



Industry 4.0 in Manufacturing

- an introduction



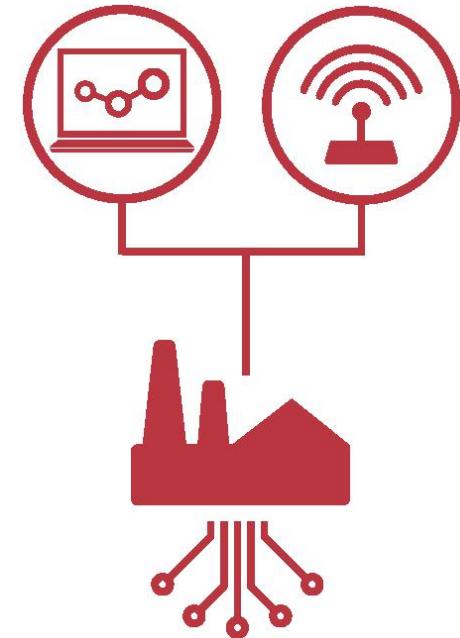
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30/Jan/2019

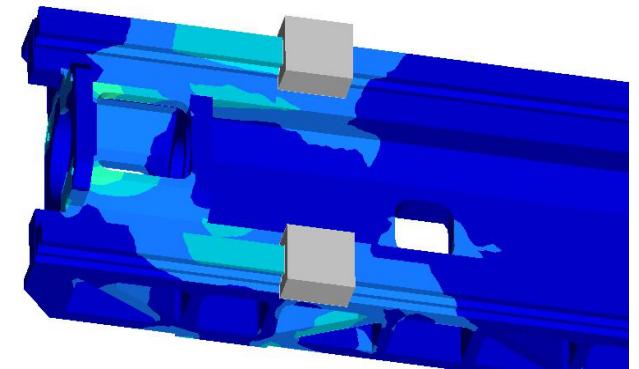
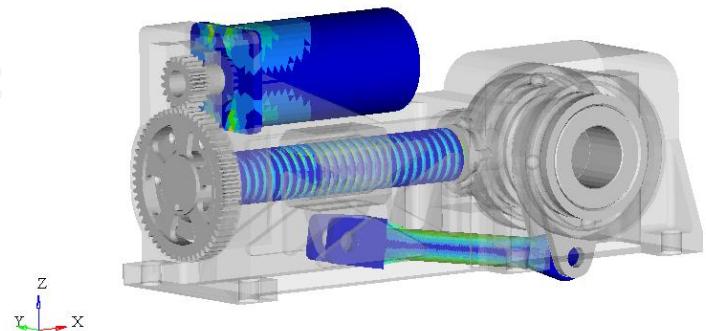
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- **Basic Steps**
- **Traditional vs Digital Manufacturing**
- **Key Benefits**
- **Supporting Technologies for I4**
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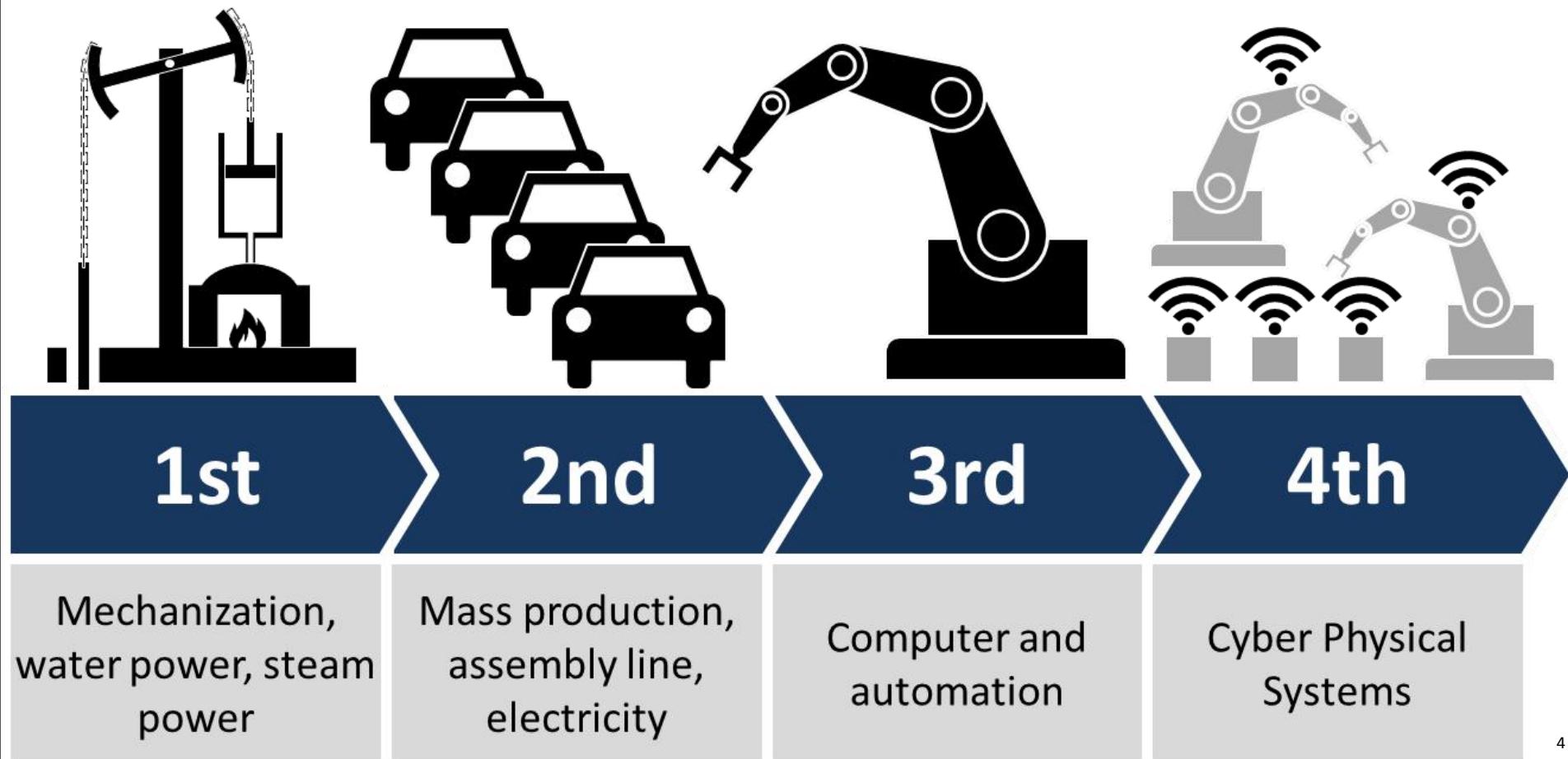
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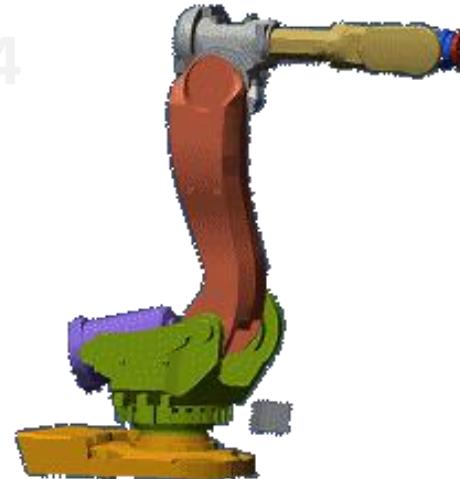
What is industry 4.0

