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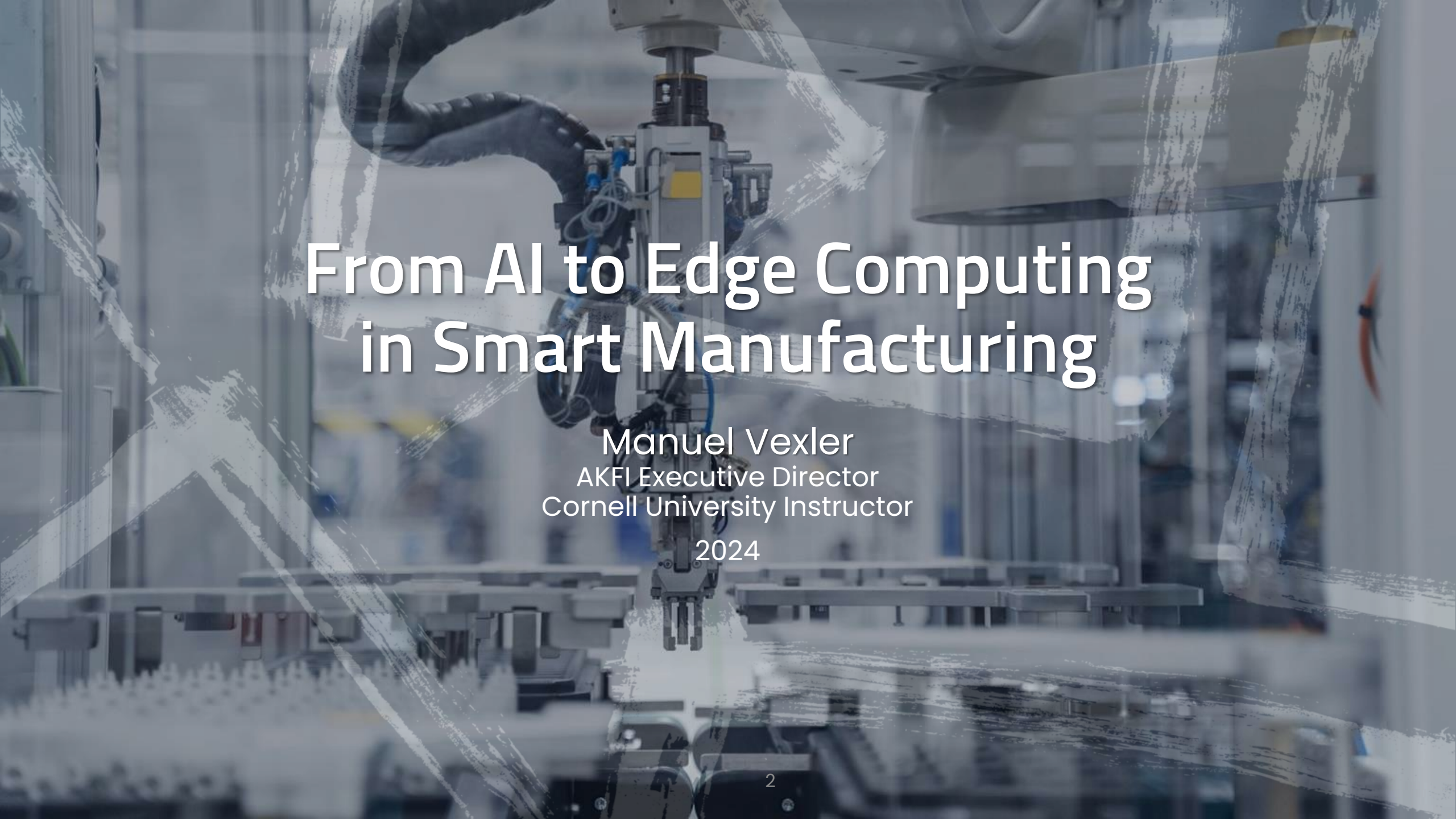

