VORTEX

Indu Sol
Industrial Solutions

2024

ABRIDGED INDUSTRIAL
NETWORK SUPPORT REPORT

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PREFACE

"The Vortex is the compass of industrial network technology and security."

Dear customers,
Dear business partners,
Dear interested parties,

In the VORTEX Report 2024, I present to you on behalf of Indu-Sol GmbH, for the 9th year in a row an up-to-date insight into the the dynamics of industrial networks, based on comprehensive analyses and the detailed investigation of the causes of faults by our measurement technology deployments over the last twelve months. This analysis, enriched with case studies and best practices, aims to provide you with an understanding of the challenges and solutions in industrial communication networks.

Indu-Sol sees itself as your partner. With our expertise in network technology and OT security, we offer not only robust network structures and infrastructures but also tailored solutions that filter critical information from operational data and use it for preventive maintenance and process optimization.

Skills labour shortages and strategies to overcome it
The ongoing shortage of skilled workers poses major challenges for many companies. Indu-Sol is responding to this with outsourcing and increased digitalization. By outsourcing certain services in a targeted manner, companies can access specialized know-how. At the same time, digitization makes it possible to make processes more efficient and ensure stable operations with fewer staff.

Increasing competitive pressure
In a highly competitive market, it is crucial to stay one step ahead. The VORTEX Report 2024 provides you with insights and recommendations on how to secure and expand your competitive advantage through innovative solutions.

Consider this an invitation to a dialogue in which Indu-Sol acts as your navigator and partner to identify and implement the best solutions for your requirements. The VORTEX Report 2024 is your compass in this evolving terrain of industrial network technology and security. I and the Indu-Sol team look forward to accompanying you on this journey.

I wish you an informative reading and hope that the VORTEX Report 2024 will inspire you to make your networks more secure, efficient and future-proof.

Bianca Körner,
Head of Service & Technology
Indu-Sol GmbH

CONTENT

INTRO

In the production world, where OT networks and OT security are playing increasingly important roles in industrial automation, the PI user organization and sources such as profibus.de highlight the progressive development of these technologies. Compliance with the NIS2 directive and IEC 62443 is becoming essential to address both operational and security challenges in the industry. These standards help to realize optimization potential and cost savings, while emphasizing the need to protect both customer data and production processes from cyberattacks.

At the OT level, the vast majority of attacks are currently coming from the “inside” rather than via the IT level, even if there are always “bycatch” cyberattacks. This highlights the importance of strengthening and continuously monitoring internal security strategies.

This is particularly relevant as compliance incidents are now located in the corporate governance and can have a direct impact on the personal liability of top management. These developments signal that the impacts are getting closer and make the importance of a robust security strategy imperative.

We offer further valuable information and practical insights in our VORTEX Report, based on the experience of our more than 150 network experts.

CARPE NETWORK

USE THE NETWORK

"Carpe network – Use the network" invites you with a wink to fully exploit the potential of industrial networks. In the current era, in which exponentially increasing data volumes are both a challenge and an opportunity, the way forward is to use networks not only more efficiently, but also more offensively. In order to meet the increasing demands on functionality, security and data permeability, innovative, networked structures are required – a demanding but worthwhile task.

In many industries, systems have been operated with the established PROFIBUS technology for many years. This year, it is celebrating its 35th anniversary. As these systems get older, the risk of failures and efficiency losses increases. In addition, established suppliers of PROFIBUS components are increasingly withdrawing, which requires the search for viable solutions to ensure production.

Indu-Sol is taking on these challenges

On the one hand, we will continue to position ourselves as a competence partner for PROFIBUS in order to expand users' specialist knowledge and make PROFIBUS networks future-proof. On the other hand, we are developing solutions for network structuring and infrastructure that support system availability and the convergence of IT and OT. The focus is particularly on OT security, an area that is of crucial importance in the networked industry.