Industry 4.0 (**I4**) is commonly referred to as **the fourth industrial revolution (4IR)**^[1].



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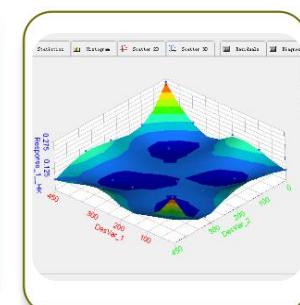
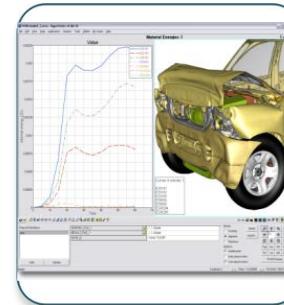
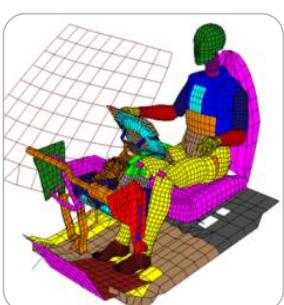
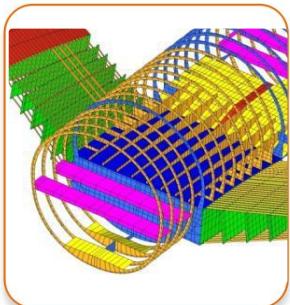
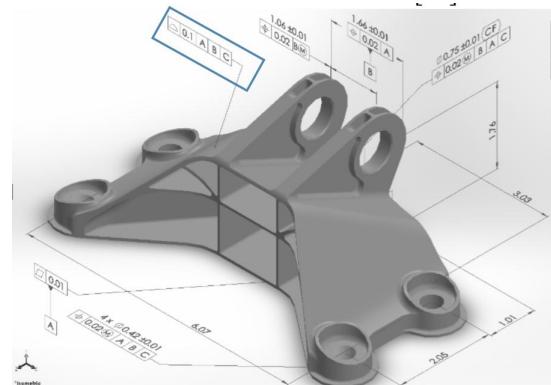
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Basic Steps