From AI to Edge Computing in Smart Manufacturing

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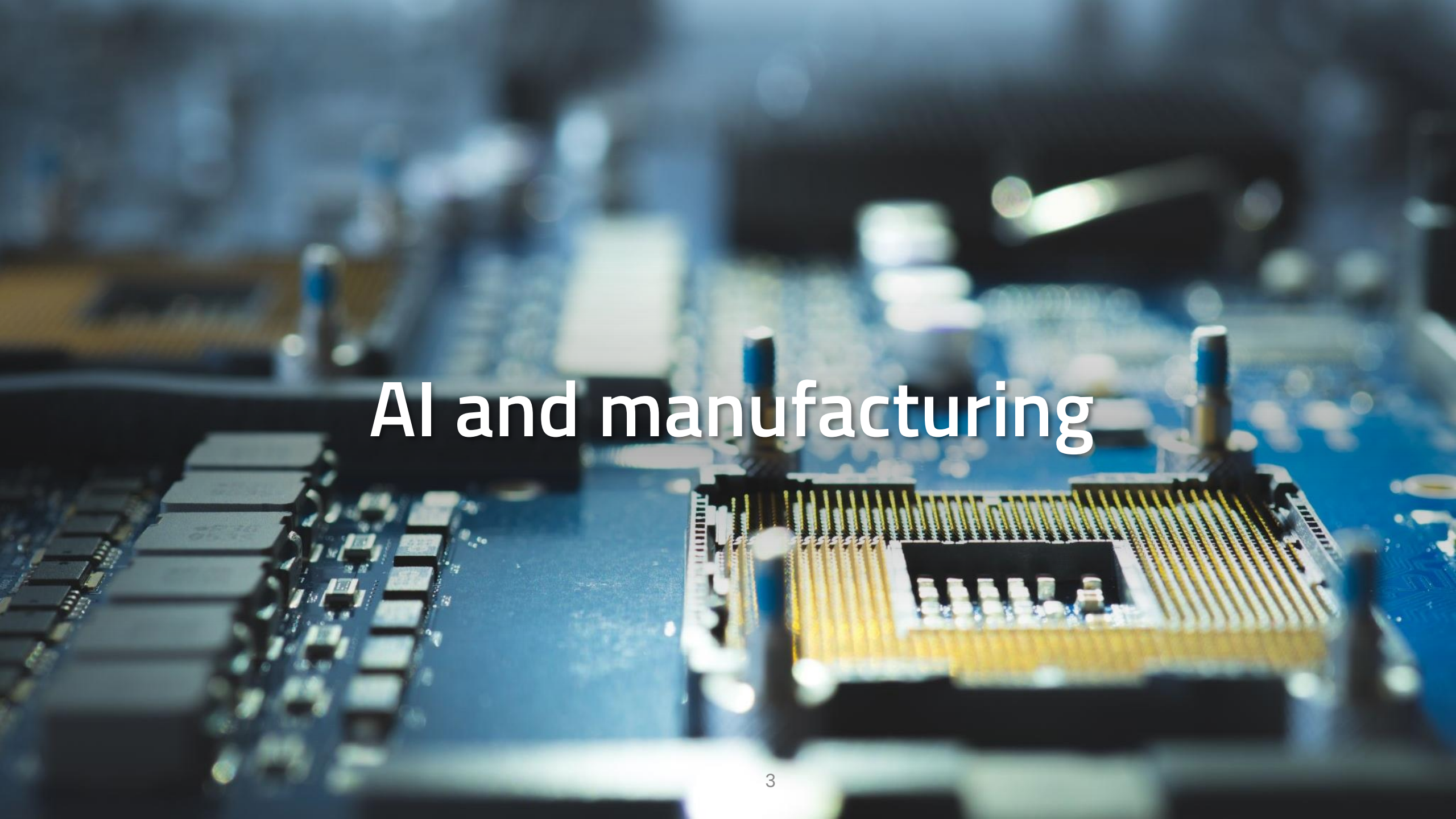
2024



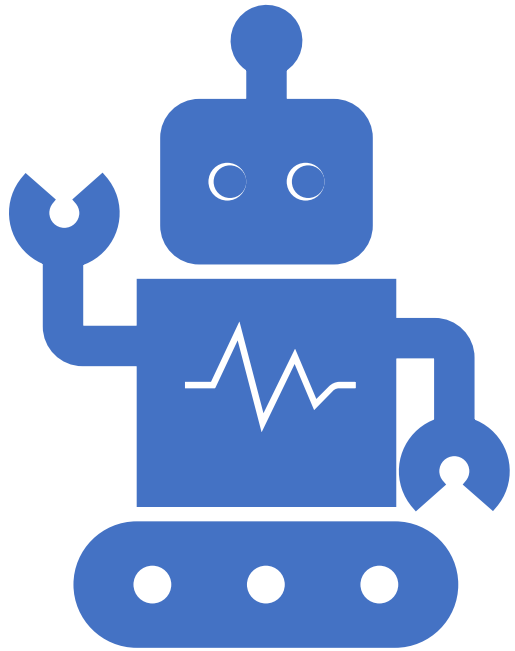
AI and manufacturing

Artificial Intelligence (AI) Defined:

- **Simulation** of human intelligence by machines
- **Automation** of repetitive tasks and decision-making processes
- **Reduces errors** and increases data processing capabilities

Generative AI:

- A **subset of AI** that creates new content, such as robots' instructions, text, or images similar to human-generated content
- Uses **machine learning and deep neural networks** to generate data from very large data sets or data 'lakes'
- Enables systems to learn and improve **from experience**



Factory automation vs. Smart manufacturing

	Factory Automation: Industry 3.0	Smart Manufacturing: Industry 4.0
Definition	The use of technology to control and manage manufacturing processes	The next phase in the digitization of the manufacturing sector, driven by AI, IoT, and data analytics
Comparison	Optimizing a single areas of a factory	Optimizing the entire production process
Strengths	• Efficient for repetitive tasks • Reduces human error • Better productivity	• Real-time decisions • Increases flexibility • Improves efficiency

Industry 4.0: AI meets data-driven manufacturing

- **Production machines:** data on operational efficiency and productivity.
- **IoT devices:** collect and transmit data in real-time.
- **Sensors:** monitoring in the manufacturing process.
- **Operator inputs:** machine operators or staff.
- **Quality systems:** monitor and report on quality.
- **ERP systems:** resources and operations.
- **MES systems:** track and document the transformation of raw materials to finished goods.
- **Factory floor:** production rates, downtime, and waste.
- **Supply chain:** logistics, and inventory management.
- **Customer feedback:** Real-time feedback.

Types of data to process

- **Real-time sensor data**: immediate insights into the performance and status of machinery and equipment enabling proactive maintenance
- **Machine performance metrics**: Monitoring and analyzing machine performance, such as Overall Equipment Effectiveness (OEE), informs on productivity
- **Environmental conditions**: Tracking environmental conditions, including temperature, humidity, and air quality, is vital for working conditions and the quality of products
- **Production line efficiency data**: Analyzing production line efficiency, such as throughput, capacity utilization, and first pass yield (FPY), offers insights into the process effectiveness
- **Digital twins**: virtual replicas of physical assets, allows modeling, environmental monitoring, and infrastructure maintenance.
- **Delivery drone data**: Delivery drones equipped with sensors can capture data for creating digital twins of large physical environments, such as solar farms or construction sites.

