

# Digital Transformation of Manufacturing



Assistant Professor Sampsa Laakso  
[sampsa.laakso@utu.fi](mailto:sampsa.laakso@utu.fi)

University of Turku  
Faculty of Technology  
Department of Mechanical and Materials Engineering  
Digital Design and Manufacturing



UNIVERSITY  
OF TURKU

# Contents

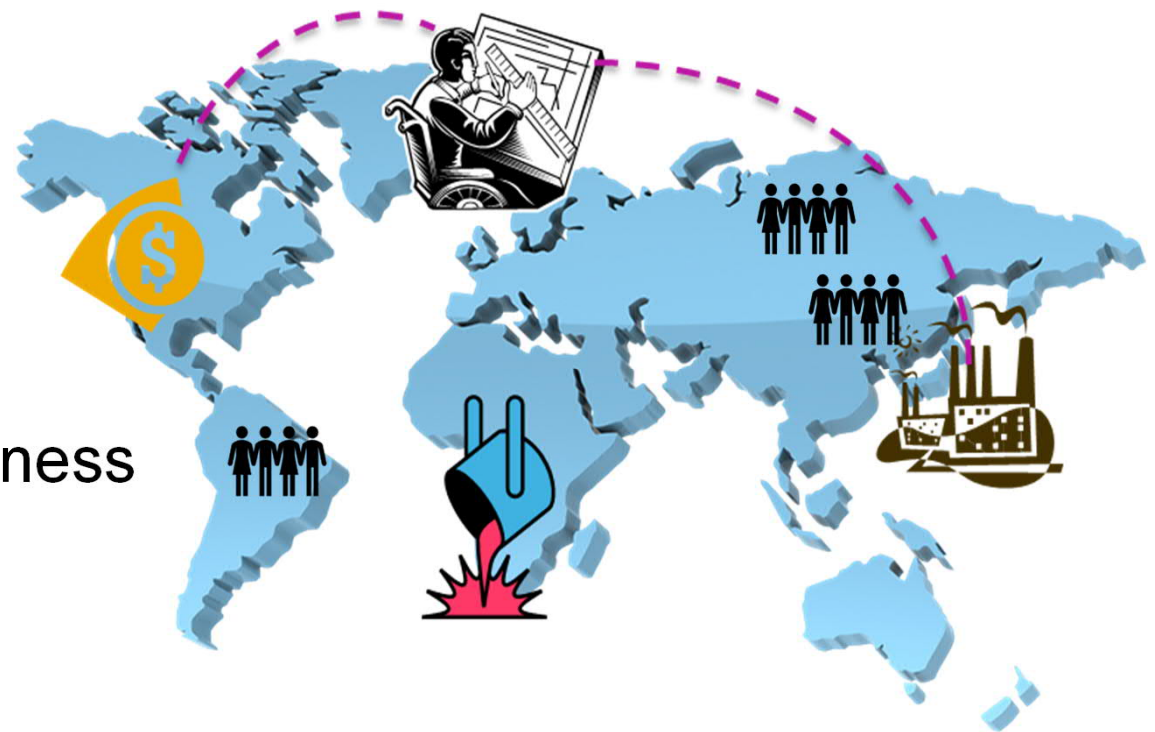
1. What factors have driven the digital transformation of industry?
2. What consequences the global scale changes have had in manufacturing?
3. What is included in the “digital manufacturing” field?
4. What is my piece of the pie?
5. What might happen in the future?