By providing tailor-made solutions that filter out relevant information from the flood of data, Indu-Sol supports companies in preventive maintenance and the optimization of their processes from network planning to commissioning and maintenance.

The VORTEX Report 2024 is based on detailed analyses of more than 500 measurement technology deployments over the last twelve months. It provides insights into the causes of network faults, from physical problems such as defective plug connections and cables to complex faults in machine communication.

NETWORK EXPERTS IN ACTION

APPLICATIONS

Increased network activity:
Impact on the maintenance and availability of industrial networks

Last year, the network experts from Indu-Sol completed over 500 assignments to meet the requests of our customers. These assignments were divided into 125 troubleshooting during production interruptions and 376 measurements.

Trends and challenges:

1. Increase in measurements and troubleshooting in PROFINET:
The increased number of measurements and troubleshooting in PROFINET networks is a sign of the continuing success of this application. PROFINET meets your process requirements. Compared to PROFIBUS, PROFINET offers higher bandwidth, real-time communication, and the ability to integrate Ethernet-based technologies, resulting in improved performance and flexibility in industrial networks. With PROFINET, the operator of a plant can access the value-adding data of the end devices in the OT network.

For example, mass flow, density, temperature, quantity counter settings, diagnostic data and much more can be provided via a single cable. At the same time, the level of digitization continues to increase, which leads to an increasing network load due to increasing communication, e.g. via TCP/IP in OT networks.
This requires a significantly more powerful network structure in the backbone and increased network monitoring in the transition by the operators of automated systems.

2. Percentage decline for PROFINET:
Although the absolute number of PROFINET error searches has increased (see point 1), the percentage decline compared to other protocols shows that PROFINET networks are robust. This stability makes PROFINET increasingly the first choice for network managers, which is reflected in the planning of network expansions or modernizations.

3. More weak points in PROFIBUS systems:
The increase in PROFIBUS measurement deployments is increasingly pointing to weak points in brownfield systems, some of which have been in operation for several decades. Avoiding unplanned system downtimes through predictive maintenance, e.g. with a network condition monitoring management system (CM&SM), is becoming increasingly important for business success.

In the past 12 months, our services for network consulting and network planning have increased by a factor of 4. This is a sign that the complexity on the operator side continues to increase and at the same time trust in Indu-Sol's services is growing.

	2021	2022	2023
PROFINET	45 %	48 %	45 %
PROFIBUS	37 %	33 %	39 %
ASi	6 %	6 %	4 %
INDUSTRIAL ETHERNET	5 %	4 %	5 %
Others	7 %	9 %	7 %

SOS

Don't wait until there is a total breakdown, because it takes an average of 2.3 days for complex systems and processes to run smoothly again.

DEPLOYMENT DISTRIBUTION

Effective monitoring and design for stable OT networks

Ethernet-based networks such as PROFINET dominate in industry. It offers operators real-time communication for precise control, seamless IT/OT integration, and reliable diagnostics to increase system availability, but there are also some pitfalls to consider. In the work of our measurement technicians, the causes of PROFINET errors are evenly distributed between logical and physical causes. In order to proactively prevent unplanned system downtime, it is crucial to continuously evaluate not only the infrastructure quality of the OT network, but also the communication quality and to detect anomalies.

