EVALUATING SUSTAINABILITY, RESILIENCE AND HUMAN-CENTRICITY IN MANUFACTURING: A MULTICRITERIA APPROACH ALIGNED WITH INDUSTRY 5.0

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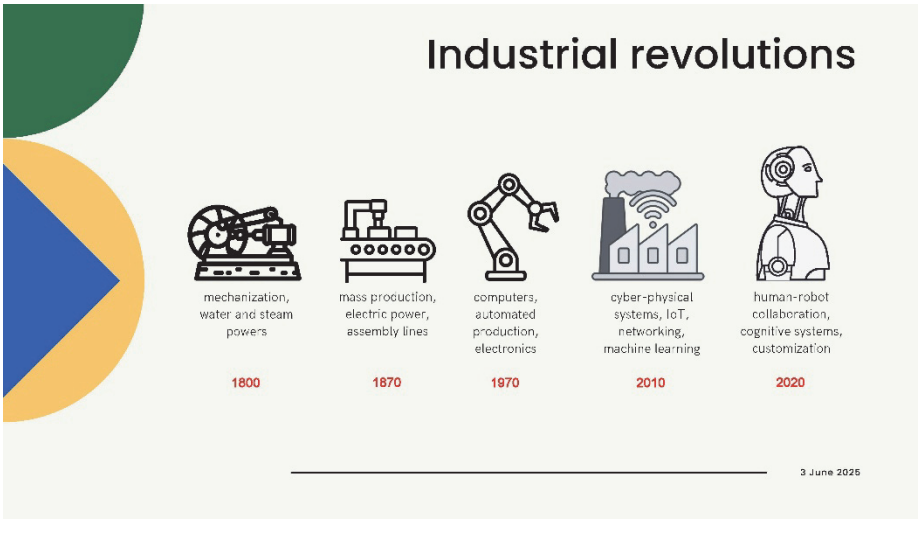

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Industry 5.0

- Industry 4.0 emphasized automation, IoT, and cyber-physical systems, aiming for efficiency and full digital integration.
- Critics argued it dehumanized work, widened inequality, and harmed sustainability.
- As a response, Industry 5.0 proposes reintroducing the human touch in production—combining human creativity with machine precision.

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Key moments

- 2019-2020: The European Commission and research institutions began formalizing the concept.
- 2021: The European Commission released a vision paper titled "Industry 5.0: Towards a sustainable, human-centric and resilient European industry".
- Since then, the concept gained traction globally across academic, political, and industrial sectors.

SME

Micro/Small/Medium	Micro/Small/Medium	Micro/Small/Medium
< 10 < 50 < 250 employees	< 2 < 10 < 50 M Eur annual turnover	< 2 < 10 < 43 M Eur in balance sheet

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Small and medium-sized enterprises (SMEs) represent 99% of all businesses.
01 High Initial Investment Costs
02 Lack of Technical Knowledge
03 Infrastructure Limitations
04 Low Production Volume
05 Lack of Information or Guidance
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Decision support method for dynamic production planning in SMEs
ktu
kauno technologijos universitetas
1922
BIOMEDICAL RESEARCH AND DEVELOPMENT
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Evaluation criteria for Industry 5.0
Human centricity
Resilience
Sustainability


Human centricity
USER EXPERIENCE (UX)
Inclusivity
SAFETY AND WELL-BEING
ENHANCED USER INTERFACES
SKILL DEVELOPMENT AND TRAINING
ERGONOMIC DESIGN
PERSONALIZED WORKFLOWS
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Resilience
REDUNDAncy
FLEXIBLE MANUFACTURING SYSTEMS
PREDICTIVE MAINTENANCE
DIGITAL TWINS
ROBUST SUPPLY CHAIN MANAGEMENT
CRISIS MANAGEMENT STRATEGIES
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Sustainability
RENEWABLE ENERGY INTEGRATION
RESOURCE EFFICIENCY
ECO-FRIENDLY MATERIALS
ENERGY MANAGEMENT SYSTEMS
SUSTAINABLE SUPPLY CHAINS
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Dimensions	Criteria	Metrics	Abbreviation
Human-Centricity	Employee Well-being	Health programs, work-life balance policies, employee satisfaction surveys	HE
	Collaboration with Robots	Number of cobots, safety incident reports, productivity improvements	HC
Sustainability	Environmental Impact	CO2 emissions reduction (EmR) and Renewable generation degree (ReG)	SE
	Sustainable Products/Services	Percentage of sustainable products, sustainability certifications, lifecycle analysis	SS
Resilience	Adaptability to Change	Innovation adoption speed, market response time, business continuity plans	RA
	Supply Chain Management	Inventory turnover, supply chain disruption recovery, waste reduction	RS
Integration of Advanced Technologies	AI and Machine Learning	AI project success rate, AI investment, AI-driven revenue	IAI
	Internet of Things (IoT)	Number of IoT devices, data analysis, performance improvements	IIoT
Innovation and Continuous Improvement	R&D Investment	R&D spending as % of revenue, number of patents, new product launches	IRD
	Continuous Learning Culture	Training hours per employee, certification rates, skill advancement	ICL

Evaluation

$$I_{5.0} = \frac{\sum HE + HC + SE + SS + RA + RS + IAI + IIoT + IRD + ICL}{10}$$

*EACH METRIC IS EVALUATED FROM 0 TO 100

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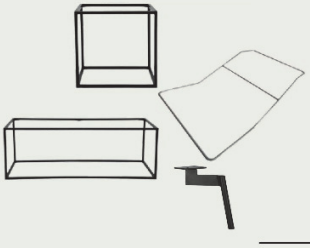
Case study

METAL PROCESSING COMPANY

PRODUCT	NUMBERS	SERVICES
	60+ employees	Welding
	2,5 M Eur turnover	Cutting
	Located in Šiauliai	Bending
	20+ year	Powder coating
	0 robotic or automatic lines	Assembly

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Metrics	Score
HE	50
HC	10
SE	50
SS	70
RA	20
RS	70
IAI	10
IIoT	30
IRD	40
ICL	30

Total result

38

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Improvement process

38 → 64 (68,5%)

Annual employee trainings

Sensors and data collection

AI-driven supply forecast tool

Use more of recycled materials

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