

# Digital Manufacturing – Industry 4.0

*This is the course 41740 Digital Manufacturing – Industry 4.0 on Denmark Technical University (DTU).*

*The main goal of this course is to provide students with an understanding and a portfolio of actionable tools (techniques) for the optimization of manufacturing processes.*

## Module 01 – Introduction to Digital Manufacturing

### Introduction

- Industry 4.0: The 4<sup>th</sup> Industrial revolution. What about the three others?
  - The first industrial revolution came with the advent of mechanisation, steam power and waterpower.
  - This was followed by the second industrial revolution, which revolved around mass production and assembly lines using electricity.
  - The third industrial revolution came with electronics, I.T. systems and automation.
  - And this has led to the fourth industrial revolution that has associated with cyber physical systems.
- What is Industry 4.0?
  - Industry 4.0 is the next phase in the digitization of the manufacturing sector, driven by disruptive trends including the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics.
- Four foundational types of disruptive technologies:
  - Connectivity, data, and computational power:
    - Cloud technology, the Internet, blockchain, sensors.
  - Analytics and intelligence:
    - Advanced analytics, machine learning, artificial intelligence.
  - Human-machine interaction:
    - Virtual reality (VR) and augmented reality (AR), robotics and automation, autonomous guided vehicles.
- The technology is only the half of the industry 4.0 equation. The thrive of the new industry, companies must ensure that their workers are properly equipped through upskilling and reskilling and then hire new people when necessary.

### The Digital Twin

- A digital twin is a virtual model designed to accurately reflect a physical object.
  - Example: A wind turbine is outfitted with various sensors related to vital areas of functionality. These sensors produce data about different aspects of the physical object's performance, such as energy output, temperature, weather conditions and more. This data is then relayed to a processing system and applied to the digital copy.
- The virtual model can be used to run simulations, study performance issues, and generate possible improvements, all with the goal of generating valuable insights – which can then be applied back to the original physical object.
- Difference between digital twin and simulations is that simulations studies one process and a digital can itself run any number of useful simulations to study multiple processes.

### Production Analytics

- Production analytics encompasses various areas of data analytics with particular emphasis on applications in manufacturing processes. These applications often focus on product development and improvement as well as process improvement, optimization, monitoring and control.