Artificial Intelligence for Production Management and Control towards Mass Personalization in Industry 4.0

Professor Dimitris MOURTZIS

Laboratory for Manufacturing Systems and Automation (LMS)
Department of Mechanical Engineering and Aeronautics
University of Patras, Greece
Email: mourtzis@lms.mech.upatras.gr
Outline

- Evolution of Manufacturing Paradigms
- Industry 4.0 and Smart Manufacturing
- Mass Personalization
- The Rise of AI in Manufacturing
- How can AI support the Production Management and Control towards Mass Personalization in Industry 4.0
- AI Basics and Factories of the Future
- Automation Applications at the Industrial Internet of Things (IIoT) Edge
- Discussion
- Looking Ahead: Exploring the Metaverse and the Digital Future
- Conclusion
- Key References
Introduction

Industrial Revolutions

1st Industrial Revolution
18th Century
Steam-based Machines
Craft Production
Job Shops
First Factories

2nd Industrial Revolution
19th-20th Century
Electrical Energy-based Mass Production
Dedicated Manufacturing Systems (DMS)
Agile / Lean Manufacturing
Mass Production

3rd Industrial Revolution
Late 20th Century
Computer and Internet-based Knowledge
Flexible Mfg. Systems (FMS)
Reconfigurable Mfg. Systems (RMS)
Computer Integrated Manufacturing (CIM)
Mass Customization (MC)

4th Industrial Revolution
Early 21st Century
Artificial Intelligence Information Technology
AI
Software
Intelligence
Big Data
IoT
Cloud
Internet of Things (IoT)
Cyber Physical Systems (CPS)
Digital Platforms
Product Service Systems (PSS)
Networks

5th Industrial Revolution
Personalization
Mass Customization
Co-operation between man, and machine
Cyber Physical Cognitive Systems
Sustainable Systems
Human Centric Systems
Resilient Systems

Time
1850 1910 1980 2010 2025

AI will lead the fourth industrial revolution of human beings' intelligence
[Adapted from “WorldBank; Kearns P., 2019; Li et al., 2020; Mourtzis D., 2020; ElMaraghy et al., 2022]

- SW: Software
- IoT: Internet of Things

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Introduction

Why Manufacturing Matters

- The manufacturing industry is propelled by advanced technologies and constant innovation
- It plays a key role in enhancing economic prosperity through increased productivity, raising GDP output, and creating higher-income jobs

![Diagram showing the impact of manufacturing on the economy](image)

Data for US Manufacturing Status

- Manufacturers contributed $2.17T to the economy, which is nearly 12.1% of the US GDP
- Advanced manufacturing and technology supports more than 40.0 million US jobs
- The average manufacturing worker in the US earned $81,289 annually while the average worker earned $63,830

Top 12 drivers of global Manufacturing Competitiveness

- Talent
- Cost competitiveness
- Workforce productivity
- Supplier network
- Legal and regulatory system
- Education infrastructure
- Physical infrastructure
- Economic, trade, financial and tax system
- Innovation policy and infrastructure
- Energy policy
- Local market attractiveness
- Healthcare system

Top Manufacturing Competitive Nations (by 2020):

- USA
- China
- Germany
- Japan
- India

[Source: Deloitte, 2021]
Introduction

Industry 4.0 – AI as a catalyst to Intelligent Manufacturing

Timeline of Disruptive Technologies in Manufacturing

Cybersecurity & Advanced Connectivity

-supportive Technologies
  -Additive Manufacturing
  -Augmented Reality
  -Advanced Robotics

-Lighthouse Factories
  -Bosch Automotive
  -BMW
  -Tata Steel
  -Procter & Gamble, etc.