# INTRODUCTION TO MANUFACTURING INDUSTRY IN THE GLOBAL CONTEXT



# Driving Factors Behind The Digitalization

1. Globalization
2. BRICS countries
3. Outsourcing
4. Paradigm change
5. IT resources
6. Sustainability awareness



# Global Business Environment

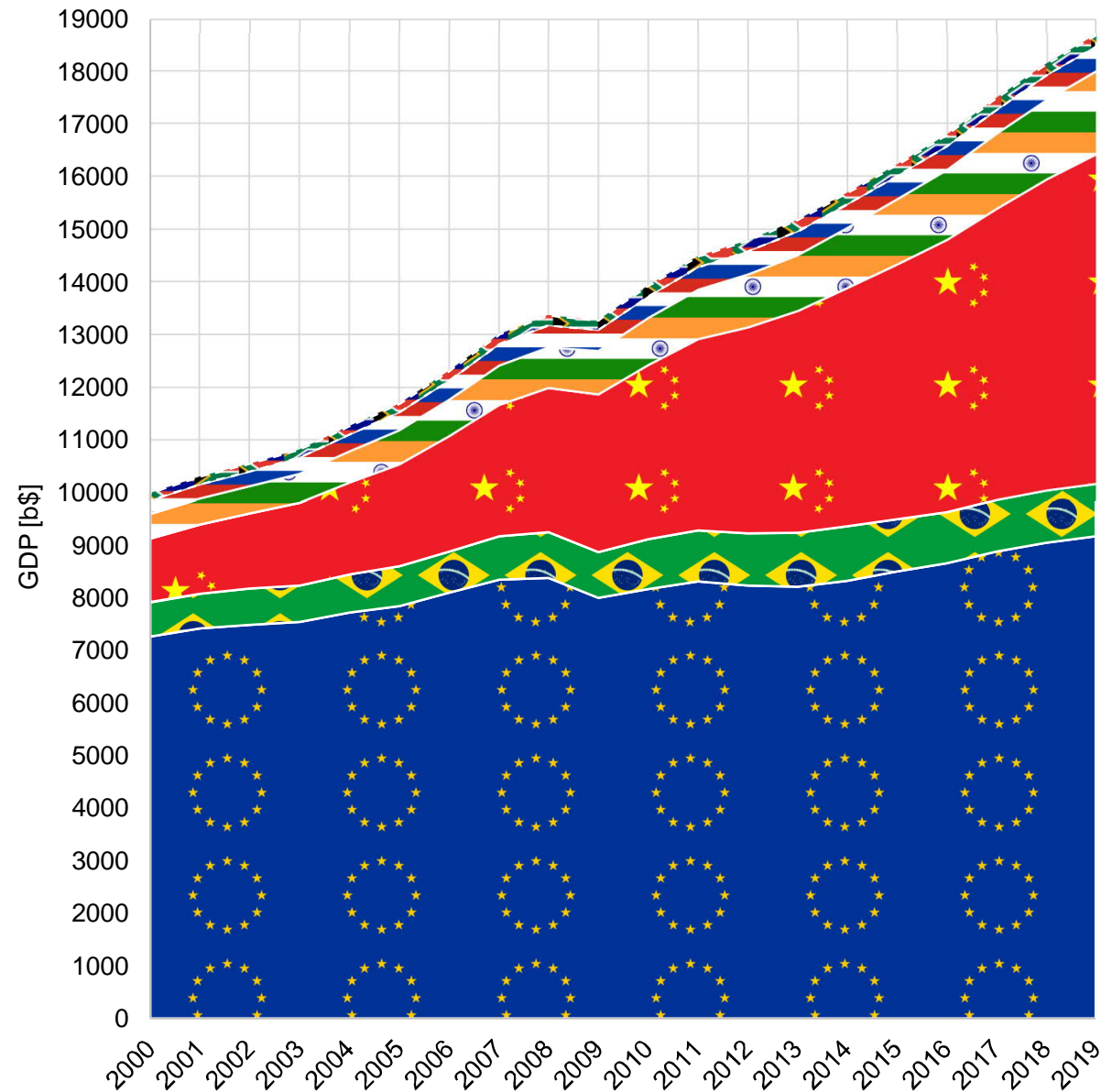
Globalization enabled by internet and international trade agreements

- Global Competition
- Global Customers
- Global Manufacturing Sites
- Global Organizations
- Global Suppliers



# BRICS-Countries

- Brazil, Russia, India, China and South-Africa
- Rising economies
- Growing middle class
- Major raw-material suppliers