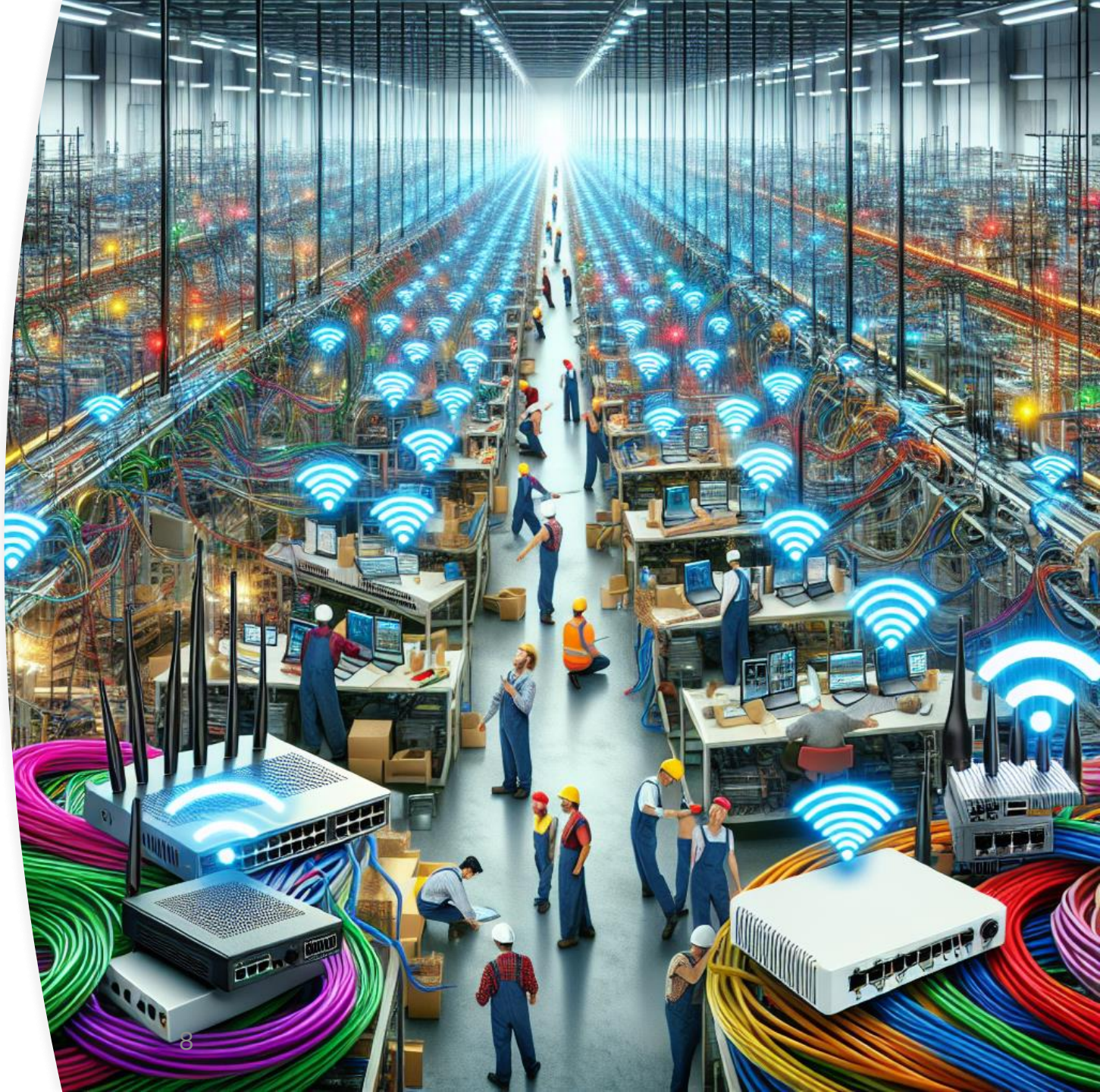
Sources of Delay in Data Transmission for Manufacturing

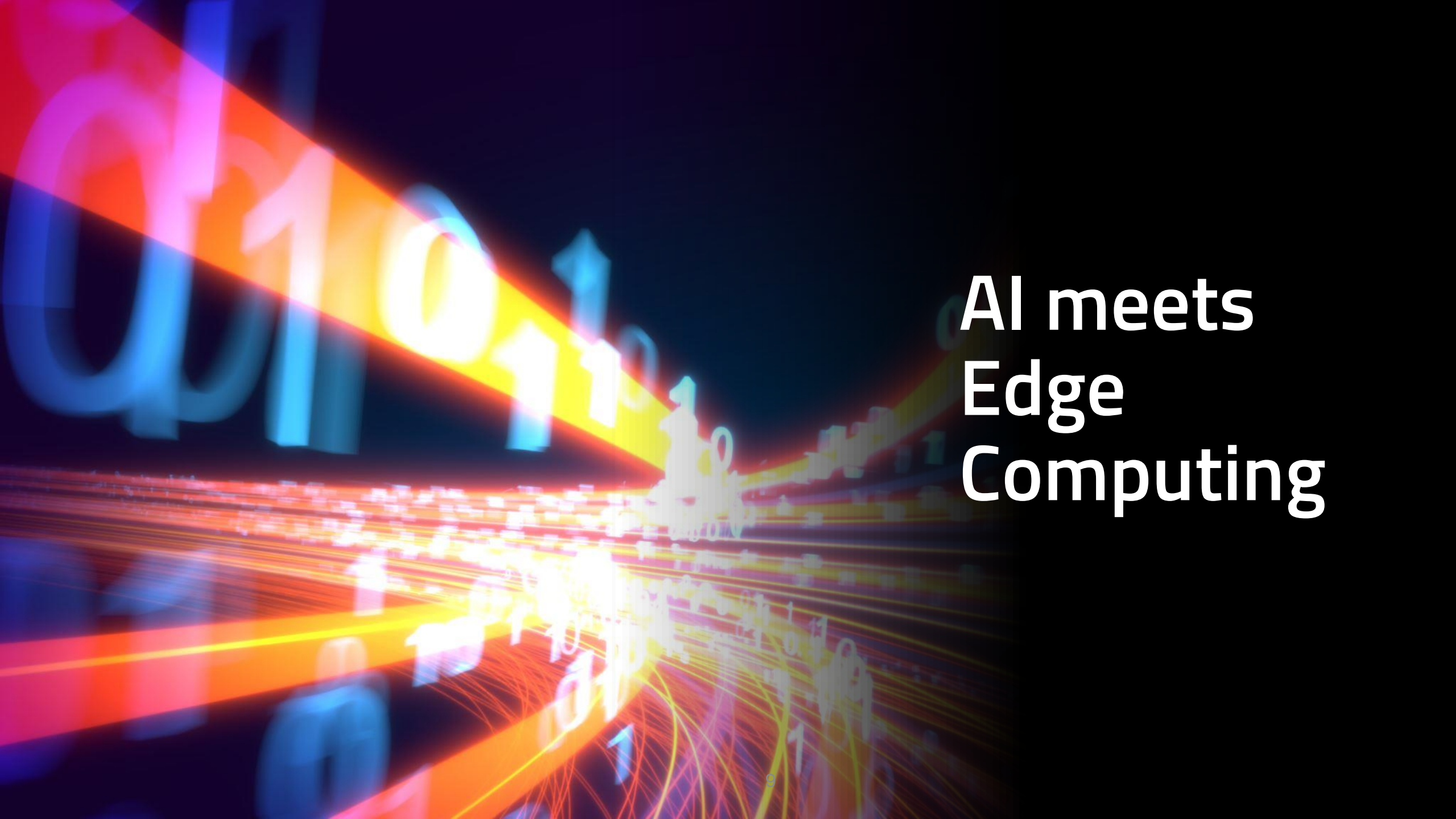
Wired Networks:

- Propagation Delay
- Transmission Delay
- Processing Delay
- Queueing Delay

Wireless Networks:

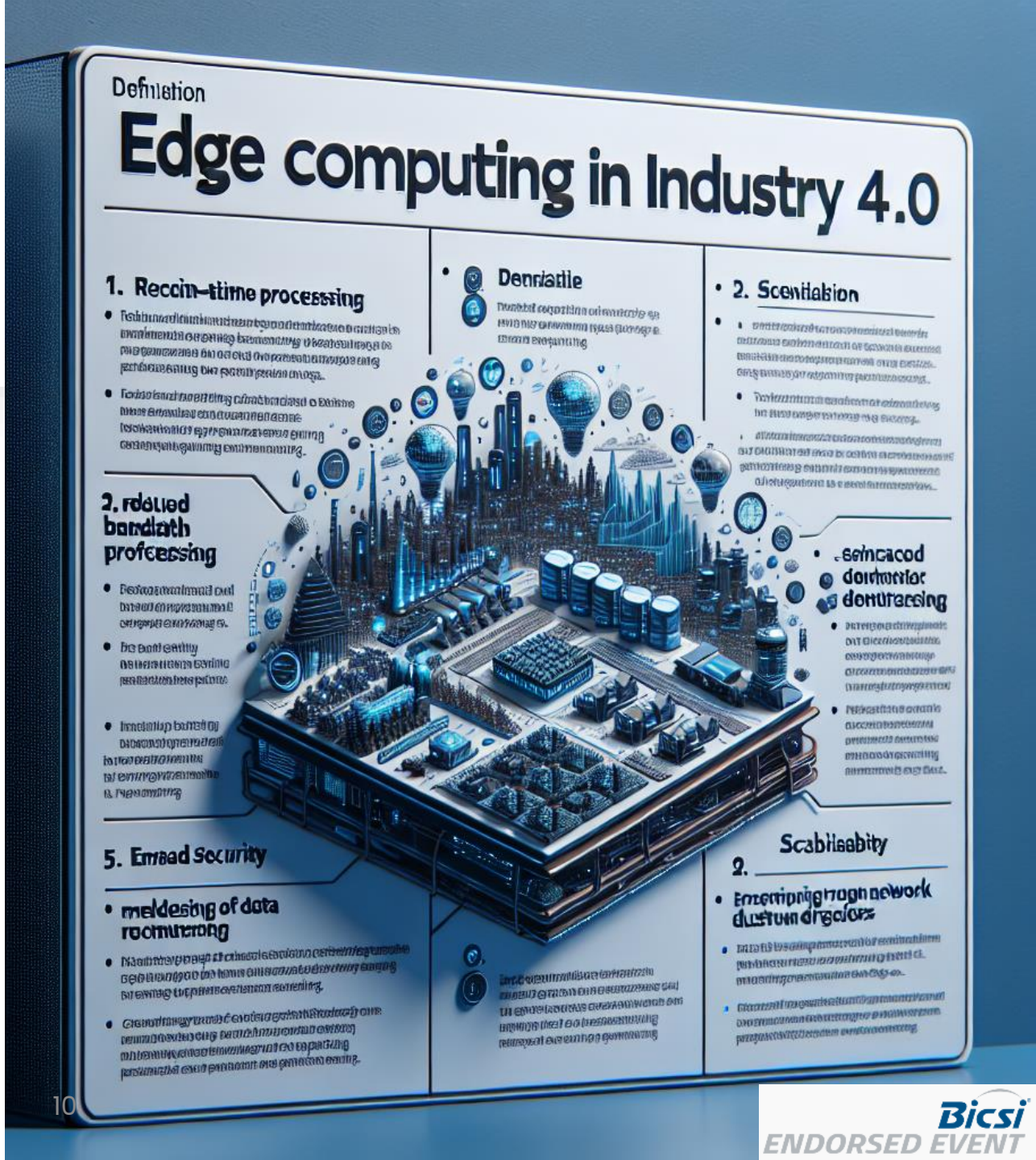
- Propagation Delay
- Transmission Delay
- Interference
- Retransmission
- Handoff Delay
- **Note:** Delays can be minimized through network optimization, choosing the right type of network for the specific manufacturing environment, and regular network maintenance.




