and money saving potential of this next private wireless use case is not insignificant.

What started as a solution to a connectivity problem is now enabling digital transformation across the aviation industry to the benefit of airlines, passengers, and the environment.



Source: Lufthansa Technik AG, Photography: Jan Brandes

Conclusion

It is clear that the market for Private wireless solutions is well into its transition from emerging technology to becoming an established part of the Industry 4.0 landscape. Early trials have enjoyed significant success and hundreds of businesses are already rolling out the technology across multiple sites and facilities.



It is also clear that the full potential of private wireless has not yet been realized. The technology offers an enhanced connectivity experience, delivering reliable and secure bandwidth over large areas. On its own this connectivity is saving worker-hours, improving safety, reducing carbon footprints, and achieving real-world business benefits.



But more can be achieved through deploying end-to-end solutions that combine AI and analytics tools and edge platforms. Together these technologies can address the most technically and logistically challenging business needs across a range of industrial settings. They can do so at a cost base that compares favorably with the alternatives, but also in a way that will work with existing WiFi, IoT, and wireline connections.



Private wireless networks are delivering immediate RoI benefits and create the platform for future industrial transformation.

Appendix


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