

The Future of Workforce Upskilling in Manufacturing



How ITIL-Driven Service Management Strengthens the Digital Factory Workforce

APRIL 2026

Published by Learning Tree International

www.learningtree.com

TABLE OF CONTENTS

Executive Summary

1 Introduction: The Manufacturing Workforce Crisis

- 1.1 The Convergence of Disruption
- 1.2 The Strategic Imperative

2 Understanding the Manufacturing Skills Gap

- 2.1 Quantifying the Challenge
- 2.2 Root Causes
- 2.3 The Cost of Inaction

3 The Case for Strategic Workforce Upskilling

- 3.1 From Cost Centre to Strategic Asset
- 3.2 Evidence from Practice
- 3.3 The Role of Standardised Frameworks

4 ITIL: The Service Management Foundation for Smart Manufacturing

- 4.1 Why Manufacturing Needs ITIL
- 4.2 ITIL 4 and the Digital Factory
- 4.3 Building ITIL Capability at Scale

5 Strategic Implementation Framework

6 Overcoming Common Implementation Challenges

7 Emerging Trends and Technologies

- 7.1 Smart Manufacturing Roles
- 7.2 Immersive Training Technologies
- 7.3 AI-Powered Personalised Learning
- 7.4 The Shift to Continuous Learning

8 Building the Business Case

- 8.1 Quantifiable Returns
- 8.2 Strategic Advantages
- 8.3 Long-Term Resilience

9 Conclusion: The Path Forward

- 9.1 Imperative for Action
- 9.2 Key Success Factors
- 9.3 The Opportunity Ahead
- 9.4 Call to Action

References

EXECUTIVE SUMMARY

The manufacturing sector faces a defining workforce challenge. As Industry 4.0 systems, AI-driven automation, and cyber-physical production networks scale globally, the demand for skilled talent far outpaces supply. Deloitte and The Manufacturing Institute project that of 3.8 million manufacturing workers needed in the United States alone by 2033, nearly half—1.9 million positions—could go unfilled ^[1]. Globally, the World Economic Forum estimates that 92 million roles will be displaced by automation by 2030, while 170 million new roles will emerge—many requiring competencies that do not yet exist at scale ^[2].

The cost of inaction is stark. Siemens calculates that unplanned downtime in automotive manufacturing now exceeds US \$2.3 million per hour ^[6]. Fortinet reports that 73 percent of organisations experienced operational technology intrusions that impacted production in 2024, up from 49 percent the year before ^[5]. Meanwhile, the convergence of information technology and operational technology in smart factories demands a new discipline: structured service management to keep digital production infrastructure reliable, secure, and continuously improving.

This is where ITIL—the world’s most widely adopted IT service management framework—becomes a strategic enabler for manufacturing. ITIL 4’s principles of value co-creation, continual improvement, and holistic thinking align directly with lean manufacturing philosophies. Organisations that embed ITIL practices alongside domain-specific frameworks such as NIST NICE (cybersecurity), ISA/IEC 62443 (automation security), and PMI (project management) build resilient, adaptable workforces capable of operating at the intersection of IT and OT.

Learning Tree International delivers role-based, metrics-driven upskilling solutions across all of these frameworks—including one of the most comprehensive ITIL 4 and ITIL 5 certification portfolios in the market, with over 30 courses accredited by PeopleCert ^[12]. Cross-functional evidence demonstrates the impact: Learning Tree’s data-literacy programme for the Judicial Council of California produced 132 percent knowledge growth and 73 percent immediate on-the-job application across nearly 1,000 personnel ^[10].

Bottom line: Strategic workforce upskilling is not an HR initiative—it is a manufacturing competitiveness strategy. The frameworks exist, the evidence is clear, and the competitive window is narrowing.

1. INTRODUCTION: THE MANUFACTURING WORKFORCE CRISIS

1.1 The Convergence of Disruption

Industrial IoT networks, collaborative robotics, AI-optimised scheduling, and digital twins are now baseline capabilities for competitive plants across North America, Europe, the Middle East, and Asia-Pacific. Yet technology adoption is outpacing human capability. McKinsey Global Institute estimates that up to 30

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

percent of hours currently worked globally could be automated by 2030—with manufacturing among the most affected sectors [3].