AI meets
Edge
Computing

The smart factory: AI meets edge computing

- **Edge Computing:** data processing decentralization brings computation and storage where needed most
- **Real-time Processing:** real-time monitoring of factory operations in Industry 4.0
- **Reduced Bandwidth Costs**: processing data at the edge, saves on bandwidth transport costs
- **Enhanced Security**: decentralizing data, reduces single disruptions taking down the network
- **Scalability**: Edge Computing provides the ability to scale processing power as needed, making it a flexible solution for the growing data demands of Industry 4.0.

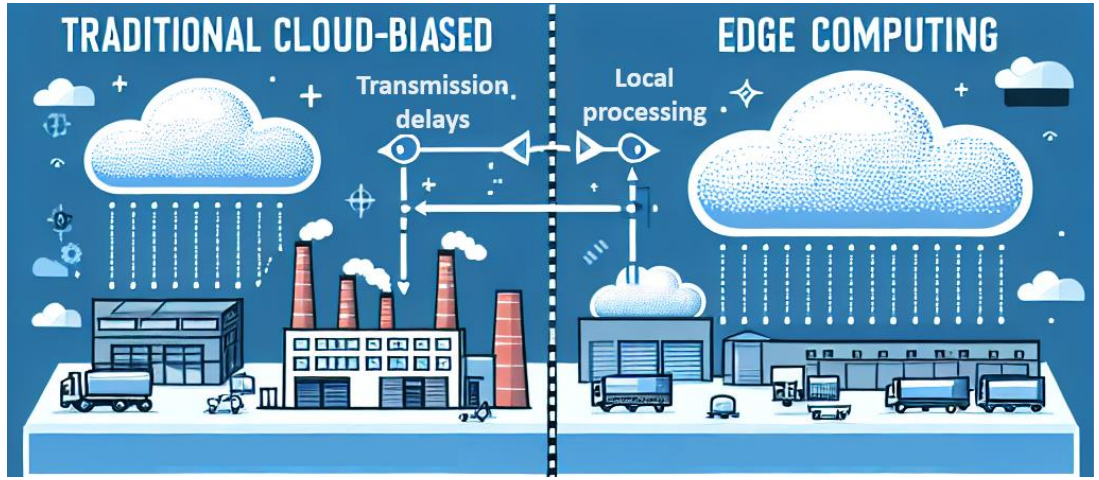


Case Study: Limitations of Large Clouds in Manufacturing

Latency Issues: Large cloud suffer from latency issues due to the physical distance between the cloud servers and the manufacturing site.

Example: In a manufacturing process where real-time data analysis is crucial for quality control, latency leads to delays in identifying and rectifying issues, resulting in waste, additional costs and decreased efficiency.

Solution: Edge computing, brings computation and data storage closer to the location where it's when is needed.



How fast is your data?

What is real time data?

- Real-time data is information that is delivered immediately after collection
  - Data generated at the speed of the physical processes .
  - Immediately available for analysis and action.
  - The immediacy of real-time data allows for instantaneous decision-making and responses.

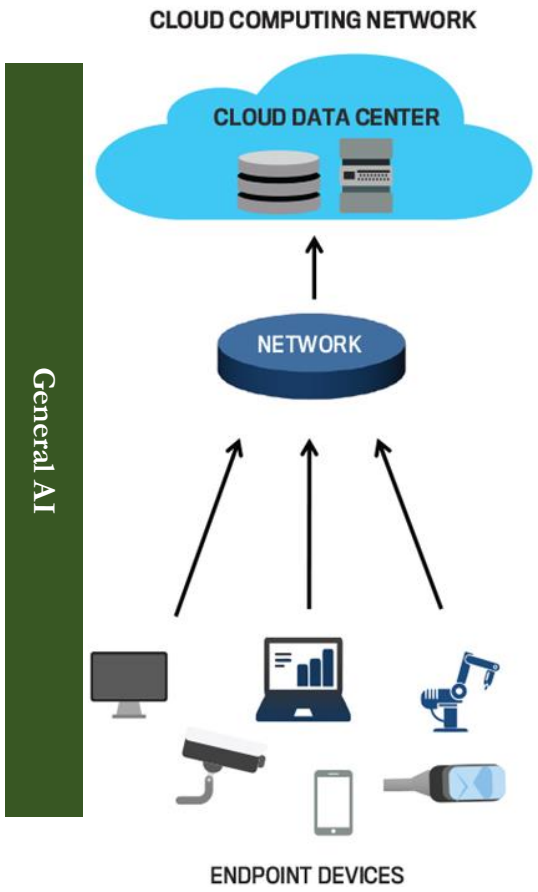
Examples of Real-Time Data

- **Manufacturing:** Sensors on a production line.
- **Healthcare**: A patient monitoring systems.
- **Transportation**: Data from GPS systems, traffic cameras, etc.

OT
Operational
Technology
IT
Information
Technology

OPERATIONAL TECHNOLOGY (OT)	INFORMATION TECHNOLOGY (IT)
Technology used to run the operational side of a business, traditionally with little IT involvement.	Use of computers for information processing and management.
For Industry 4.0, OT encompasses the convergence of IT and OT in the Industrial Internet of Things (IIOT)	Traditionally deals with data systems, including servers, networking devices, and endpoints.
Involves the monitoring and control of devices, processes, and infrastructure in industrial settings	Historically operated separately from OT, with distinct technology stacks, protocols, standards, and governance models
Includes hardware and software that primarily interacts with the physical world, such as industrial control systems like programmable logic controllers (PLCs) and supervisory control and data acquisition (SCADA)	With the rise of Industry 4.0 and the Industrial Internet of Things, IT and OT are converging, allowing for the integration of data from both domains to drive operational efficiency and productivity

