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How decarbonisation, digitisation and circular solutions forge the sustainable European steel future?

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FORGING THE FUTURE:

THE EVOLUTION OF AUTOMATION IN STEEL MANUFACTURING (1974 TO PRESENT)

ESTEP
European Steel Technology Platform

DIGIMET

DANIELI AUTOMATION

UNIVERSITÀ DEGLI STUDI DI UDINE
HIC SUNT FUTURA

Drafting a Future in Steel

Career Beginning in Steel

I started as an electrical draftsman in 1974, entering the steel industry after technical school.

Optimism Prevailed

Good salaries were waiting, $500-$700 per month, the first affordable, hand-held calculators were entering the market, no more slide rules. Optimism was high.

But Storm Clouds Covered the Horizon

1970's – Optimism vs Reality

Economic Turbulence

The period was marked by the oil embargo aftermath an ongoing Middle East war, the American auto industry was in decline, and labor unions were striking.

Industrial Control "Islands of Automation"

There were no PLCs and no networks. Variable-speed A.C. drives were yet to achieve market acceptance. Most "automation" was relay logic, discrete controllers and data collection was a series of chart recorders.

Rising Global Competition

Steel manufacturers in Japan, Korea and India were already having a competitive impact on the U.S. Soon, Japan emerged as a leader in production, quality, and innovative labor practices.
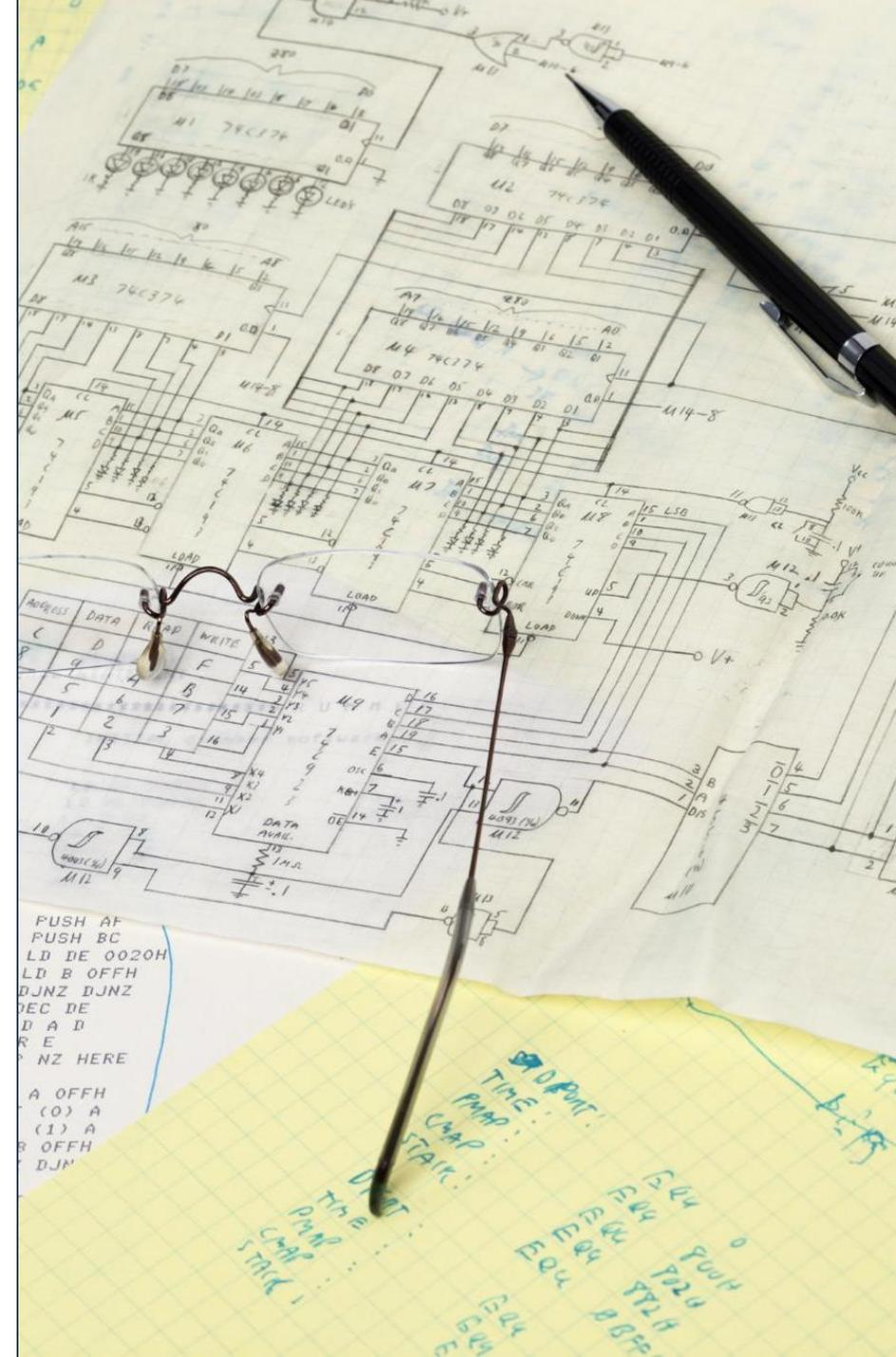
Mini-Mills Rise from the Cornfields

Emergence of Mini-Mills

Mini-mills arose in rural areas, offering leaner, agile steel production suited for niche markets.