Simultaneously, an ageing workforce is accelerating knowledge loss. Across OECD economies, the manufacturing workforce is ageing faster than the general labour force, with retirement rates in precision trades and process-engineering roles significantly exceeding new-entrant rates [1][2]. The result is a structural gap: advanced systems deployed alongside workforces unprepared to operate, maintain, and optimise them.

1.2 The Strategic Imperative

The skills gap is no longer an HR concern—it is a board-level strategic risk. Contractor reliance inflates operating expenditure and erodes intellectual property security. Siemens estimates that unplanned downtime in automotive manufacturing costs approximately US \$2.3 million per hour in lost throughput [6]—a figure that has risen sharply as production lines become more digitally integrated and interdependent.

Cybersecurity exposure compounds the risk. Fortinet's 2024 State of Operational Technology report found that 73 percent of organisations experienced OT intrusions with operational impact, nearly double the rate observed two years earlier [5]. Without skilled personnel to manage and secure converged IT/OT environments, manufacturers face cascading vulnerabilities from the shop floor to the supply chain.

2. UNDERSTANDING THE MANUFACTURING SKILLS GAP

2.1 Quantifying the Challenge

The talent deficit is global in scope, though its character varies by region:

- **North America:** Deloitte and The Manufacturing Institute project that the United States will need 3.8 million manufacturing workers by 2033. At current trajectory, approximately 1.9 million of those positions will remain unfilled—costing an estimated US \$1 trillion in unrealised output over the decade [1].
- **European Union and United Kingdom:** Korn Ferry projects a shortfall of over one million skilled workers across EMEA manufacturing by 2030, driven by retirements and reshoring-induced capacity expansion [4]. Eurostat data confirms that manufacturing job vacancy rates across the EU have remained elevated, with particular pressure in Germany, France, and the Netherlands [19].

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

- **Japan:** The Ministry of Economy, Trade and Industry reports persistent structural decline in the manufacturing workforce, with particular severity in precision machining, semiconductor fabrication, and digital competencies ^[18]. Fewer than one in seven manufacturing workers has received formal digital-skills training.
- **Saudi Arabia and the Middle East:** Saudi Arabia's Vision 2030 industrialisation agenda requires an estimated 920,000 additional skilled positions across manufacturing and related sectors by 2030, creating acute domestic demand and opportunity for international training partnerships ^[17].
- **Canada:** Canadian Manufacturers & Exporters have similarly flagged acute shortages in digital and automation skills across the manufacturing sector, with digital transformation roles among the most difficult to fill.

Critical competencies ranked by severity of shortage:

1. Industrial automation and control systems (PLC, SCADA, OPC-UA)
2. IT service management for manufacturing IT/OT environments
3. OT/IT cybersecurity
4. Data analytics and MES integration
5. Predictive maintenance and reliability engineering
6. Digital project and portfolio management

2.2 Root Causes

- **Education system lag:** University and vocational programmes have been slow to integrate Industry 4.0 competencies. Curricula in automation, edge analytics, and IT/OT convergence remain uncommon in most engineering faculties ^[2].
- **Brand perception:** Younger workers associate manufacturing with legacy industries, despite rapid technological transformation. Surveys consistently show that Generation Z prioritises continuous learning and development—advantages modern manufacturing can offer but often fails to com-

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

municate.

- **Chronic underinvestment:** The Association for Talent Development reports average organisational training spend of US \$1,283 per employee ^[8], but manufacturing has historically allocated among the lowest percentages of payroll to formal workforce development. Best-in-class organisations invest two to three percent of payroll in structured training; many manufacturers remain well below this threshold.

2.3 The Cost of Inaction

Vacancy costs compound rapidly. Each unfilled technical role increases reliance on contractors (at premiums of 30–50 percent over direct employees), extends mean time to repair for critical equipment, and drives unplanned downtime. Organisations lacking in-house data and analytics talent pay significantly more for external services while forfeiting the intellectual property those insights generate.

Quality costs are equally punitive. Understaffed quality and maintenance functions allow defect rates and unplanned stoppages to escalate, pushing total cost of quality upward by double-digit percentages in affected plants.

3. THE CASE FOR STRATEGIC WORKFORCE UPSKILLING

3.1 From Cost Centre to Strategic Asset

SHRM research indicates that fully loaded employee replacement costs range from 50 to 200 percent of annual salary, depending on role complexity and market scarcity ^[9]. For specialised manufacturing roles—automation engineers, OT cybersecurity analysts, MES administrators—replacement costs sit at the upper end of that range due to scarce talent pools and extended ramp-up periods.