-industry 4.0

-business Perspective
  -Adaptive Business Models
  -Service & Value Oriented Manufacturing
  -Short- & Long-Term Investments
  -Technology Adaptation

-internet Of Things
  -Every Thing Connection
  -Any Place Connection
  -Any Time Connection
  -RFID

-cloud Computing
  -Software As a Service
  -Platform As a Service
  -Infrastructure As a Service
  -Pay-As-You-Go

-fog Computing
  -Extended cloud to things
  -Geographical distribution
  -Heterogeneity
  -Interoperability

-industrial AI
  -Data Technology
  -Analytic Technology
  -Operation Technology
  -Platform Technology

-cybersecurity & Advanced Connectivity
  -Internet of Things
  -Cloud Computing
  -Fog Computing
  -Industrial AI

-P2P: Peer to Peer
M2M: Machine to Machine
RFID: Radio Frequency Identification

[Source: Jay Lee et al., 2019]
Industry 4.0 and Smart Manufacturing

Industry 4.0 – The Framework

✔ Networking of value chains
✔ Digitization of products & processes
✔ Digitalization of platforms & processes
✔ New Business Models

Industry 4.0 – Framework

1. Digitization & Integration of Vertical and Horizontal Value Chains
2. Digitization of the product and service portfolio
3. Innovative Digital Business Models

Data & Analytics as Core Capability

[Source: Industry 4.0 – Opportunities and challenges of the Industrial Internet, PwC, 2020]
Industry 4.0 and Smart Manufacturing

Industry 4.0 – The Origin

✓ Is Industry 4.0 a brand-new business model?

~1980s: Computer Integrated Manufacturing (CIM)

Islands of Automation

Industry 4.0 and Smart Manufacturing

Technological Pillars Towards Digital Transformation

[Adapted from BCG: Embracing Industry 4.0 and Rediscovering Growth, https://www.bcg.com/capabilities/operations/embracing-industry-4.0-rediscovering-growth.aspx]

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Industry 4.0 and Smart Manufacturing

Industry 4.0 – Digitalization of Manufacturing is NOT a Future Trend

Manufacturing has a real impact on the global economy: It accounts for 70 percent (70%) of global trade.

Digitalization of Manufacturing has created new job positions for 34 million people.

Industry 4.0 is NO longer a ‘future trend’ [PwC, 2016]

Digital factories at the top of the Agenda

![Diagram showing the degree of digitisation in Industry 4.0]
Industry 4.0 and Smart Manufacturing

Problem Statement

- Increase in the involvement/engagement of end-users in the product lifecycle
- Requirement: Flexible manufacturing operations to produce cost-effective individualized products in dynamic batch sizes at scale taking into consideration the unique preferences of each customer

Quick Response to changing demands and disruptions for increased resilience to:
- The factory Operation
- Supply chains & Production Networks
- Unique Customer needs

How is this achieved?

- Production Management & Control
- Self-optimizing manufacturing systems & operations to achieve:
  - flexible, autonomous, and error-tolerant production
- The main technological drivers of MPe are the Big Data Sets and Artificial Intelligence (AI)
Personalization vs. Mass Personalization

**Personalization**
“degree to which receivers perceive a message reflects their distinctiveness as individuals differentiated by their interests, history, and relationship network”

[Source: O’Sullivan and Carr, 2018]

≠

**Mass (user-initiated) customization**
“individuals deliberately tailor content by choosing options and/or creating new content and become sources of communicative interactions (i.e. self-as-source)”

[Source: Mourtzis and Doukas, 2014; Elmaraghy et al., 2021]

**Mass Personalization**
“the act of creating highly-personalized digital experiences for specific audiences based on a set of criteria. Usually, this will be using a segmentation model, which helps businesses split their customer base for effective targeting”

[Source: O’Sullivan and Carr, 2018]
Why Personalization Matters – Market Share

- The global personalization software market is expected to grow from $620 million in 2020 to $2.2 billion by the end of 2026

- The recommendation engine market size is projected to reach $12.03 billion by 2025, up from $1.14 billion in 2018, with a CAGR of 32.39% during 2020-2025

[Source: Exciting Personalization Trends to Watch for in 2022]
Mass Personalization