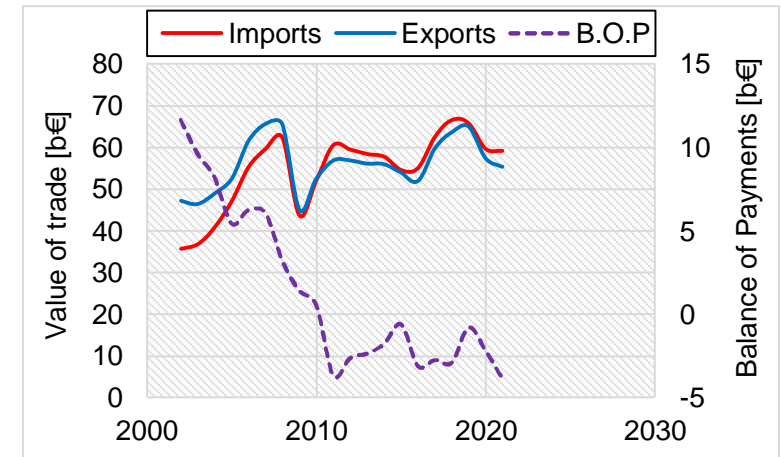




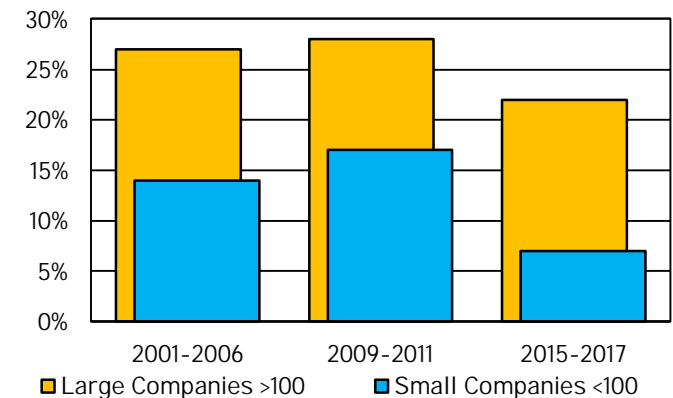
# Outsourcing

- 70% of OEM products added value is done by outsourcing
- Practically only assembly is done in the OEM
- Main driving force is lower labor costs and fixed assets
- Loss of manufacturing expertise and cost awareness
- Societal losses and decreased GDP and BOP

## Balance of Payments in Finland



## Outsourcing of Industrial Companies Functions in Finland



# Paradigm Change

- Customers demand customized or unique products in small batches: mass production vs. mass customization
- Products are embedded with smart-system features.
- Design complexity and freedom has increased with new manufacturing technologies like Additive Manufacturing
- These require extreme agility and leanness from manufacturing companies
- Many companies have moved towards service business and away from equipment supplier role