Redirecting even a fraction of replacement and contractor spending into structured reskilling yields measurable returns. Organisations with mature learning cultures consistently outperform peers in revenue per employee, profit margins, and employee retention ^[8].

3.2 Evidence from Practice

Judicial Council of California—Scaling Data Literacy at Enterprise Scale

Learning Tree partnered with the Judicial Council of California to deliver a role-segmented Power BI training programme across 48 courts and approximately 1,000 employees. The programme included tailored pathways for viewers, designers, administrators, and developers, and produced independently measured outcomes ^[10]:

- **132 percent** knowledge growth (pre- to post-assessment)
- **73 percent** of participants reported immediate on-the-job application
- **97 percent** programme satisfaction
- Self-service reporting capability reduced the report-generation backlog from six weeks to four

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

days

This programme demonstrates that well-designed, role-based upskilling can deliver rapid, measurable transformation across large, distributed workforces—precisely the model manufacturing requires.

Cross-Industry Evidence

Beyond individual case studies, the pattern is consistent. PwC's enterprise VR training study found that immersive learners trained four times faster and were 275 percent more confident in applying skills post-training compared to traditional classroom methods ^[7]. Organisations with structured learning programmes routinely report 30–50 percent reductions in external recruitment within two to three years as internal mobility pipelines mature.

3.3 The Role of Standardised Frameworks

Manufacturing's digital transformation demands a portfolio of complementary frameworks:

- **ITIL 4/5** provides the service management discipline to operate, maintain, and improve digital manufacturing infrastructure—from MES and ERP to IoT platforms and cloud services ^[12].
- **NIST NICE Workforce Framework** creates a common taxonomy for cybersecurity roles, enabling gap assessment, training roadmaps, and compliance verification. NICE v2.0.0 now includes an OT Cybersecurity Engineering work role specifically addressing industrial environments ^{[11][14]}.
- **ISA/IEC 62443** establishes security requirements for industrial automation and control systems, providing the standard for OT security competency ^[16].
- **PMI frameworks** govern the project and portfolio management competencies essential for capital-intensive transformation programmes.

Learning Tree offers comprehensive training and certification across all four framework families, with role-based learning paths that map to specific manufacturing functions ^{[12][13]}.

4 ITIL: THE SERVICE MANAGEMENT FOUNDATION FOR SMART MANUFACTURING

4.1 Why Manufacturing Needs ITIL

The proliferation of digital systems on the factory floor has fundamentally changed the nature of manufacturing operations. MES platforms, ERP systems, IoT sensor networks, SCADA systems, digital twins, and cloud-based analytics are no longer peripheral to production—they are production infrastructure. When these systems experience unplanned outages, configuration errors, or security breaches, the impact is immediate and costly.

ITIL provides the structured practices manufacturers need to manage this digital infrastructure as a portfolio of services:

- **Incident Management** ensures rapid restoration of IT/OT services when disruptions occur, mini-

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

mising production impact.

- **Problem Management** drives root-cause analysis to prevent recurring system failures.
- **Change Enablement** provides controlled processes for deploying software updates, firmware patches, and configuration changes—critical in environments where an untested change can halt a production line.
- **Service Level Management** defines and measures the availability, performance, and reliability of digital manufacturing systems, linking IT metrics directly to production KPIs such as OEE and MTTR.
- **Continual Improvement** embeds a systematic cycle of assessment and optimisation aligned with lean manufacturing principles.

4.2 ITIL 4 and the Digital Factory

ITIL 4's evolution from prescriptive processes to a flexible Service Value System makes it particularly well suited to manufacturing environments:

- The **four dimensions model** (organisations and people, information and technology, partners and suppliers, value streams and processes) mirrors the integrated thinking required for smart factory operations.
- ITIL 4's guiding principles—"Focus on value," "Start where you are," "Progress iteratively with feedback"—align directly with kaizen and continuous-improvement cultures already embedded in many manufacturing organisations.
- **ITIL 5**, the latest evolution, places greater emphasis on AI integration and digital transformation—capabilities directly relevant to manufacturers deploying AI-driven quality inspection, predictive maintenance, and autonomous logistics.