Financial and Strategic Upheaval

Mergers, venture capital, and retrenchment reshaped the steel industry's financial landscape.

Into The Darkness

Collapse of 'BIG' Steel

Traditional big steel companies declined due to inefficiencies and global competition in the 1980s.

The Birth of the 'Rust Belt'

Across western Pennsylvania and eastern Ohio, 150,000 workers lose their jobs. The spillover was millions of jobs lost. Entire communities are boarded up and become "ghost" towns.

The Shift to a Service-Based Economy

A gradual increase in employment by the service-sector provided some cushion.

The Versatility Revolution – PLCs

Economic and Labor Pressure Reshapes the Industry

Japanese quality set the bar as the U.S. mini-mills target leaner, efficient operations. European OEMs introduce quality manufacturing, adherence to high standards and willingness to innovate new technologies.

Replacement of Relay Logic

PLCs replaced bulky relay systems, bringing programmable flexibility that transformed control engineering with modular and scalable capabilities.

Reduced Downtime and Reliability

PLCs improve system reliability and reduce downtime through faster troubleshooting and flexible control.

Foundation for Advanced Automation

PLCs laid the groundwork for sophisticated control architectures in modern industrial automation.

Third Generation Automation Takes Root in the U.S.

Lean, Local, and Leading

Mini-mills' Efficiency

Mini-mills utilize lean operations and local responsiveness to dominate steel production efficiently.
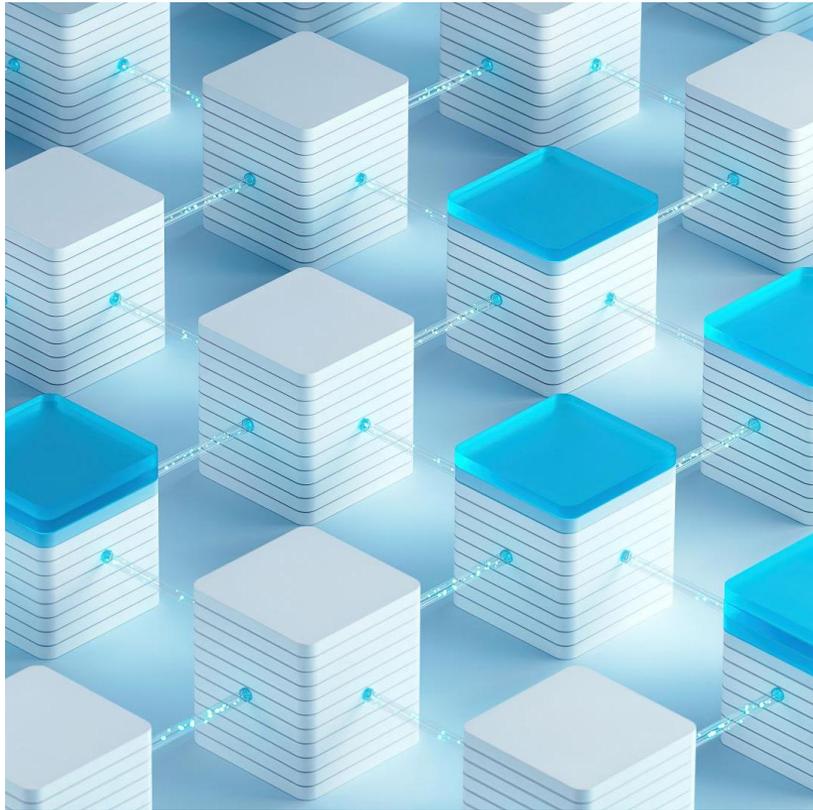
Big Steel Specialization

Traditional steel companies focus on high-grade alloys and specialty markets to sustain competitiveness.

Industry Strategic Evolution

Agility and specialization enable coexistence and success of mini-mills and big steel in different markets.

From Innovation to Integration

CIM Pyramid Framework
The CIM pyramid illustrates structured integration of technology components in manufacturing processes.

Data Flow Integration
Data flows seamlessly from sensors to servers, enabling real-time monitoring and control.

Supporting Infrastructure
Infrastructure components like thin clients, server racks, and high-speed networks support efficient workflows.