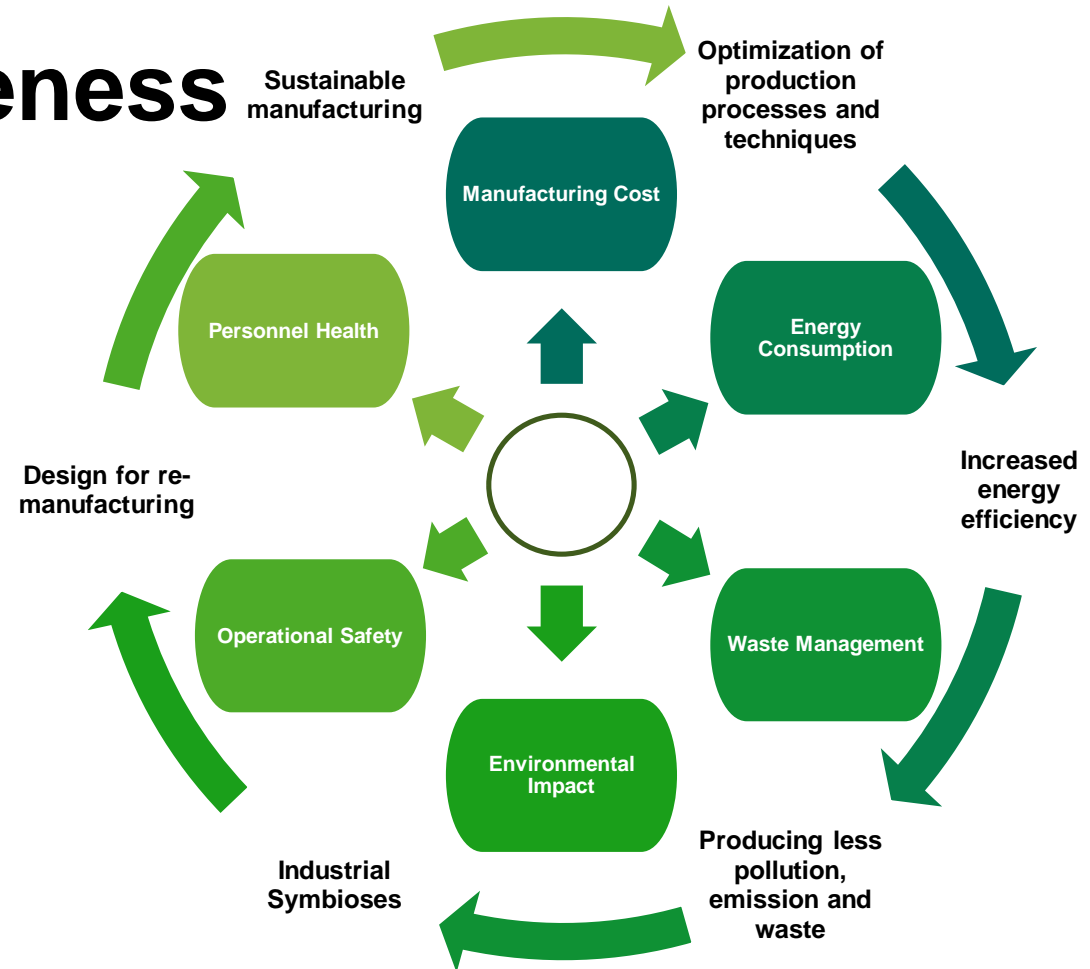


# IT Resources

- IT resources have become more efficient and available
- Internet enables global customer base, which is a two-way street
- Cloud computing, Big Data, AI, sensors and high-speed communications networks bring new opportunities for product development and manufacturing process control
- Real-time information about products and manufacturing processes