4.3 Building ITIL Capability at Scale

Learning Tree International offers one of the most comprehensive ITIL certification portfolios available, with over 30 courses spanning ITIL 4 Foundation through ITIL 4 Strategic Leader and the emerging ITIL 5 curriculum—all accredited by PeopleCert ^[12].

For manufacturing organisations, Learning Tree's enterprise solutions include ^[13]:

- Skills assessments to benchmark current IT service management maturity
- Role-based learning paths tailored to manufacturing IT/OT functions
- Virtual instructor-led training that accommodates shift schedules and distributed workforces
- Measurement and analytics using Kirkpatrick and Phillips ROI frameworks to demonstrate business impact ^[15]

5. STRATEGIC IMPLEMENTATION FRAMEWORK

Phase 1: Assess and Target

- Conduct an enterprise-wide skills inventory using ITIL capability maturity models (for IT/OT service management), NICE Framework (cybersecurity), ISA/IEC 62443 (automation security), and relevant industry taxonomies.
- Prioritise gaps that endanger OEE, safety, regulatory compliance, or service continuity.
- Define baseline KPIs: unplanned downtime hours, mean time to repair, scrap percentage, contractor expenditure, incident resolution time.

Phase 2: Design Role-Based Pathways

- Operator > Digital Cell Technician (8-week path incorporating ITIL Foundation)
- Maintenance Technician > Predictive Analytics Specialist (12-week path: IIoT sensors, Python, ITIL service management)
- IT Support > OT Cyber Analyst (6-week path: ISA/IEC 62443, NICE framework, SOC fundamentals)
- Plant IT Manager > IT/OT Service Manager (10-week path: ITIL 4 Managing Professional, OT-specific modules)

Phase 3: Blended Delivery

- 70-20-10 model: 70 percent project-based work on real production data, 20 percent coaching and mentoring, 10 percent formal instruction.
- Virtual instructor-led sessions minimise travel disruption; simulation labs for hazardous or high-risk tasks.
- Shift-compatible micro-modules (45 minutes or less) scheduled during planned changeovers.

Phase 4: Build Internal Capability

- Train-the-trainer model: one certified facilitator per 25 learners, with quality stipends tied to delivery outcomes.
- Knowledge management portal integrated with MES; digital badges feed HRIS for internal mobility and talent marketplace visibility.

Phase 5: Measure, Refine, Scale

- Learning Tree's measurement framework links learning outcomes to operational KPIs through Kirkpatrick and Phillips ROI models ^[15].
- Target 12-month payback; publish quarterly value reports to sustain executive sponsorship.
- Refresh curriculum every six months aligned to the technology roadmap.

6. OVERCOMING COMMON IMPLEMENTATION CHALLENGES

Challenge	Financial Risk	High-Leverage Solution
Line shutdowns for training	Lost throughput (US \$50,000–200,000/hr)	Modular e-learning and simulation labs off-line; schedule training during planned maintenance windows
Skills heterogeneity across workforce	Programme attrition and wasted investment	Pre-assessments and adaptive learning paths personalise content to each learner's starting point
Workforce scepticism toward change	Low adoption and engagement	Co-design curricula with shop-floor input; link credentials to step-progression pay bands
Proving ROI to executive sponsors	Budget reduction or programme cancellation	Baseline metrics before training; use Learning Tree's Kirkpatrick/Phillips ROI measurement framework ^[15]
Sustaining momentum after initial cohorts	Skill decay and loss of gains	Establish Communities of Practice; implement KPI-linked refresher cycles; maintain executive scorecard visibility

7. EMERGING TRENDS AND TECHNOLOGIES

7.1 Smart Manufacturing Roles

As automation accelerates, new roles are emerging: Digital Thread Architect, Robotics Supervisor, AI Quality Analyst, and IT/OT Service Manager. McKinsey estimates that up to 30 percent of current manufacturing work hours could be automated by 2030, but this displacement creates demand for higher-value roles that blend domain expertise with digital fluency ^[3]. Organisations seeding these talent pipelines now secure first-mover advantages in cost, quality, and speed.

7.2 Immersive Training Technologies

PwC research demonstrates that VR-based learners train four times faster and are 275 percent more confident applying new skills than classroom-trained peers ^[7]. While capital costs for immersive training remain significant, the ROI is compelling for high-risk, high-repetition manufacturing tasks—from welding and assembly to hazardous materials handling. As headset costs decline and content libraries expand, immersive training is transitioning from pilot to programme.