Use of advanced diagnostic tools

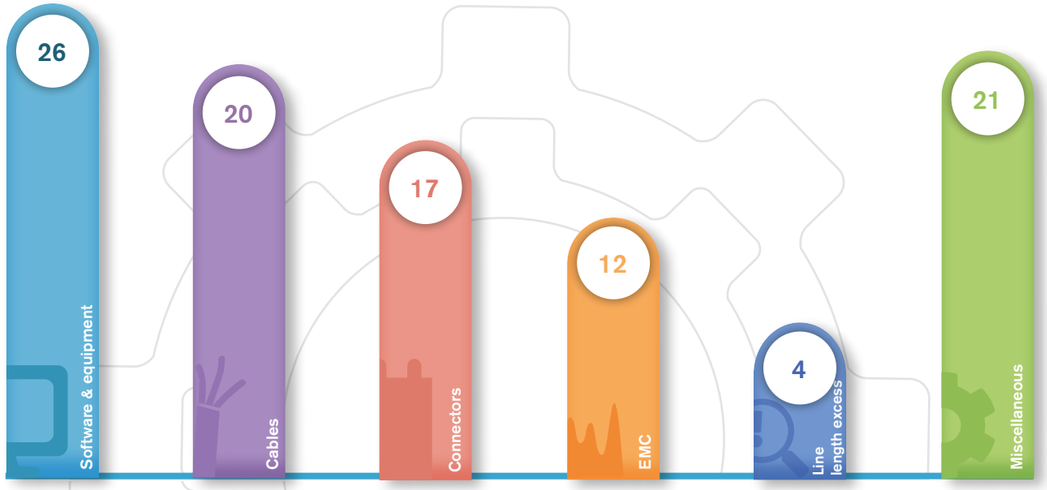
Advanced diagnostic tools and monitoring systems detect and report errors/anomalies in the network and in the application such as PROFINET etc. In this way, most of the causes of unplanned downtime can be identified early enough to be converted into structured maintenance measures.

Challenges in the "Miscellaneous" category

The increase in errors in the "Miscellaneous" category from 13% to 21% is particularly noteworthy.

This includes, for example, unsuitable network structures, excessive network loads, incorrect timing, programming errors and inadequate WLAN coverage. Organically grown networks that have been expanded or modified can lead to design gaps if the latest technological framework conditions are not taken into account.

COMMON SOURCES OF ERRORS



OVERVIEW

	2015 ··· 2021	2022	2023
Software & equipment	21 %	27%	29 %	26 %
Cables	15 %	27%	24 %	20 %
Connectors	11 %	16%	14%	17 %
EMC	36 %	10%	14 %	12 %
Line length excess	4 %	7%	6%	4 %
Miscellaneous	13 %	13%	13%	21 %

PREDICTIVE MAINTENANCE

90% of all breakdowns can be prevented with predictive maintenance

There are two key findings from our latest measurements:

» **1. Undersized machine networks cause unplanned downtime**

In nearly 60 of the companies surveyed, our network experts identified a lack of sufficient bandwidth in the machine networks. In particular, specific bottlenecks lacked a high-performance OT backbone in the gigabit range as the main connection to the higher-level SCADA and IIT network levels. In most cases, this prevented problems and unplanned system downtime.