Edge computing = Manufacturing AI



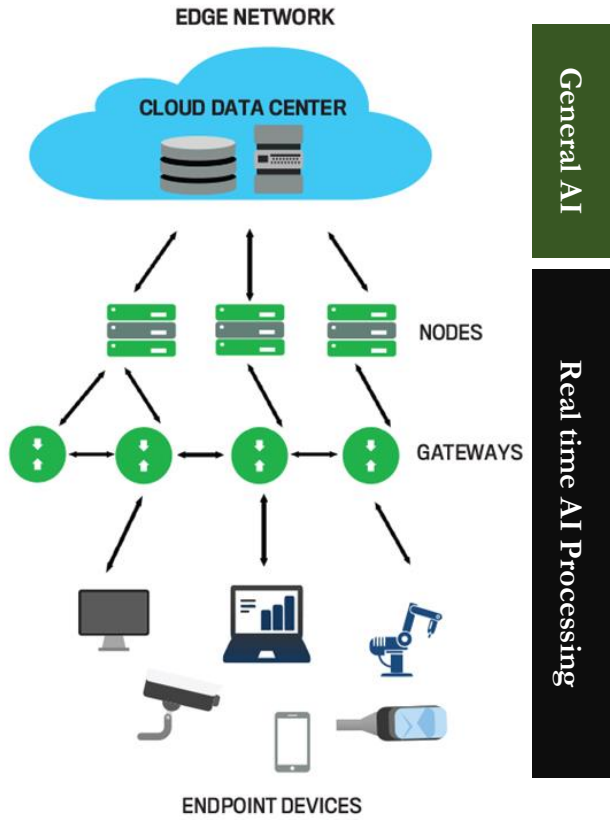
General AI adapts to tasks, while Specialized AI excels in specific manufacturing processes.

General AI requires substantial resources, whereas edge computing enables efficient real-time AI.

Specialized AI can optimize manufacturing, while General AI is not tailored for specific industries.

General AI has broader applications, but Specialized AI provides precise solutions in manufacturing.

Edge computing in Specialized AI reduces latency, a feature not inherent in general AI.



https://www.sfmagazine.com/articles/2021/april/manufacturing-and-edge-computing/

How to protect an OT network?


TRUST ME. OUR CLOUD SECURITY IS SO GOOD EVEN YOU WON'T BE ABLE TO ACCESS YOUR DATA!
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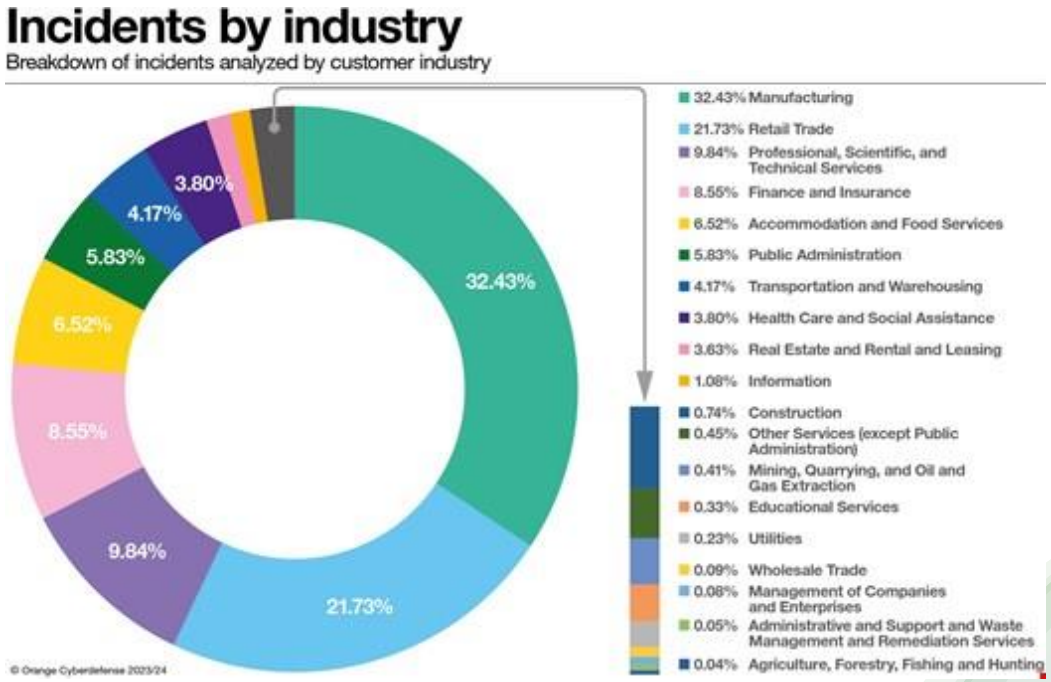
Secure Networks Require Separation of OT and IT Physical Infrastructure

- **Differing Purposes**: OT is focused on monitoring and controlling physical devices and processes in industrial settings, while IT is centered around information processing and management
- **Specialized Requirements**: OT devices are purpose-built with specialized software and proprietary protocols, designed to operate decades without failure, as they control critical infrastructures. In contrast, IT devices are off-the-shelf, replaceable, and have a shorter lifespan, running on common operating systems like Windows, iOS, and Linux.
- **Security Considerations:** OT security encompasses the protection of hardware, software, and devices within the OT infrastructure from attacks and other cyber risks. OT devices are physically separated from unsecured networks, a practice known as air-gapping.
- **Distinct Network Infrastructure:** OT networks are typically kept separate from IT networks and are not connected to the public internet. This is a significant obstacle to attackers and is essential for maintaining the security and integrity of OT systems.
- **Operational Continuity:** The convergence of IT and OT, while beneficial, requires to ensure the operational continuity and security of critical infrastructure. Separating the physical infrastructure of OT and IT helps to maintain the reliability and resilience of industrial processes.