# Sustainability Awareness

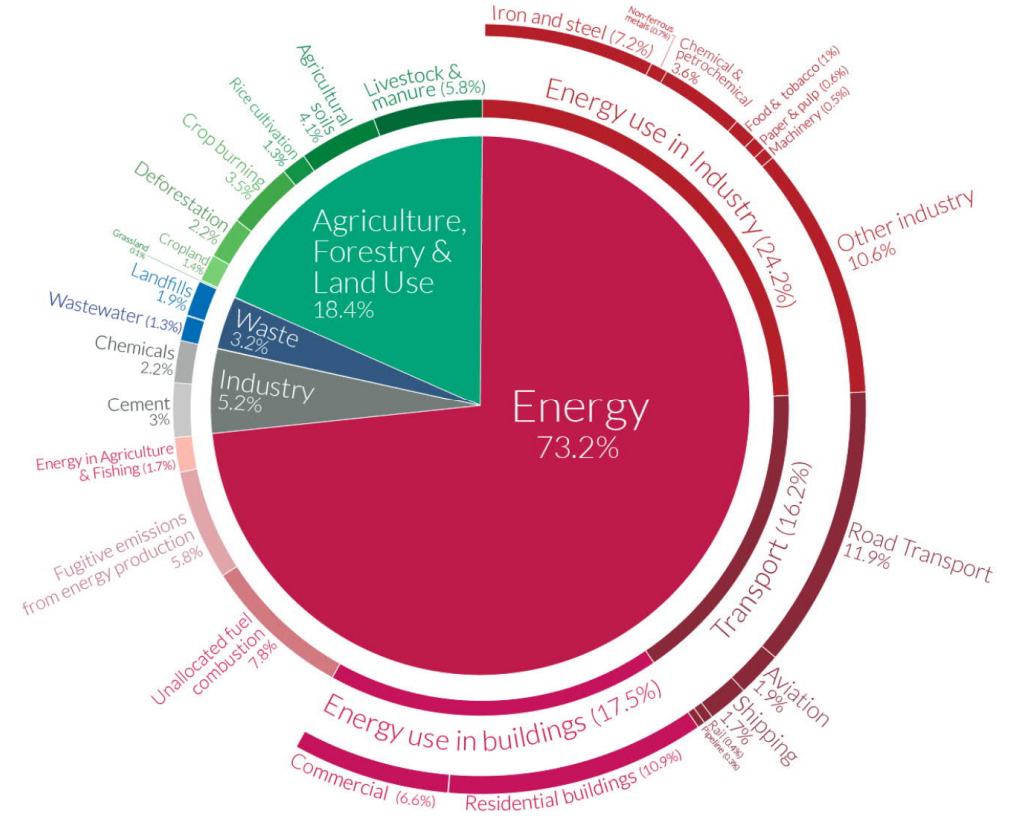
- OECD defines that Sustainability contributes beneficially to 1) economy, 2) society and 3) environment
- Economy has always been the driving force in manufacturing
- Environment has become the focus, but societal impact has been left in the sidelines



# CO2 Emissions

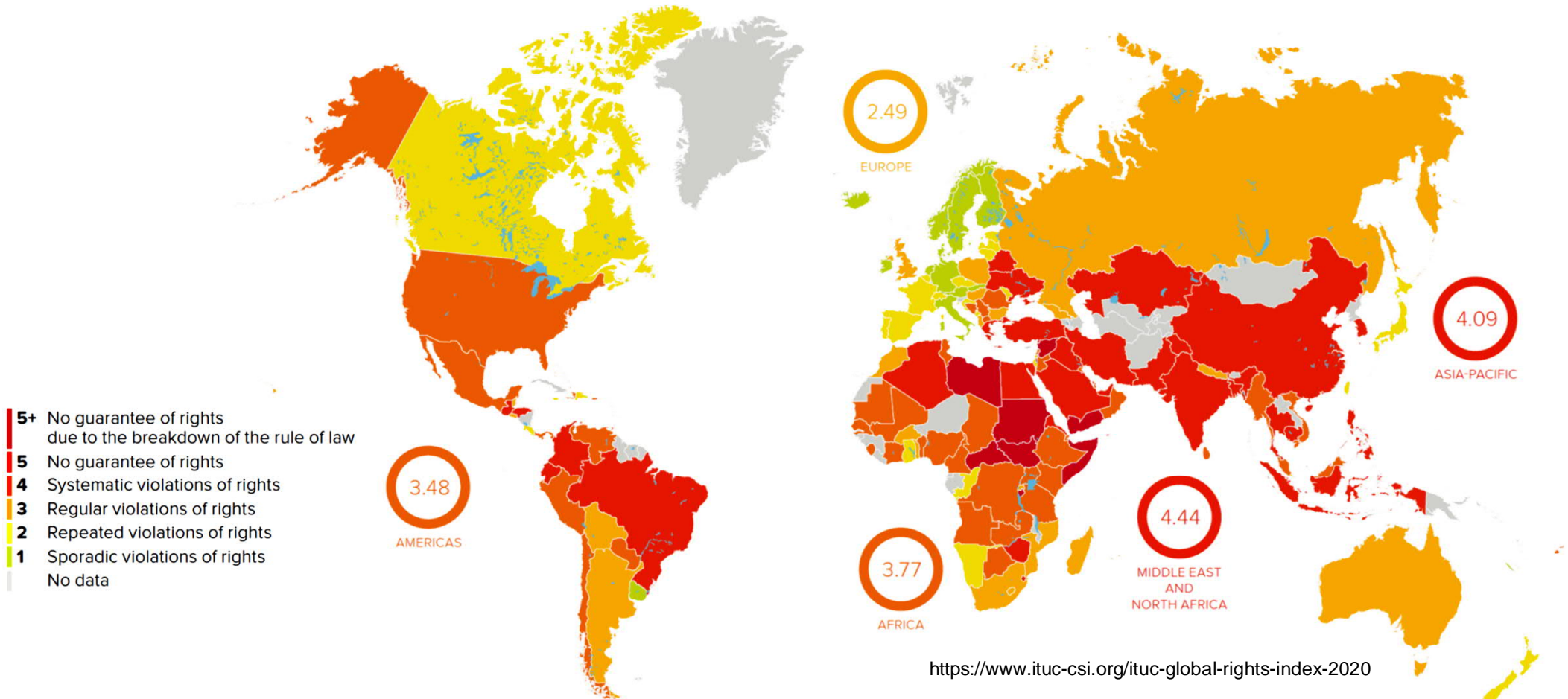
- Industry produces 5.2% of greenhouse gas emissions directly
- Indirectly industry produced additional 24.2% through energy consumption and 1.7% through shipping
- Total: 31.1%