Reasons for Mass Personalization

Why does Mass Personalization Matter

✔ Customer: being integral part of Online Personalized Experience
✔ Elevated Consumer Expectations:
  ▪ Relevant, Contextual & Convenient Experiences to Unprecedented Heights

91% of consumers are more likely to shop with brands who recognize, remember, and provide them with relevant offers and recommendations

[Source: Accenture survey, 2018]

Personalization means using Audience and Data Analytics to meet the individual needs of a consumer

1. Use your data to outline the details of who each of your customers is,
2. What their intention is at any particular moment, and
3. Where, when, and how they’ve engaged with your brand previously

[Source: Personalization: The Basics, SITESCORE, 2022]
Key Marketing Personalization Statistics

- 80% of consumers are more likely to buy from a company that provides a tailored experience
- 66% of consumers expect brands to understand their individual needs
- 70% of consumers say that how well a company understands their individual needs impacts their loyalty
- 71% of customers are frustrated by impersonal shopping experiences
- 42% of customers are frustrated by impersonalized content
- 72% of customers will only engage with personalized messaging
- 63% of consumers won’t buy from brands that have poor personalization
- 60% of marketers say their digital content is extensively or very extensive personalized
- 88% of marketers say their biggest goal with personalization is to improve the customer experience
- 70% of consumers are more likely to buy from company’s that understand how they use their products/services

[Source: 56 Top Personalization Statistics: Facts And Trends For 2022, Link]
Mass Personalization

Key Marketing Personalization Statistics

- Companies that use advanced personalization see returns of $20 per $1 spent
- Personalization reduces customer acquisition costs by as much as 50%
- According to 55% of marketers, the #1 benefit of personalization is better visitor engagement and customer experiences
- Including personalized subject lines in your emails improves open rates by 26%
- Personalized emails drive 6x more transactions
- 52% of consumers will look elsewhere if an email isn’t personalized
- 74% of consumers are frustrated by website content that is not personalized

[Source: 56 Top Personalization Statistics: Facts And Trends For 2022, Link]
Mass Personalization

Reasons for Mass Personalization

How to Make Personalization a Reality?

Scale
Start small. Then scale across your brand’s channels at your own pace and deploy personalization where it will drive impact

Speed
No need for months of development

Insights
From holistic reporting to actionable recommendations, intelligent insights enable constant improvement

Optimize every interaction
Deliver the right content, at the right time, on the right channel

• Know your customers

• Make a good first impression

• Drive KPIs and ROI

*KPIs: Key Performance Indicators
ROI: Return of Investment
Mass Personalization Overview

Mass Production, Mass Customization, and Mass Personalization Manufacturing (MPe) Paradigms

[Source: Adapted from Aheleroff, 2019]
Mass Customization, the Next Big Trend in eCommerce

- **Situation**: global acceleration in the adoption of digital trends, such as eCommerce, due to COVID pandemic
- 84% of Americans expect their digital brands to have a seamless experience between physical and online

What are the next trends and practices that will put early adopters ahead of the competition?

**Mass Customization?**

- Personalization based on user choice
- Synchronous Production

*Source: The Digital Consumer, Appnovation Research Report, 2021*

*Source: ShapeDiver, 2022*
Industry 4.0 Key Technologies enabled Mass Personalization

[Source: Adapted from Aheleroff et al., 2020]
Importance of Internet of Things (IoT) in Industry 4.0

- By means of **low-cost computing**, the **cloud**, **big data sets**, **analytics**, and **mobile technologies**, physical things can:
  - share and
  - collect data

with **minimal human intervention**

- **Hyperconnected world**: digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate

What Technologies have made IoT Possible?