One Third of Cyberattacks Target the Manufacturing Industry

- Globally, the manufacturing sector was the most targeted, representing 20% of all cyber extortion campaigns (Orange Cyberdefense).
- The most common hostile action in these incidents was the deployment of backdoors, occurring in 28% of cases (IBM).
- The manufacturing sector contributed the most to confirmed incidents (32.43%), followed by Retail Trade (21.73%) and Professional, Scientific, and Technological Services (9.84%) (Orange Cyberdefense).
- Manufacturing accounted for 65% of industrial ransomware incidents in 2022 (NAM).
- Supply chain attacks increased by 600% in 2022 (CSO).



3 cyberattacks

Clorox (2023) Cost: $356 million USD

- **Summary:** The attack disrupted operations, causing a 20% decline in net sales and product shortages. The breach led to widespread disruption of production capabilities, affecting large retailers' product orders

Norsk Hydro (2019) Cost: $70 million USD

- **Summary:** The ransomware attack forced plant closures and manual operations, resulting in significant business losses.

Mondelez International (2017) Cost: $100 million USD

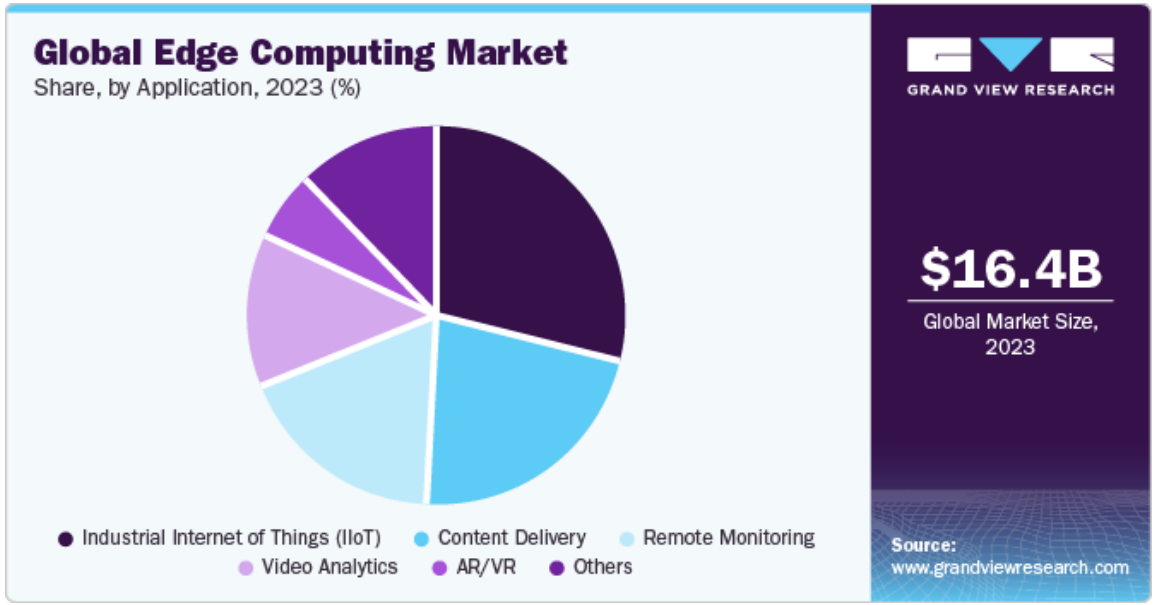
- **Summary:** The attack with NotPetya virus damaged servers, impacted production, and led to a legal dispute with the insurer.

https://arcticwolf.com/resources/blog/top-8-manufacturing-industry-cyberattacks/


Near Shoring:
Adding all together
AI, Edge and, Cloud

The “ideal” nearshoring candidate

Industry 4.0 and Edge Computing Markets



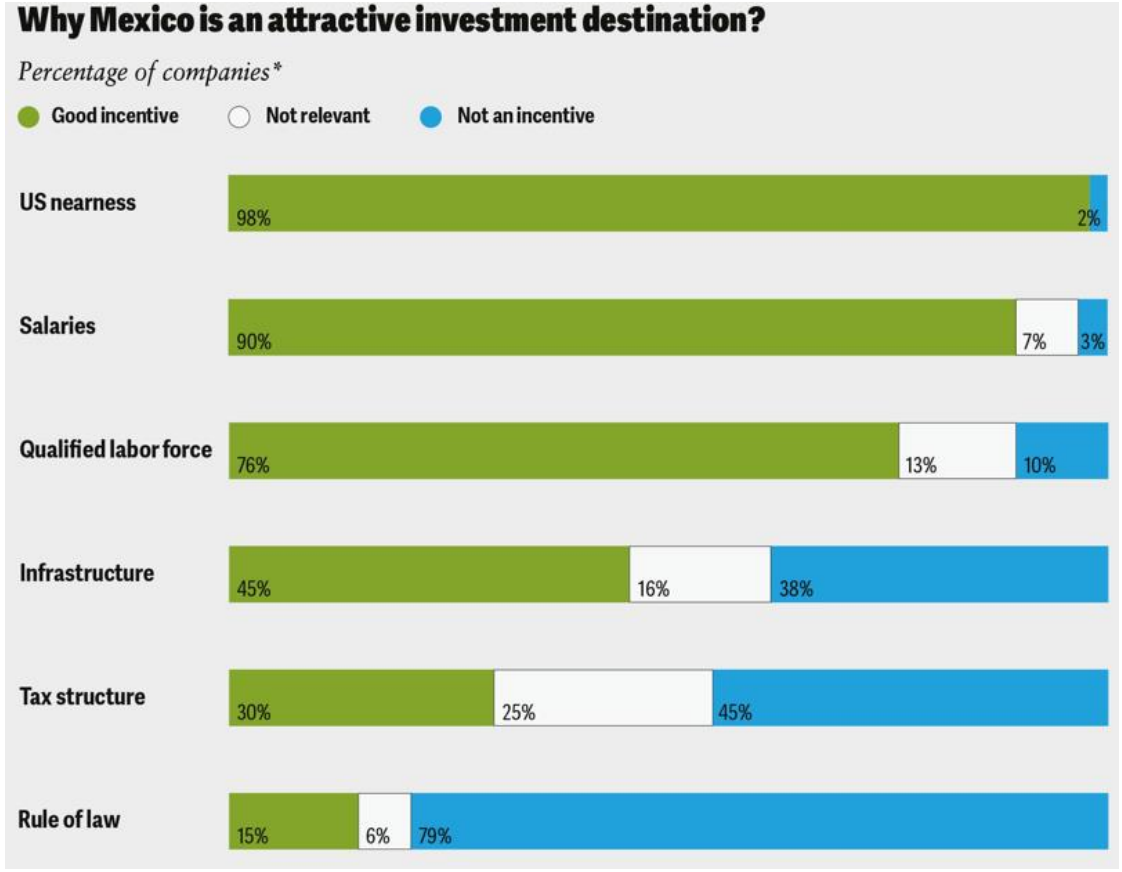
- **Industry 4.0 market**: USD 146.14 billion in 2022.
- **Expected growth**: CAGR of 19.9% (2023-2030).
- **Growth drivers**: Automation and digitalization.
- **Key technologies**: ML, AI, IoT, 5G, cloud services.
- **Benefits**: Real-time monitoring, quality control.
- **Hardware segment**: 50.0% market share in 2022.
- **Software segment**: Expected CAGR of 20.0% by 2030.
- **IIoT segment**: Over 27.0% market share in 2022.
- **Blockchain segment**: Expected CAGR of 21.0% by