Global greenhouse gas emissions by sector  
 This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO<sub>2</sub>eq. Our World in Data



OurWorldinData.org – Research and data to make progress against the world's largest problems.  
 Source: Climate Watch, the World Resources Institute (2020). Licensed under CC-BY by the author Hannah Ritchie (2020).

# ITUC Global Rights Index 2020



<https://www.ituc-csi.org/ituc-global-rights-index-2020>

# Summary

- Industry operates in global environment with strict requirements on delivery times, quality and costs
- Suppliers, manufacturing sites, engineering and customers are globally dispersed
- Customers demand customized products, small batches and smart-system features
- Sustainability has become important and is being enforced with taxes and general population attitudes

# Consequence: Digital Manufacturing

Digital manufacturing provides tools for:

- a) Collaboration in the network
- b) Advanced manufacturing planning and control
- c) Product and process development

# DIGITAL MANUFACTURING

COLLABORATION			SIMULATION			MANUFACTURING		
Concurrent Design	Supplier Integration	Customer Relations	Product	Resources	Process	Advanced Processes	e-Manufacturing	Virtual Reality
Web 2.0	Supplier Network Management	Online Production Data	FEM	Logistics	Cutting and Forming	Additive Manufacturing	Industrial Internet and IoT	V/A-R Work Instructions
Collaborative CAD	System Integration	Customer Management	MBS	Production Line	Casting	5-axis Machining	Industry 4.0	V/A-R Testing
Design Platform Integration	Knowledge Sharing	Digital Product History	CFD	Worker Allocation	Welding	Hybrid Processing	ERP+APS+MES	V/A-R Training
Topics penetrating all the fields.			AI & Big Data					
			Digital Twins: Real Time Sensor Data Driven Virtual Models					
			Sustainability and Circular Economics					