Innovation to Operations
Innovations became routine, creating mature manufacturing environments adaptable to evolving technologies.

Networks – The Long Road to Reliability

Early Network Technologies

Initial industrial networks like Open DeviceNet and token ring aimed for interoperability but faced market fragmentation and limited standardization.

Challenges in Network Reliability

Engineers often spent time troubleshooting complex network topologies rather than optimizing manufacturing processes, highlighting communication difficulties.

Progress Toward Robust Networks

Despite setbacks, the drive for real-time data exchange and open architectures fueled ongoing advancements in reliable industrial networking.
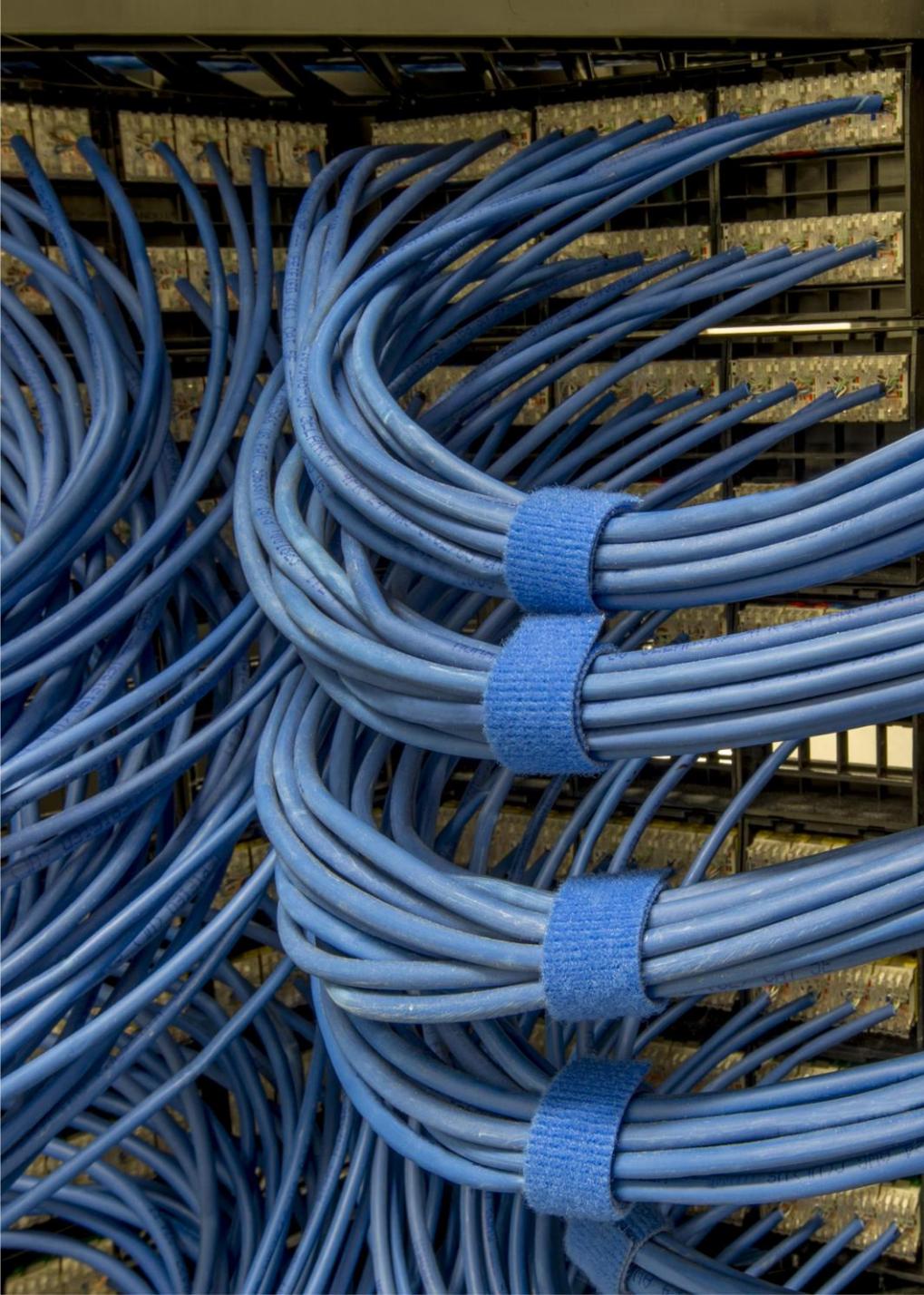
Human Evolution – From Maintainers to Technologists

Evolving Worker Roles

Worker roles in steel evolved from manual maintenance to complex technological tasks requiring advanced skills.

Education and Training

Technical education reforms and workforce development programs were essential to equip workers for new automation demands.

Human-Technological Symbiosis

The synergy between human expertise and automation ensures technology complements rather than replaces workers.