https://www.grandviewresearch.com/industry-analysis/industry-4-market-report

Growth Opportunities: Nearshoring

- Investment Surge**: $516B of private investments** since President Biden took office, as of September 26, 2023, according to White House figures.
- **Sterling Infrastructure's market value jumped 506%** in the past 4 years, reaching $2.4Bfrom $390M.
- **Construction companies** like Quanta, Fluor, and others have a combined backlog of nearly $120B, about $20B higher than their pre-pandemic average.
- **Spending on construction and manufacturing reached $198B** on an annualized basis in August 2023, marking a nearly 66% increase from the previous year, the highest level since the 1950s, as tracked by the Bureau of Economic Analysis.

Case study: Mexico Nearshoring



https://www2.deloitte.com/us/en/insights/economy/issues-by-the-numbers/advantages-of-nearshoring-mexico.html

TESLA nearshoring

- The arrival of Tesla in Nuevo León is expected to bring a substantial investment of around 10 billion dollars to the region. This investment is part of a broader trend of nearshoring, which has generated approximately 30 billion dollars in Mexico during 2022, with indications that this trend will continue.
- Tesla's gigafactory in Mexico, situated in the Santa Catarina area, is expected to lead to a spike in nearshoring activity. The local government has already begun preparations for the projected increase in vehicular flow in the area, anticipating the establishment of facilities by Tesla's suppliers. Additionally, Tesla plans to produce its next-generation electric vehicle at the gigafactory in Mexico, further solidifying its commitment to nearshoring production in the region.

In past two years, Colombia attracted over $1 billion nearshoring investments

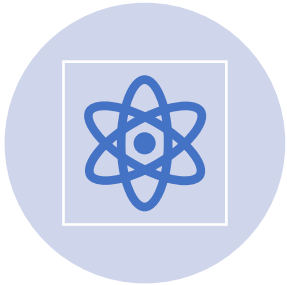
- **Facebook**: Facebook has established operations in Colombia, contributing to the country's growing appeal as an investment destination
- **Chilean hotel chain Atton**: invested in Colombia, demonstrating the country's attractiveness to international businesses
- **Japanese company Furukawa**: opened a fiber optics plant in Colombia, highlighting the country's potential for foreign investment in high-tech industries.
- **Hero MotoCorp**: Indian company, started the construction of a new motorcycle assembly plant in Cauca, emphasizing Colombia's appeal as a location for foreign investment
- **Teleperformance**: The French digital company plans to hire an additional 10,000 staff in its offices in Colombia

Nearshoring top sectors

Clean Energy: Investments in the clean energy sector in Latin America and the Caribbean (LAC) are significant, with a focus on renewables, grids, and energy efficiency. The size of the renewable energy market is expected to be nearly **$2 trillion by 2030**.

Infrastructure: The infrastructure sector in LAC is expected to reach **USD 2.72 trillion in 2024** and grow at a CAGR of 6.27% to reach USD 3.69 trillion by 2029. Infrastructure projects in LAC have shown potential for direct and indirect short-term employment generation.

Medical Devices: Medical Devices: Costa Rica has been particularly successful in nearshoring medical device manufacturing, attracting 10% of aggregate annual medical device purchases made by the US and Asia.



Semiconductors: Nearshoring of semiconductor manufacturing to LAC countries could significantly impact the region's economy and global supply chains. Mexico, Costa Rica and Brazil are projected to see the biggest gains from this initiative.

https://www.iadb.org/en/news/americas-partnership-idb-responsible-investment-forum

Conclusions

- Smart manufacturing and Industry 4.0 accelerate AI and Edge Computing use
- Fixed and mobile networks must be designed for minimum latency
- Cybersecurity starts with the physical separation of OT and IT networks
- Nearshoring boosts economy, creates jobs, and enhances technological advancement in Latin America


OF COURSE YOU WANT TO KNOW WHERE YOUR DATA IS BEING STORED, MADAM. LET ME SEE – YOUR CLOUD'S JUST PASSING OVER PERU AT THE MOMENT...
CLOUD HELP DESK
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Q&A