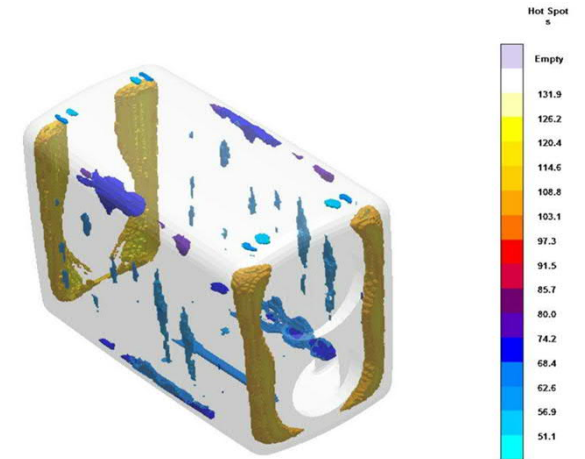
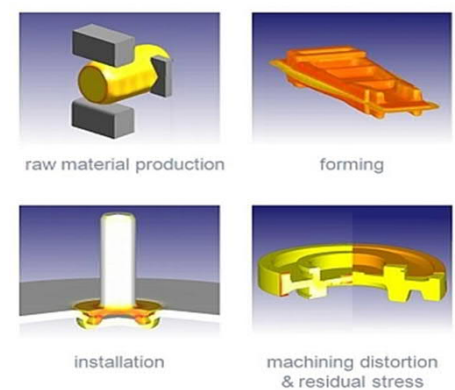
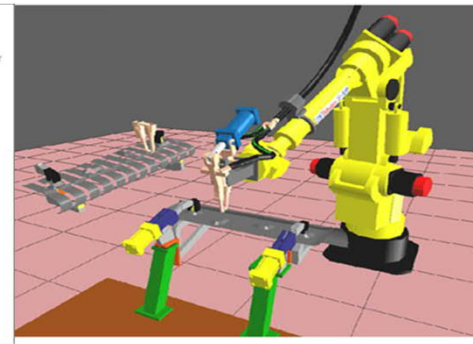
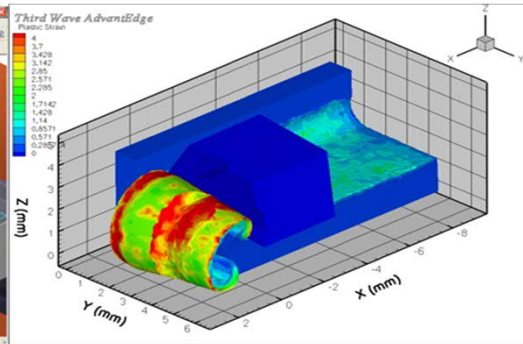
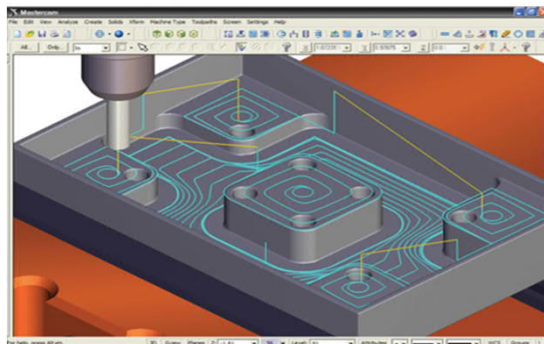
# Benefits of digital manufacturing

- Shortened product development
- Early validation of manufacturing processes
- Faster production ramp-up
- Faster time to market
- Improved product quality
- Enhanced product knowledge dissemination
- Reduction in errors
- Increase in flexibility
- Reduced manufacturing costs

# Process simulations

Dr. Sampsa Laakso's research in Digital Manufacturing

- Cutting simulations
- Forming simulations
- Casting simulations
- Machine simulations (tool, machine tool, robot etc.)



# Emergence of “*Total Manufacturing*”

- Manufacturing both targeted and used as a tool in global politics.
- Environmental effects have significant role in political decision making.
- Young generations have more wholesome career plans. “*making the world a better place*”
- Labor conditions and rights are improving but still globally uneven.

*China targets rare earth export curbs to hobble US defence industry*  
-Financial times, 16.2.2021

*EU parliament votes to make ships pay for their pollution*  
-Reuters, 15.9.2020

*EU imposes tariffs on Chinese steel wheel imports over dumping*  
-Reuters, 4.3.2020

# Future of Manufacturing

- China, India & South Americas are becoming even stronger economies.
- Industrializing Africa.
- From sales of products to sales of services.
- Circular economy, recycling and re- and demanufacturing.
- Smart and connected products.
- Competition over resources
- Decreased and localized material supply.
- “Lights-out manufacturing”: Nearly 100% automation rate.
- Artificial Intelligence.
- Sustainability tariffs
- Hydrogen economy





**UNIVERSITY  
OF TURKU**

**Thank you!**

Hope your coffee was strong and tasty!