- **Access to low-cost, low-power sensor technology**
- **Connectivity**
- **Cloud computing platforms**
- **Machine learning and analytics**
- **Conversational artificial intelligence (AI)**
Internet of Things (IoT) Standards & Networks

- IPv6 over Low-Power Wireless Personal Area Networks (6LoWPAN)
  - enables any low-power radio to communicate to the internet, including 802.15.4, Bluetooth Low Energy (BLE) and Z-Wave (for home automation)

- ZigBee (based on the IEEE 802.15.4 standard)
  - low-power, low-data rate wireless network used mainly in industrial settings

- LiteOS
  - Unix-like operating system (OS) for Wireless Sensor Networks (WSNs)

- OneM2M
  - machine-to-machine service layer that can be embedded in software and hardware to connect devices

- Data Distribution Service (DDS)
  - IoT standard for real-time, scalable and high-performance M2M communication

- Advanced Message Queuing Protocol (AMQP)
  - enables encrypted and interoperable messaging between organizations and applications

- Constrained Application Protocol (CoAP)
  - specifies how low-power, compute-constrained devices can operate in the IoT

- Long Range Wide Area Network (LoRaWAN)
  - support huge networks, such as smart cities, with millions of low-power devices

[Source: Foote K., A Brief History of the Internet of Things, 2022]
The Rise of AI in Manufacturing

A perspective on the history of Artificial Intelligence (AI)

[Source: Adapted from Roy, 2020; Mittal S., 2020]
The Rise of AI in Manufacturing

From Smart Manufacturing (SMFG) towards Intelligent Manufacturing (IMFG)

Key Question: What relationship exists between SMFG and IMFG as well as Big Data and AI? How do they evolve?

AI evolution from the perspectives of content and control

DAI (AI 1.5D): evolution of collaborative multi agents (MAs), interoperability in messages and mutually learning from experience

AI 1.0: symbolic approaches characterized by structured contents and centralized control structures

A new version, called Artificial Intelligence 2.0 (AI 2.0)

Web AI (AI 1.5W): transition from 1.0 to 2.0 called 1.5X

The Rise of AI in Manufacturing

Definitions

SMART MANUFACTURING

• SMFG is the application of advanced smart technologies that enable rapid and stable manufacturing of new products, dynamic response to personalized product demands, and real-time optimization of production and supply chain networks.

• SMFG platforms can integrate design, products, operations, and business systems that span shop floor, centers, factories, enterprises, and entire supply chains.

INTELLIGENT MANUFACTURING

• IMFG automation performs manufacturing functions as if skilled humans are doing the task. IMFG systems utilize AI techniques to minimize human involvement and intervention into manufacturing activities and systems.

• From a system integration view, IMFG combines manufacturing processes and systems with different degrees of machine intelligence, including AI-supported systems, AI-integrated systems, and totally Intelligent Manufacturing System (IMS).

[Source: Smart Manufacturing Leadership Coalition. Implementing 21st century smart manufacturing [Internet]. Schaumburg: Control Global; c2004–2020]

AI Algorithms in Manufacturing

**Supervised Learning**
- Regression
  - Random Forest
  - Linear Regression
- MARS*
- Classification
  - K-Nearest Neighbors
  - Naive Bayes
  - Conditional Decision Tree

**Reinforcement Learning**
- Q-Learning
- SARSA*
- Temporal Difference Learning

**Unsupervised Learning**
- DBScan
- K-Means
- Clustering
- K-Modes
- Principal Component Analysis
- Linear Discriminant Analysis
- Dimensionality Reduction
- Generalized Discriminant Analysis
- Recursive Neural Network

* MARS – Multivariate Adaptive Regression Splines
* SARSA – State Action Reward State Action
What is the potential of AI in Manufacturing?

Challenge 1: The personalization of Mass Products

Challenge 2: Digitized Products

Challenge 3: Compliance with Environmental Standards & Wastage

Mass Personalization Manufacturing Paradigm

[Source: AI In Manufacturing, PwC, 2021]
How Can Artificial Intelligence Be Applied in Manufacturing?

✓ AI and Machine Learning are giving manufacturers an unprecedented ability to:

1. improve throughput,
2. optimize their supply chain, and
3. accelerate research and development

✓ What’s Driving the Urgency to Adopt AI?