Basically, **4IR** can be summarised as the following steps:

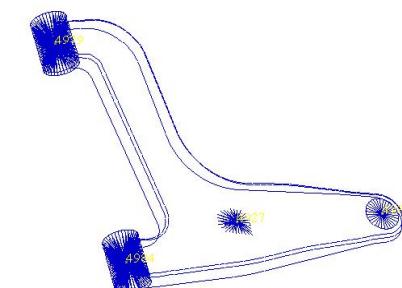
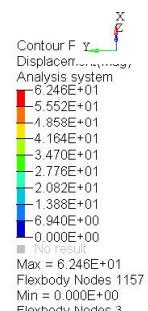
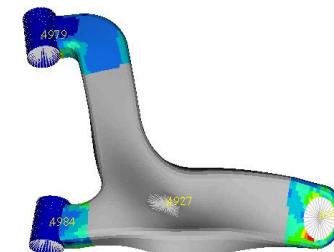
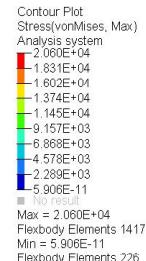
1. Virtual Prototype (e.g. Digital Design)
2. **Digital Manufacturing**
3. Physical Prototype or Products
4. Intelligent Service (e.g. Product Lifecycle Management)



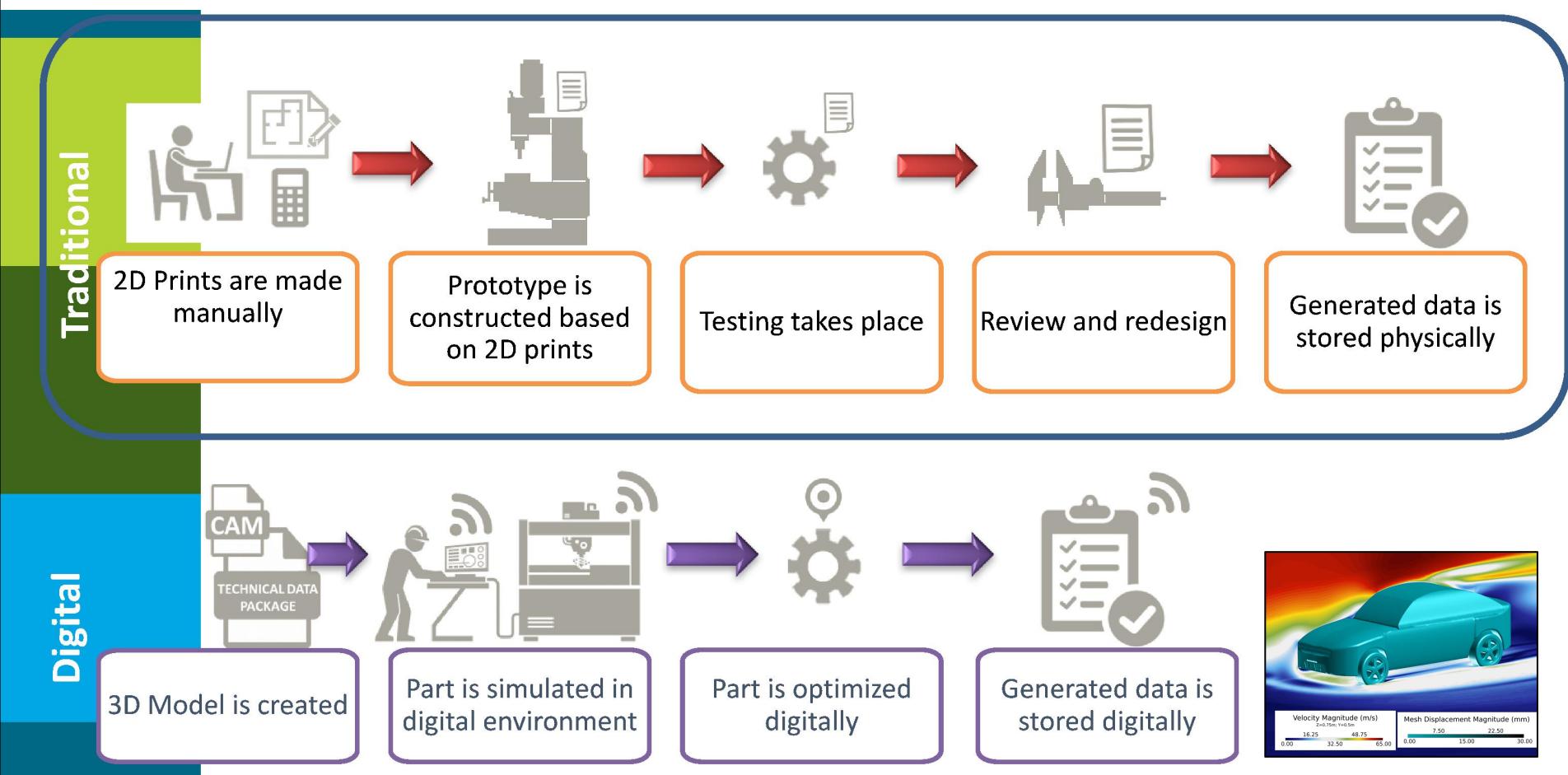
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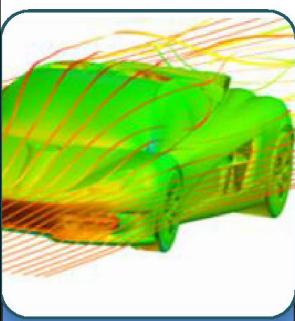
Traditional vs Digital Manufacturing