Today's Frontier – 4th Gen Tech and Its Shadows

Advanced Automation Technologies

4th generation technologies like AI, edge computing, and predictive maintenance enhance real-time optimization in steel manufacturing.

Emerging Vulnerabilities

New systems bring risks such as environmental sensitivity, cybersecurity threats, and planned obsolescence requiring robust strategies.

Sustainability and Policy Influence

Global digitalization and climate policies drive adoption of smarter, greener manufacturing technologies for sustainability.
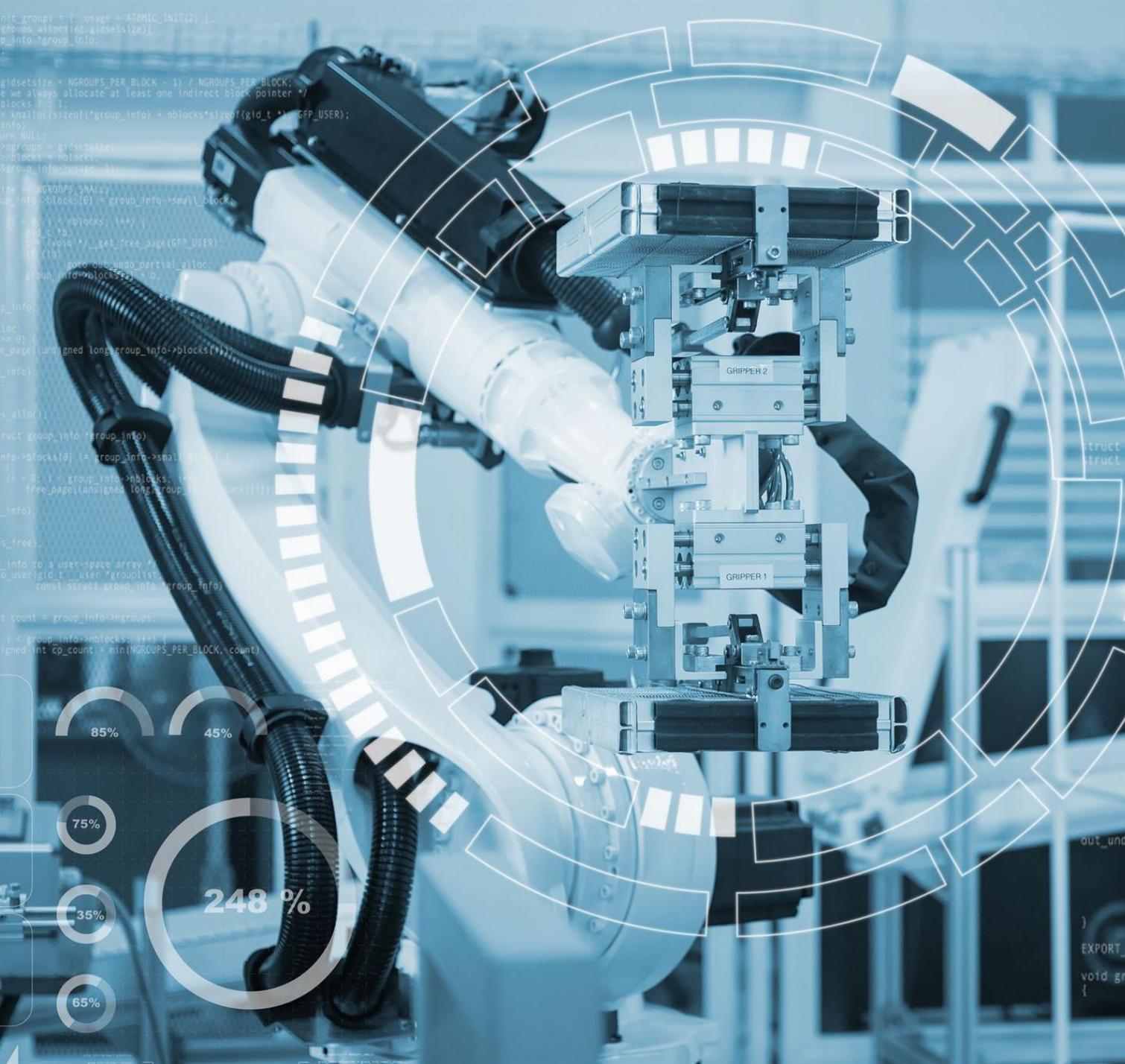
Three Principles for Tomorrow

Robustness in Design

Design systems to withstand harsh environments while minimizing redundancies for reliability and efficiency.

Worker Integration

Track and enhance worker skills to adapt effectively to evolving industrial changes and technologies.

Open-Source Innovation

Embrace community-driven open-source platforms to foster innovation and shared technological progress.

Questions?

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