7.3 AI-Powered Personalised Learning

Adaptive learning platforms that analyse assessment performance and engagement data to customise difficulty and pacing are showing promising results in manufacturing contexts. Early adopters report faster time-to-proficiency and higher knowledge retention than traditional cohort-paced programmes. Implementation requires clear data governance, ethical guardrails, and human-in-the-loop oversight.

7.4 The Shift to Continuous Learning

Leading manufacturers are moving from episodic training to continuous learning cultures. This includes protected learning time (typically two to four hours per month), micro-credentialing that feeds promotion criteria, and Communities of Practice that sustain knowledge sharing. Organisations that sustain a two-to-three-percent-of-payroll training investment achieve significantly higher internal mobility and outperform peers on long-term profitability metrics [8].

8. BUILDING THE BUSINESS CASE

8.1 Quantifiable Returns

The following illustrative model demonstrates the economics of a 200-person upskilling programme in a mid-size manufacturing operation:

Benefit Stream	Calculation Basis	12-Month Impact
Contractor avoidance	20 specialists × (market rate – internal cost)	US \$800,000–1,200,000
Unplanned downtime reduction	15 hours avoided × US \$50,000–200,000/hr	US \$750,000–3,000,000
Scrap and rework reduction (20%)	Applied to annual cost of quality	US \$400,000–800,000
Attrition reduction (5 percentage points)	10 fewer exits × replacement cost (100% of salary)	US \$600,000–900,000
Total estimated benefit		US \$2,550,000–5,900,000
Programme cost	200 learners × US \$5,000 per learner	US \$1,000,000
Estimated first-year ROI	(Net benefit / Total cost)	155–490%

Note: Ranges reflect variation by industry segment, plant size, and wage levels. Individual organisations should model based on actual cost structures. Figures are illustrative and should not be cited as guaranteed outcomes.

8.2 Strategic Advantages

- **Agility:** Upskilled teams commission new production lines faster and adapt to product changeovers with less external support.
- **Innovation:** Data-literate operators contribute to continuous improvement through kaizen, generating measurable quality and efficiency gains.
- **Employer brand:** Organisations with visible development programmes attract talent more effectively and reduce time-to-hire.

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

- **Cybersecurity resilience:** ITIL-managed, NICE-aligned OT environments demonstrate significantly lower incident rates—a factor increasingly weighted by cyber insurers and regulators.

8.3 Long-Term Resilience

Organisations that sustain structured workforce investment at two to three percent of payroll consistently achieve higher internal mobility rates and outperform industry peers on EBITDA growth over multi-year horizons [8]. The compounding effect of retained institutional knowledge, reduced dependency on external labour markets, and accelerated innovation cycles creates a durable competitive advantage that is difficult for competitors to replicate.

9. CONCLUSION: THE PATH FORWARD

9.1 Imperative for Action

The manufacturing skills gap is structural and accelerating. Capital equipment without human capability to operate, maintain, and optimise it is stranded investment. Manufacturers that delay structured upskilling face escalating contractor costs, mounting cybersecurity exposure, and competitive erosion.

9.2 Key Success Factors

1. **Strategic alignment:** Tie every learning objective to OEE, quality, margin, or risk reduction.
2. **Framework-based design:** Map roles to ITIL (service management), NICE (cybersecurity), ISA/IEC 62443 (automation security), and PMI (project management).
3. **Experiential learning:** Apply the 70-20-10 model with real production data and live systems.
4. **Rigorous measurement:** Baseline before training, measure throughout, and report quarterly using validated frameworks.
5. **Leadership commitment:** Executive scorecards, protected budgets, and visible sponsorship.
6. **Continuous evolution:** Refresh curricula every six months; sunset obsolete skills; invest in emerging competencies.

9.3 The Opportunity Ahead

Strategic upskilling is among the rare investments that simultaneously reduces cost, mitigates operational risk, and unlocks new revenue potential. Organisations that act now will build the talent others will seek to recruit—or rent at a premium—in the years ahead.