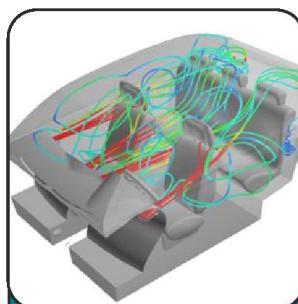
The Evolution of the Playstation Controller



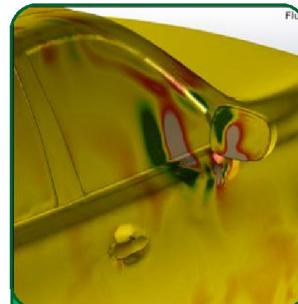
The Evolution of the Xbox Controller



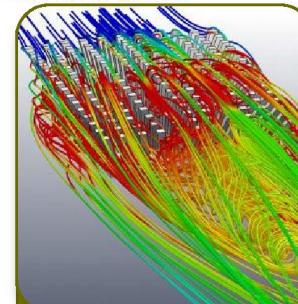
Aerodynamics



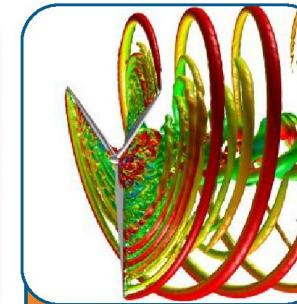
Thermal Management



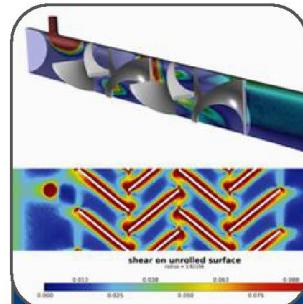
Computational
Aero-acoustics