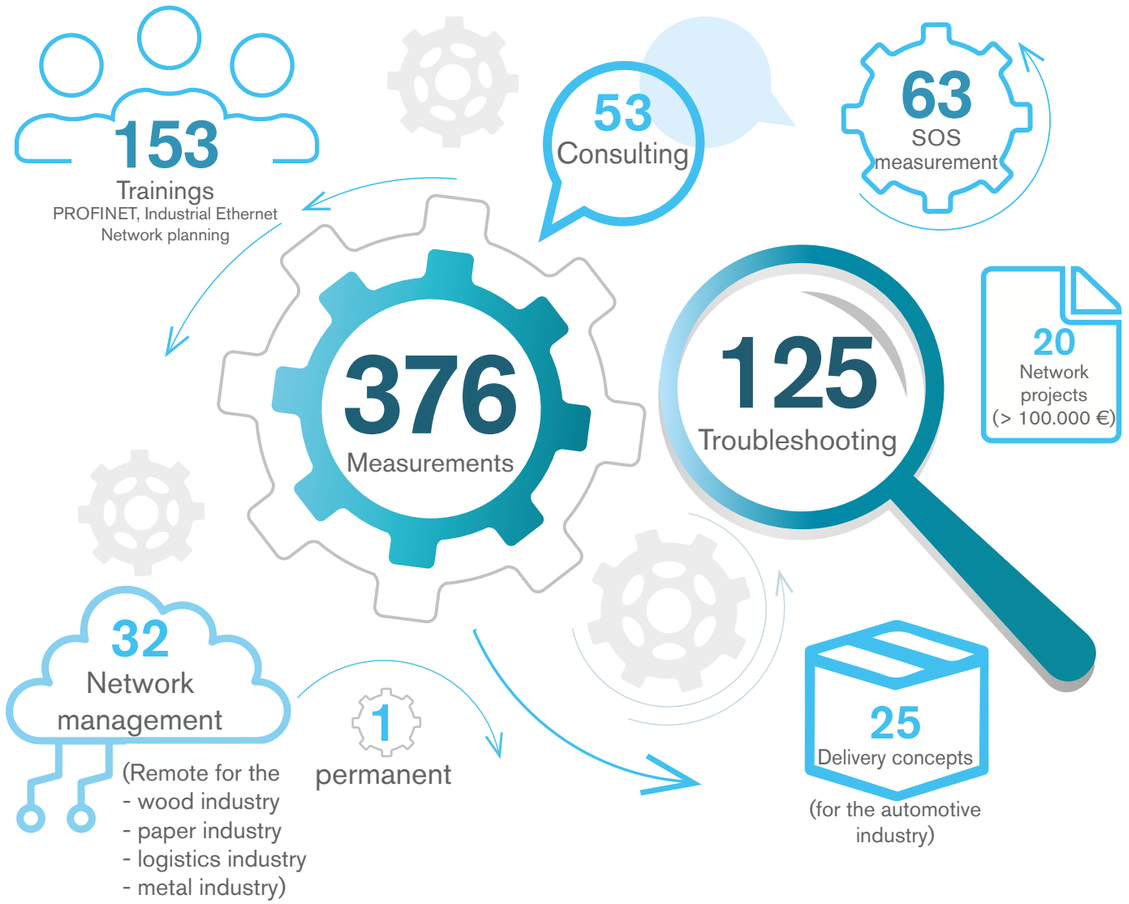
» **2. Avoidable deployments through network condition monitoring**

Many of the deployments of our network experts could have been avoided. A network condition monitoring system can detect up to 90% of physical and logical anomalies at an early stage so that unplanned downtimes can be effectively avoided through proactive measures.

VDI 2983 recognizes 47 KPIs and provides guidance on the creation of KPIs for planning, controlling, monitoring and analyzing plant maintenance. By linking the business figures, potential savings as well as performance potentials are uncovered.

Nevertheless, in our experience, around 78% of companies stick to reactive maintenance after an SOS deployment. Strategic considerations may be the reason for this. Read more about this on page 14.

OUR SERVICE IN NUMBERS



DOWNTIME COSTS

The true cost of unplanned downtime – A look at different industries

Since the outbreak of the coronavirus pandemic, the cost of unplanned downtime has increased by up to 50% in almost all industries, according to a study by Senseye 2024. This study, "The true costs of downtime, 2023," shows that in an average production plant up to 25 hours of unplanned downtime per month in an average can occur. In addition to the direct costs of downtime, the total losses have increased significantly.

The costs of unplanned downtime vary considerably depending on the industry and core process. But how high are the costs per hour of unplanned downtime? Compare this to the investment in solutions such as condition monitoring & safety management systems! By using such systems, up to 90% of anomalies that lead to unplanned downtime can be detected and reported in good time. This allows them to be turned into a structured maintenance process before they lead to failures.

It is worth noting that the proportion of companies that switch from reactive maintenance to predictive maintenance after an SOS deployment is around 22%. This figure has risen slightly compared to the previous period. In our opinion, however, this figure is still far too low, which means that too much productive capital is being burned by reactive maintenance strategies.