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

9.4 Call to Action

1. **Assess now:** Commission a 30-day skills audit across critical production lines, including IT service management maturity.
2. **Design a pilot:** Select one bottleneck area and launch a Learning Tree micro-credential sprint incorporating ITIL, cybersecurity, or data analytics pathways.
3. **Partner with experts:** Leverage Learning Tree's proven curricula, NICE-aligned skills analytics, and measurement frameworks to accelerate results ^{[13][14][15]}.
4. **Measure and scale:** Target first-year ROI; replicate successful programmes plant-wide within 12 months.
5. **Build a learning culture:** Embed credentialing into career progression, protect learning time, and celebrate mastery.

The manufacturers that thrive through the next decade will be those that master the discipline of workforce upskilling today. The evidence is compelling, the frameworks are proven, and the competitive window is narrowing.

REFERENCES

- [1] Deloitte & The Manufacturing Institute, "Creating Pathways for Tomorrow's Workforce Today: Manufacturing Talent Study," 2024. Available: <https://www.deloitte.com/us/en/insights/industry/manufacturing-industrial-products/supporting-us-manufacturing-growth-amid-workforce-challenges.html>
- [2] World Economic Forum, "The Future of Jobs Report 2025," January 2025. Available: <https://www.weforum.org/publications/the-future-of-jobs-report-2025/>
- [3] McKinsey Global Institute, "A New Future of Work: The Race to Deploy AI and Raise Skills in Europe and Beyond," 2024. Available: <https://www.mckinsey.com/mgi/our-research/a-new-future-of-work-the-race-to-deploy-ai-and-raise-skills-in-europe-and-beyond>
- [4] Korn Ferry, "The \$8.5 Trillion Talent Shortage," 2024. Available: <https://www.kornferry.com/insights/this-week-in-leadership/talent-crunch-future-of-work>
- [5] Fortinet, "2024 State of Operational Technology and Cybersecurity Report," 2024. Available: <https://www.fortinet.com/content/dam/fortinet/assets/reports/report-state-ot-cybersecurity.pdf>
- [6] Siemens, "The True Cost of Downtime 2024," 2024. Available: <https://www.siemens.com/global/en/products/automation/topic-areas/the-true-cost-of-downtime.html>
- [7] PwC, "The Effectiveness of Virtual Reality Soft Skills Training in the Enterprise," 2022. Available: <https://www.pwc.com/us/en/tech-effect/emerging-tech/virtual-reality-study.html>
- [8] Association for Talent Development (ATD), "State of the Industry Report," 2024.
- [9] Society for Human Resource Management (SHRM), "The Real Costs of Recruitment," 2024.
- [10] Learning Tree International, "Case Study: Judicial Council of California Empowers Courts with Tailored Power BI Training," 2024. Available: <https://www.learningtree.com/blog/case-study-judicial-council-of-california-empowers-courts-with-tailored-power-bi-training/>
- [11] NIST, "NICE Workforce Framework for Cybersecurity (SP 800-181 Rev. 1)," updated 2025. Available: <https://nicsc.com>

THE FUTURE OF WORKFORCE UPSKILLING IN MANUFACTURING

cisa.gov/workforce-development/nice-framework

- [12]** Learning Tree International, "ITIL Certification & Training," 2026. Available: <https://www.learningtree.com/certifications/itil/>
- [13]** Learning Tree International, "Enterprise Solutions," 2026. Available: <https://www.learningtree.com/enterprise-solutions/>
- [14]** Learning Tree International, "Cybersecurity Skills Analytics," 2026. Available: <https://www.learningtree.com/skills-analytics/cyber/>
- [15]** Learning Tree International, "Measuring Success: Proving the Impact of Learning," 2026. Available: <https://www.learningtree.com/measuring-success/>
- [16]** International Society of Automation, "ISA/IEC 62443: Industrial Automation and Control Systems Security," current edition.
- [17]** Konrad Adenauer Stiftung, "Vision 2030 and the Socio-Economic Reform Process: The Future of Labour and Migration in Saudi Arabia," 2025. Available: <https://www.kas.de/en/web/rpg/detail/-/content/vision-2030-and-the-socio-economic-reform-process-the-future-of-labour-and-migration-in-saudi-arabia-2>
- [18]** Japan Ministry of Economy, Trade and Industry (METI), "Manufacturing White Paper (Monodzukuri White Paper)," 2024.
- [19]** Eurostat, "Job Vacancy Statistics by NACE," 2024. Available: <https://ec.europa.eu/eurostat>
- [20]** U.S. Bureau of Labor Statistics, "Employment Projections: Manufacturing Sector," 2024. Available: <https://www.bls.gov/emp/>