1. High revenue volatility
2. Need to continuously find cost savings
3. Short production times
4. Increased regulation and inspections
5. Learning and adaptability on the factory floor
6. Manufacturing capacity and supply chain demands
7. Increased need for small-batch and/or customized goods

[Source: Renner L. 2020]
AI & Mass Personalization in Industry 4.0

Industrial Artificial Intelligence can empower smart manufacturing

How Can AI Be Applied in Manufacturing?

Platform Technology
Enabling Technologies for Realization of CPPS* in Manufacturing

*CCPS: Cyber Physical Production Systems

[Source: Jay Lee et al., 2019]
Making Business Sense of AI

“AI is a foundational technology that in the next couple of years will be found in most of our propositions”

Jeroen Tas
Chief Innovation & Strategy Officer
Philips

In 2023, approximately what percentage of business processes will use AI? (% of respondents)

[Source: MIT Technology Review Insights survey, 2020]
The Rise of AI in Manufacturing

Why AI is Critical to the Future of the Manufacturing World?

- According to MIT Survey (2020) ~60% of manufacturers are using AI to improve product quality, achieve greater speed and visibility across the supply chain, and optimize inventory management.

![Bar chart showing the share of respondents for various AI applications in manufacturing. Quality Control: 59%, Inventory Management: 44%, Monitoring, Diagnostics: 32%, Customer Care: 29%, Personalization of Products/Services: 22%, Asset Maintenance: 22%]
The Rise of AI in Manufacturing

Overview of AI Technologies in Industry 4.0

- Knowledge Graph Analysis
- Natural Language Processing
- Reinforcement Learning
- Machine Learning
- Computer Vision
- Perception
- Speech Recognition
- Decision Making
- Recommendation System
- Intelligent Robot

Customized Product Design
Customer Management
After-sales Service
 Manufacturing Management
Customized Product Manufacturing
Market Analysis
 Manufacturing Maintenance
Customized Product Logistics
Manufacturing Maintenance

Customized/Personalized Manufacturing

[Source: Adapted from Wang L., 2019]
The four types of AI in Mass Personalization

**Hardwired/Specific Systems**

**Human in the Loop**
- Assisted intelligence: AI systems that assist humans in making decisions or taking actions. Hard-wired systems that do not learn from their interactions.

**Augmented intelligence**: AI systems that augment human decision making and continuously learn from their interactions with humans and the environment.

**No Human in the Loop**
- Automation: Automation of manual and cognitive tasks, both routine and non-routine. This does not involve new ways of doing things - it automates existing tasks.

- Autonomous intelligence: AI systems that can adapt to different situations and can act autonomously without human assistance.

Industry 4.0 Key Technologies enabled Mass Personalization
AI & Mass Personalization in Industry 4.0

Industry 4.0 – Big Data Sets

Big Data ≡ data that requires more processing resources to PRODUCE VALUE

AI in Manufacturing: Examples

French food manufacturer **Danone Group** uses Machine Learning to improve its demand forecast accuracy. Results:

- 20% decrease in forecasting errors
- 30% decrease in lost sales
- 50% reduction in demand planners’ workload

[Source: Whiteside J., 2021]

Fanuc (Japanese automation company) uses robotic workers to operate its factories round-the-clock:

- Production of essential components for CNCs and motors
- Operation of all production floor machinery non-stop
- Facilitation of continuous monitoring of all operations

[Source: FANUC]
AI in Manufacturing: Examples

**Porsche**

Use autonomous guided vehicles (AGVs) to automate significant portions of automotive manufacturing.

The AGVs take vehicle body parts from one processing station to the next, eliminating the need for human intervention and making the facility resilient to disruptions like pandemics.

(Source: Porsche/Siemens)

**BMW Group** uses automated image recognition for:

- Quality checks, inspections, and
- Elimination of pseudo-defects (deviations from target despite no actual faults)

Result: high levels of precision in manufacturing.