Downtime costs in various industries

Dairy

Ø Downtime costs per hour
» 40,000 €

Ø Downtime costs per year
» bis zu 2,628,000 €

Pharmaceuticals

Ø Downtime costs per hour
» 1,500,000 €

Ø Downtime costs per year
» bis zu 98,550,000 €

Automotive

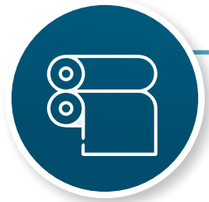
Ø Downtime costs per hour
» 2,000,000 €

Ø Downtime costs per year
» bis zu 131,400,000 €

Bakery

Ø Downtime costs per hour
» 25,000 €

Ø Downtime costs per year
» bis zu 1,642,000 €



Paper

Ø Downtime costs per hour
» 90,000 €

Ø Downtime costs per year
» bis zu 5,900,000 €

Logistics

Ø Downtime costs per hour
» 200,000 €

Ø Downtime costs per year
» bis zu 13,140,000 €

MAINTENANCE MIX

The importance of a flexible maintenance mix for various industries

Many companies rely on a risk-based maintenance mix to increase their efficiency and react to changes in the market. This flexibility requires an intelligent combination of different maintenance approaches - damage-oriented, preventive, condition-oriented and predictive - depending on the current business situation and the critical importance of the plant components.

Advantages of flexible maintenance management

Flexible maintenance management not only enables cost savings and a reduction in unplanned downtime, but also sustainable utilization of the systems and continuous continuous improvement of plant performance. Indu-Sol offers expertise and condition monitoring solutions, to help companies successfully implement this risk-based maintenance successfully implement this risk-based maintenance mix and optimally prepare for future business developments.

Example from the process-driven chemical industry:

In the chemical industry, maintenance management is closely linked to business developments and reacts proactively to special events such as:

Increase in demand (recovery):
Maintenance activities are being stepped up to support the expected expansion of production capacity.

Peak in demand (sold out):
Maintenance activities are temporarily postponed in order to maintain production.

Decline in demand due to overcapacity:
Preventive maintenance measures are reduced in order to free up financial resources for ongoing business.

Irrespective of these short-term adjustments, long-term maintenance strategies remain unaffected.

» A risk-based maintenance mix is used to increase efficiency and respond to current and **foreseeable market developments.** «

SERVICE INSIGHTS

High availability - high pressure: Practical example of logistics

Fabian Nostitz: "As a network specialist at Indu-Sol, I have gained deep insight into the challenges of plant availability. Condition monitoring provides significant relief to plant operators where downtime is unacceptable, as unplanned downtime can have financial and reputational consequences.

One example is a logistics center with sporadic failures and faulty packet unloading due to network congestion, particularly between the controller and the first switch. The causes were excessive line depths and communication anomalies such as jitter and faulty telegrams.

The solution not only involved replacing faulty devices, but also a comprehensive restructuring of the network, which relieved the critical points on the backbone and stabilized operations. Similar challenges also occur in the food, automotive and paper industries.

This example shows that proactive condition monitoring is preferable to reactive maintenance. It enables targeted maintenance measures to be carried out without interrupting production. An early warning system supports strategic maintenance planning and increases the profitability of the systems."

Fabian Nostitz
Service technician

A quote from a project in the food sector puts it in a nutshell:

"When the plant is standing and the food to be processed there has to be disposed of after a maximum of 48 hours, you have to stay focused, despite the hectic activity around you."