(Source: BMW Group, 2022)
Personalization Trends for 2022

1. Increase in 1-1 Experiences

2. Personalized **Mobile Customer Experiences**
   - the share of *mobile commerce* in all e-commerce is around 73% by 2021
   - 79% of smartphone users have made a *purchase online using their mobile devices* in the last 6 months

3. Image Recognition

4. AI-Powered Personalization

5. Data Privacy and Cookieless Personalization

6. Personalizing **Longer Customer Journeys**

7. Increasing Importance of **Customer Loyalty**

8. Omnichannel Personalization

9. **Anonymous Visitor Personalization**

[Source: BCG Global AI Survey, 2018; BCG Analysis]
The Basics of AI in Operations

The capabilities of AI are far beyond human capacity

7 BENEFITS OF AI IN MANUFACTURING

1. Direct Automation
2. 24/7 Production
3. Safety
4. Lower Operational Costs
5. Greater Efficiency
6. Quality Control
7. Quick Decision Making

[Source: King et al., 2019]
AI will become Increasingly Important during the Next Decade

- **Relevance to Improving Productivity**

  - 11-percentage-point increase

  - 2018: 29%
  - 2030: 40%

  *AI rated as the most important lever for productivity improvement*

- **Impact on Conversion Costs**

  - Reduction in Conversion Costs enabled by Fully Implementing AI in operations

  *UPTO 20%*

[Source: BCG Global AI Survey, 2018; BCG Analysis]
Why AI is Critical to the Future of the Manufacturing World

✓ Survey results about companies using AI conclude that:
  ▪ Cost Savings
  ▪ Revenue Growth

✓ AI can improve forecasting accuracy in manufacturing by 10-20%, which translates to a 5% reduction in inventory costs and a 2-3% increase in revenues

✓ Benefits of AI in manufacturing include (among others):
  ▪ Predictive maintenance to reduce unplanned downtime
  ▪ Operate near-shore facilities using advanced manufacturing technologies (3D printers, robots) to reduce labor costs and stay resilient despite supply chain disruptions
  ▪ Create optimal, AI-enabled generative design to ensure efficiency and reduce waste

[Source: BCG Global AI Survey, 2018; BCG Analysis]

16% of those surveyed noticed a 10-19% decrease in costs
18% saw a 6-10% increase in overall revenue

The Factories of the Future Should...

**Detect defects throughout the production process**

The Factories of the Future Should... detect defects throughout the production process. AI-based predictive maintenance can boost availability by up to 20% while reducing inspection costs by 25% and annual maintenance fees by up to 10%. [Source: McKinsey & Company, 2021]

**Deploy predictive maintenance to reduce downtime**

AI-based predictive maintenance can boost availability by up to 20% while reducing inspection costs by 25% and annual maintenance fees by up to 10%. [Source: McKinsey & Company, 2021]

**Respond to real-time changes in demand across the supply chain**

According to McKinsey, 61% of manufacturing executives report decreased costs, and 53% report increased revenues as a direct result of introducing AI in the supply chain. Further, more than one-third suggested a total revenue bounce of more than 5%. [Source: McKinsey & Company, 2019]

**Validate whether intricate goods like microchips have been perfectly produced**

According to a McKinsey study, the application of AI/ML use cases delivers the most value—about 40% in optimizing semiconductor manufacturing efficiencies. These use cases significantly improve the throughput of a Fabrication Plant (Fab). With consistent application, a Fab can expect cost-cutting to the range of 17%. [Source: McKinsey & Company, 2021]

**Reduce costs of small-batch or single-run goods, enabling greater customization**

By 2020, 85% of customer interaction in retail will be managed by AI, according to Gartner. [Source: Arthur R., 2017]

**Improve employee satisfaction by shifting mundane tasks to machines**

29% of US employees are engaged with their work and feel fulfilled by their duties, while another report states that 83% of US workers believe they could be more constructive if they had better productivity monitoring software to do so. [Source: Enlear Academy, 2021]
AI technologies have several applications in manufacturing operations:

- **Machine Vision**
  Sensing the production environment through visual, x-ray, or laser signals—for example, using a camera to classify parts and products.

- **Speech Recognition**
  Processing speech and other acoustic signals—for example, using a virtual assistant similar to Alexa or Siri to process comments from operators about quality issues.

- **Natural-Language Processing**
  Parsing text and interpreting its most probable meaning—for example, creating summaries from different performance reports.

- **Information Processing**
  Extracting knowledge from unstructured text and retrieving answers to queries—for example, by searching in production-related text reports.

(Source: Mewari and Kamath, 2022)
AI in Smart Factory Operations

AI technologies have several applications in manufacturing operations:

Learning from Data
Predicting or classifying values on the basis of empirical production-related data—for example, using historical data generated by machines and processes to predict events.

Planning and Exploring
Choosing a sequence of actions that maximizes a specified goal—for example, enabling an automated guided vehicle (AGV) to identify its best next movement.

Navigation and Movement
Maneuvering through physical environments—for example, enabling an AGV to move and optimize its routes autonomously within a factory.

Speech Generation
Communicating with humans via written text or acoustic speech—for example, reading instructions aloud.

Handling and Control
Manipulating physical objects—for example, enabling robots to pick unsorted parts from a storage bin without requiring specific training.

Supply Chain Optimization
Today’s supply chains are super complex networks to manage, with thousands of parts and hundreds of locations. With machine learning algorithms, manufacturers can define the optimized supply chain solution for all their products.

[Source: Mewari and Kamath, 2022]
Open Issues & Potential Solutions in AI through Machine Learning

Potential Solutions

- Diverse & Unstructured Data
- Heterogeneity of Systems
- Complexity & Computing Power
- Security Threats

Effective Big Data Analytics

- Large Number of Training Data
- Diverse & Real-World Industrial Areas

Use modern GPUs or FPGAs

Multiple Fog Devices

Parallel ML Algorithms

Software and Hardware Security Countermeasures

Open issues and potential solutions towards tackling faults in Industry 4.0 through ML

[Source: Angelopoulos et al., 2019]

GPU: Graphical User Interface
FPGA: Field-programmable gate array
ML: Machine Learning
Looking Ahead – Society 4.0

Universities should focus on how we develop our careers, cultivate our skills, meet people and nurture relationships.

To fully collaborated and integrated systems.
Looking Ahead – Society 5.0

Society 5.0 – Digital Platforms for Value Creation

New Skills are REQUIRED

Looking Ahead – Society 5.0

Enablers for Integration of Society 5.0

- Japanese students may soon be saying **goodbye to traditional divisions** between grades and subjects in a new **focus on human skills to get the most out of technology**

> “The essence of Society 5.0 is that it will become possible to quickly elicit the suitable solution that meets the needs of the most individuals”

**Educational Approaches**

1. Make grade progression more **flexible**
   - Ensure there are **NO GAPS IN UNDERSTANDING**

2. Removing the barriers between **subjects** and **discipline**
   - Education system in which subjects like math, data science and programming are **BASIC REQUIREMENTS**, as are subjects such as philosophy and languages

[Source: https://foreignpolicy.com/sponsored/how-japan-is-preparing-its-students-for-society-5-0/]
Looking Ahead: Industry 5.0 – Digital Platforms for Value Creation

Industry 5.0 – European Commission

✓ Aims beyond efficiency and productivity as the sole goals, and reinforces the role and the contribution of Industry to Society
✓ It complements the existing "Industry 4.0" approach by specifically putting Research and Innovation at the service of the transition to a Sustainable, Human-Centric and Resilient European Industry

Why Industry 5.0

✓ Industry 5.0 brings benefits for Industry, Technicians & Society
✓ It empowers Technicians, as well as addresses the evolving skills and training needs of employees. It increases the competitiveness of industry and helps attract the best talents

Looking Ahead: Industry 5.0 – Digital Platforms for Value Creation

Human CENTRIC

RESILIENT

SUSTAINABLE

[Source: The 3 pillars of Industry 5.0 according to the EC – human-centric, resilient and sustainable]
Platforms for Value Creation: Metaverse