SERVICE INSIGHTS

IT/OT connectivity:
Challenges and solutions for tomorrow's success

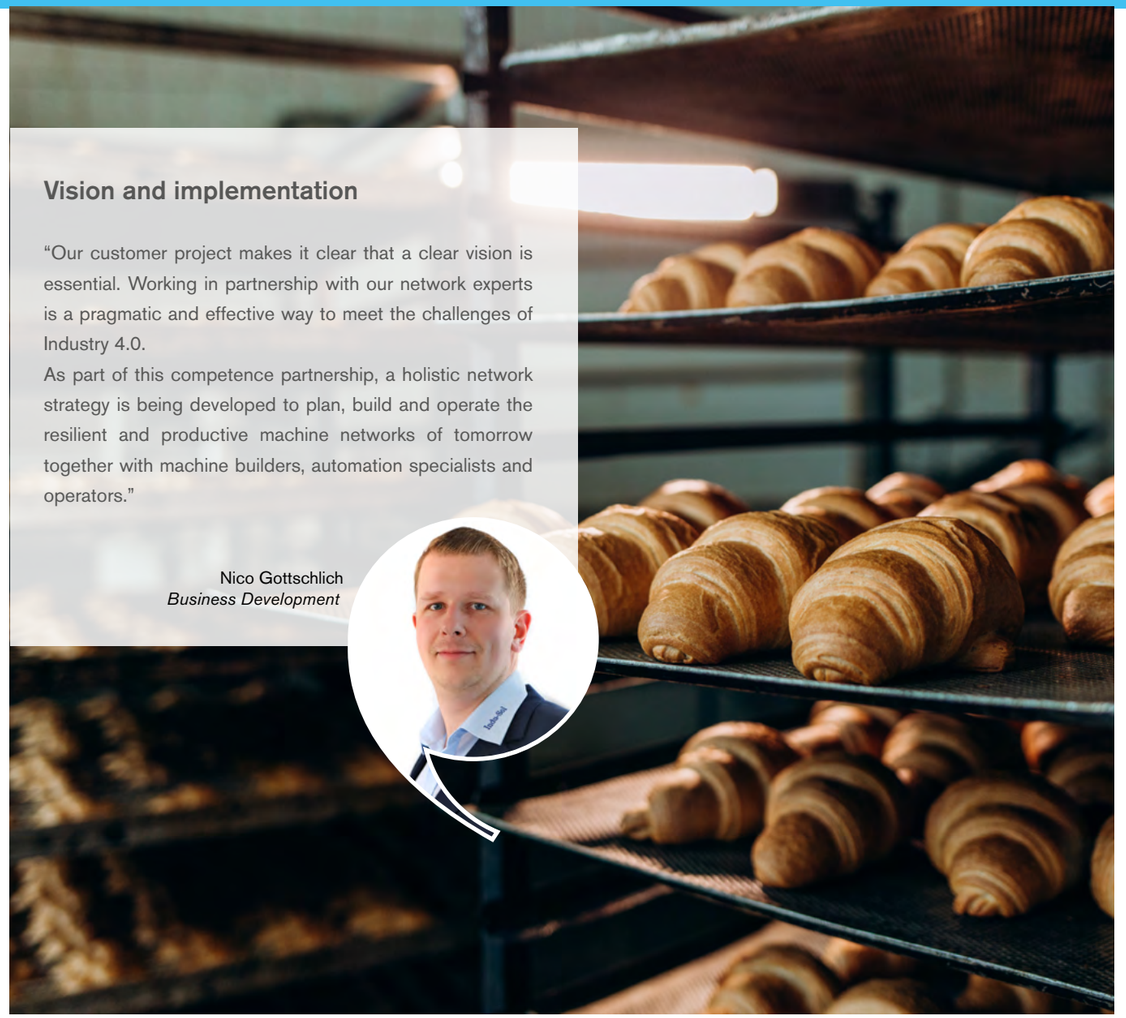
Machine builders and system integrators have often paid little attention to the need for connective network planning that encompasses IT and OT systems. They have stuck to homogeneous fieldbuses without considering the security requirements of modern industrial environments.

Legal frameworks and standards such as the CyberResilience Act, the IEC 62443 standard, the NIS2 directive, the new Machinery Directive and the concept of OT Zero Trust are now key elements in the discussion about OT security. These regulatory requirements form the basis for secure and efficient IT/OT integration

A recent example from the food industry shows how it can work. The client is a food manufacturer that produces around 230,000 tons of products per year and stores them in a connected, automated high-bay warehouse.
The connectivity between the OT and IT networks enables direct access to all end and control devices in order to carry out software updates and continuous asset management.

SL* 3 was achieved with a combination of VLANs and firewalls, without the need to physically seal off individual parts of the network. Connectivity and OT security in accordance with IEC 62443 are not contradictory if adequate measures are taken.

**Explanation: SL = Security Level*



Vision and implementation

"Our customer project makes it clear that a clear vision is essential. Working in partnership with our network experts is a pragmatic and effective way to meet the challenges of Industry 4.0.
As part of this competence partnership, a holistic network strategy is being developed to plan, build and operate the resilient and productive machine networks of tomorrow together with machine builders, automation specialists and operators."

Nico Gottschlich
Business Development

35 YEARS OF PROFIBUS

A milestone in automation technology

The 35th anniversary of PROFIBUS is symbolic of significant developments in industrial communication technology. Over the decades, this technology has significantly influenced and improved production environments around the world.

Today, at a time when efficiency and reliability in production are more important production are more important than ever, operators and network managers are faced with numerous new challenges:

1. **Ageing of the systems:**
   Each additional year of operation increases the risk of breakdowns and efficiency losses in the systems.
2. **Increased maintenance requirements:**
   The need for regular maintenance ties up more and more resources that could be used efficiently elsewhere.
3. **Dwindling technological support:**
   With the withdrawal of established technology providers, the search for sustainable and future-proof solutions is becoming increasingly urgent.
4. **Unplanned shutdowns:**
   Such events can lead to significant financial losses that must be avoided at all costs.
5. **Generational change in personnel:**
   The loss of knowledge due to changes in the workforce exacerbates the skills shortage and poses a further challenge to maintaining production output.

These points illustrate the high business impact of these challenges and underline the need for the right decisions and proactive action at all levels of the company. Adequate training and further education of technical staff is essential in order to successfully master technological change.

Indu-Sol remains firmly at the side of PROFIBUS the user

Indu-Sol continues to support PROFIBUS users, helping them meet the challenges of today and the technology of tomorrow. Our mission remains to provide you with the right tools and knowledge to operate your systems efficiently and safely.

Key milestones:

1989: Introduction of the PROFIBUS standard

1993: Spread in production automation

2000: Integration of PROFIBUS in leading leading systems

2010: Expansion of the PROFIBUS family with PROFINET

2022: Approx. 68 million devices installed worldwide in use

CONCLUSION

Network expertise in the planning phase

» Indu-Sol presents itself as a competent partner for industrial automation and emphasizes the crucial role of network expertise right from the planning phase of new or modernized systems. This commitment not only guarantees safety and efficiency, but also leads to significant cost savings. «

Advanced network technologies

The use of advanced network technologies such as PROFINET and the continuous monitoring of network performance play a key role in avoiding unplanned downtime and minimizing operating costs.

Strategic planning and OT security

In complex network structures, typical for industries in KRITIS and NIS, strategic planning that focuses on OT security and network performance leads to increased operational security and considerable savings.