Definition

✓ “The concept of a fully immersive virtual world where people gather to socialize, play, and work”

✓ It is a simulated digital environment that combines Augmented Reality (AR), Virtual Reality (VR), Blockchain, and Social Media principles to create areas for rich user interaction that imitate the real world [Laeeq K., 2022]

✓ “A virtual environment where you can present yourself with people in digital spaces. You can kind of think of this as an embodied Internet that you're inside of, rather than just looking at” [Zuckerberg, Meta CEO]
Platforms for Value Creation: Metaverse

Market Size, 2021 - 2030

Looking Ahead - Metaverse

[Source: PWC, “To work for everyone, the Metaverse must be decentralized”, Cointelegraph, November 2021]
Platforms for Value Creation: Metaverse

The Seven Layers of the Metaverse

- **Experience**: Games, Social, Esports, Theater, Shopping
- **Discovery**: AD Networks, Social curation, Ratings, Stores
- **Creator Economy**: Design Tools, Asset Markets, Workflow, Commerce
- **Spatial Computing**: 3D Engines, XR, Multitasking, Geospatial Mapping
- **Decentralization**: Edge Computing, AI Agents, Microservices, Blockchain
- **Human Interface**: Wearables, Haptic Gestures
- **Infrastructure**: 5G, WIFI 6, Cloud, chip technology, GPUs

[Source: Deloitte Research and analysis, Global XR industry insight | Metaverse: unlocking imagination and embracing reality]
Platforms for Value Creation: Metaverse

Which are the Key Principles in the Metaverse?

- **Decentralized**
  - Community-driven protocols, without central oversight and governance

- **Interconnected & Interoperable**
  - Open standards enable real-time access to shared virtual worlds for unlimited users

- **Safe & Trustworthy**
  - Ensuring safety, cybersecurity and data privacy from the start and throughout the metaverse

[Source: GSMA Intelligence, 2022]
Platforms for Value Creation: Metaverse

Opportunities and Applications

Which are the Key Enabling Factors?

- 5G Networks and Beyond
- Wearable Technology
- Artificial Intelligence
- Avatars
- Non-fungible tokens (NFTs)

[Source: GSMA Intelligence, 2022]
Conclusion

- It is time to get personalized!
  - Brands need to have the right personalization tool that is easy to use and comprehensive
- The trend towards personalization is not new, but it's becoming an increasingly important part of businesses
- As AI progresses and models improve, enterprises are building the unreal world
- Elevating authenticity within the organizations is very important
- Authenticity is the compass and the framework that will guide the marketplace to use AI in a genuine way across industries, use cases, and time, by considering provenance, policy, people, and purpose
- It will unlock new attitudes towards and experiences with AI, unleashing the benefits of the unreal world
Conclusion

AI as a building block of a resilient post-pandemic world

- All kinds of organizations are looking ahead to build **resilient systems** that can better withstand future disruptions such as pandemics, natural disasters, cyberthreats, and other destabilizing scenarios.

The Pandemic Battle at hand

- “IBM” and “The Weather Company”, has released the **Weather Channel Interactive Incidents Map**, which presents the latest COVID-19 data at the local level
  - **IBM Cognos**: IBM Global COVID-19 Statistics Dashboard - Robust tool for deeper analysis

Aiding overwhelmed help desks

- IBM trained Watson Assistant on trusted information from the CDC and other sources and offered it at no cost for at least 90 days to governments, businesses, healthcare and academic organizations
  - Tool: **Natural Language Processing (NLP)**

Repairing broken supply chains

- Smarter supply chains powered by AI can be built for **resilience and flexibility** during such disruptions
- AI-infused supply chain is animated by **sensors, RFID tags, actuators, GPS, news media data, and more**
  - Tool: **Machine Learning**
Data without CONTEXT is just USELESS

Questions?
Key References

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Thank You!

For more information:

Professor Dimitris Mourtzis
mourtzis@lms.mech.upatras.gr