Early anomaly detection

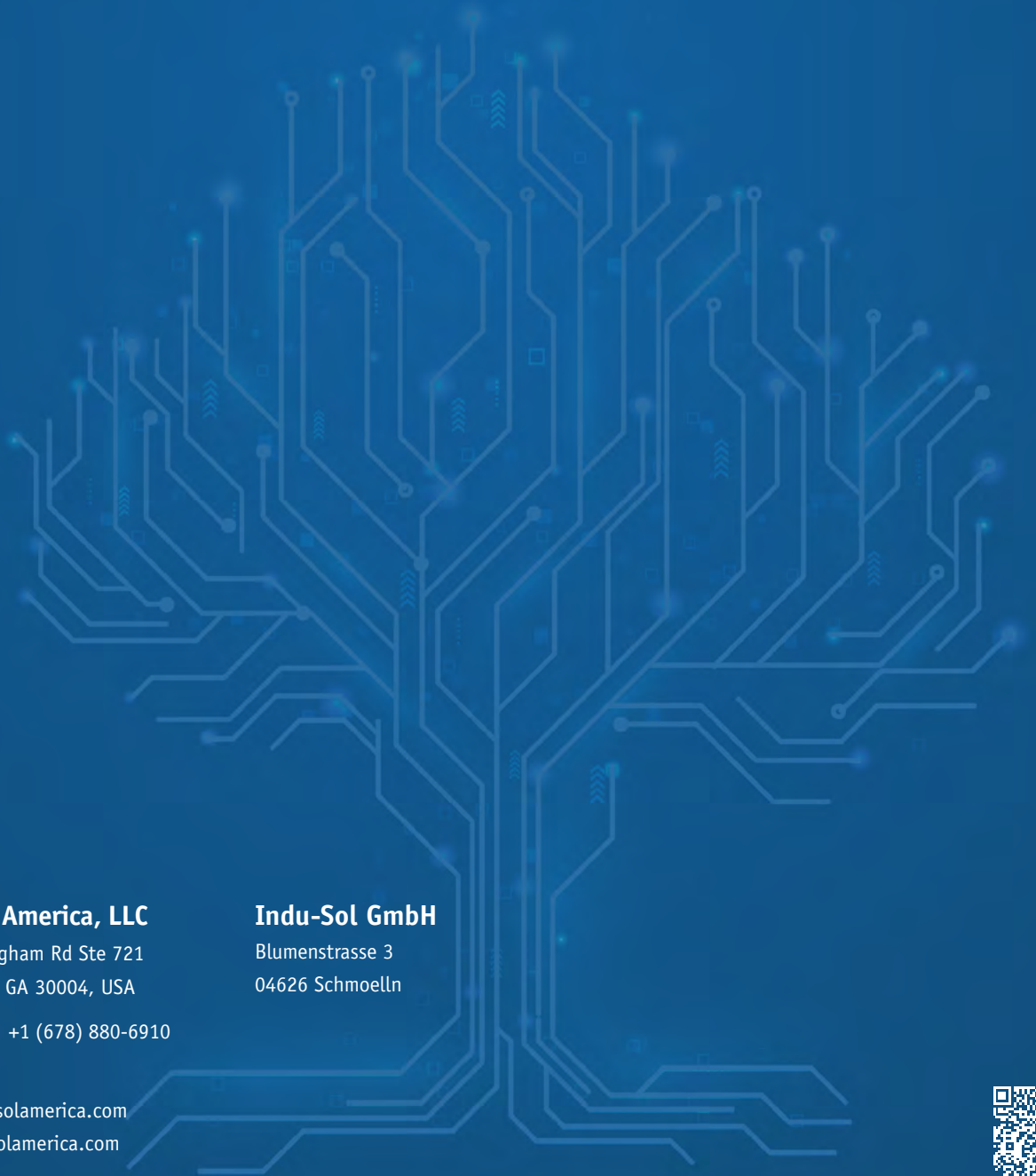
The use of intelligent diagnostic tools and an effective network condition monitoring system enables Indu-Sol to detect and proactively address more than 90% of physical and logical anomalies at an early stage.

Successful restructuring

An outstanding example is the deployment in the logistics center, where the comprehensive restructuring of the network not only drastically reduced the engineering and programming effort, but also the costs.

Recommendation for investment

Indu-Sol recommends that all operators of industrial plants invest in technologies that ensure efficient and secure networking. Involving Indu-Sol's network experts in the planning processes at an early stage not only ensures high plant availability and performance, but also makes the networks future-proof and resistant to OT cyber threats.



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More about Indu-Sol:

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