Electronic
Cooling

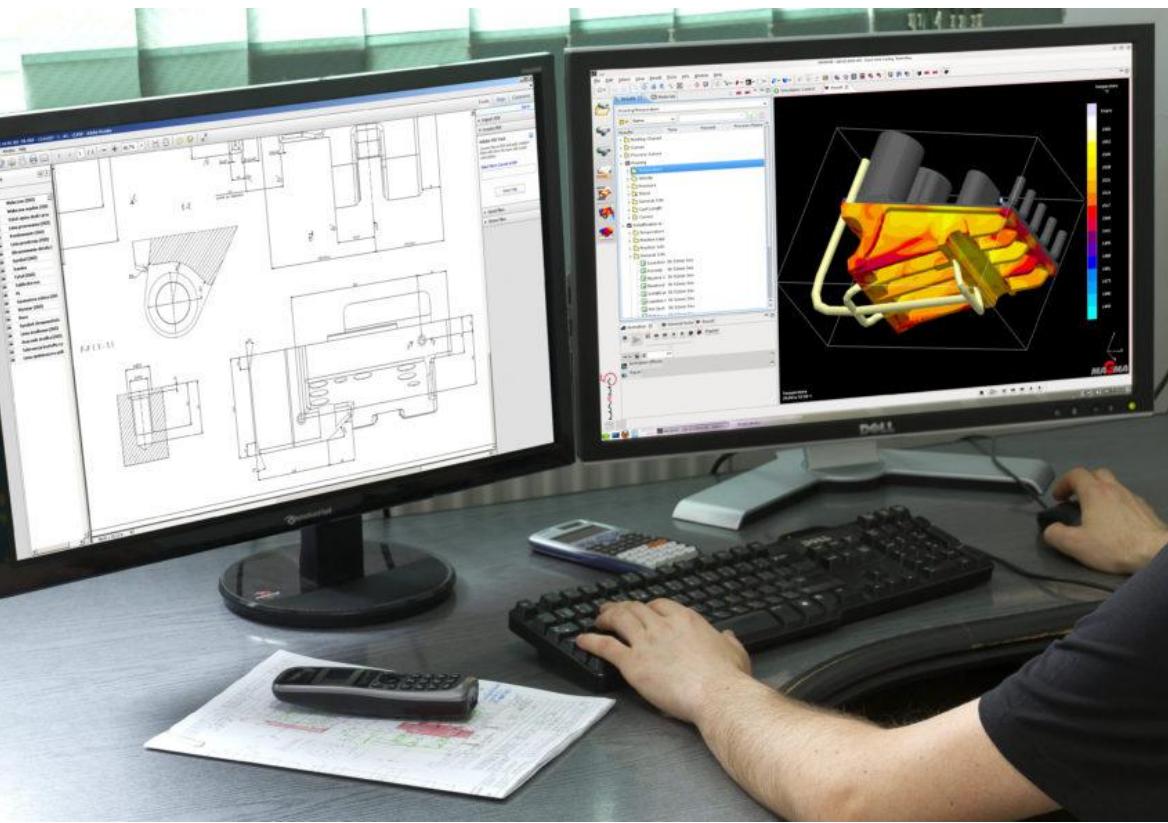
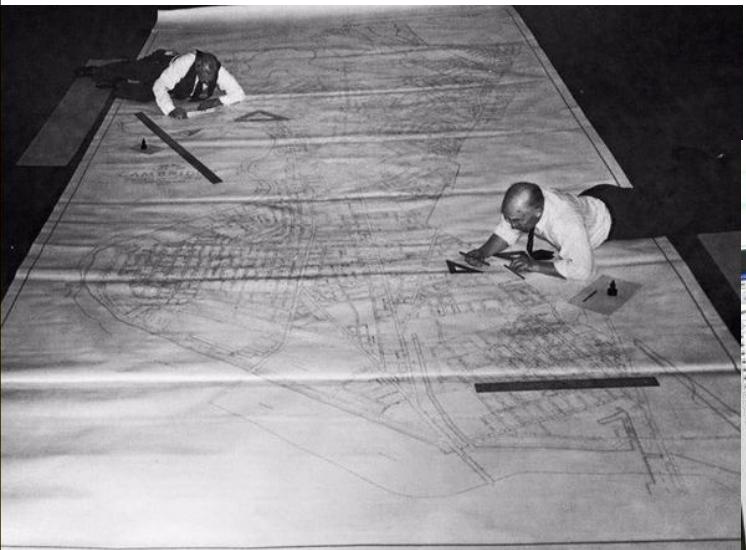


Fluid-
Structure
Interaction



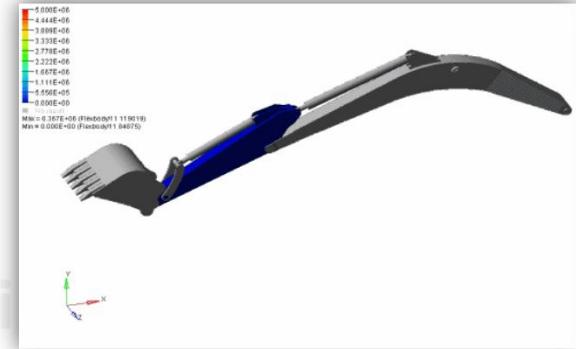
Non-
Newtonian
Flow
Simulation

Traditional Design **vs** Digital Design



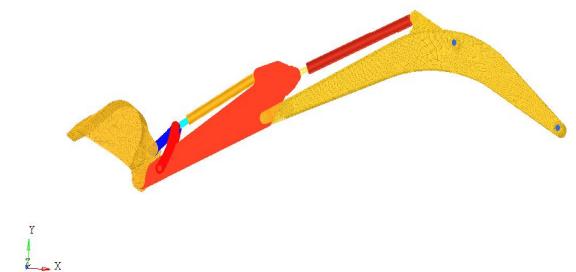
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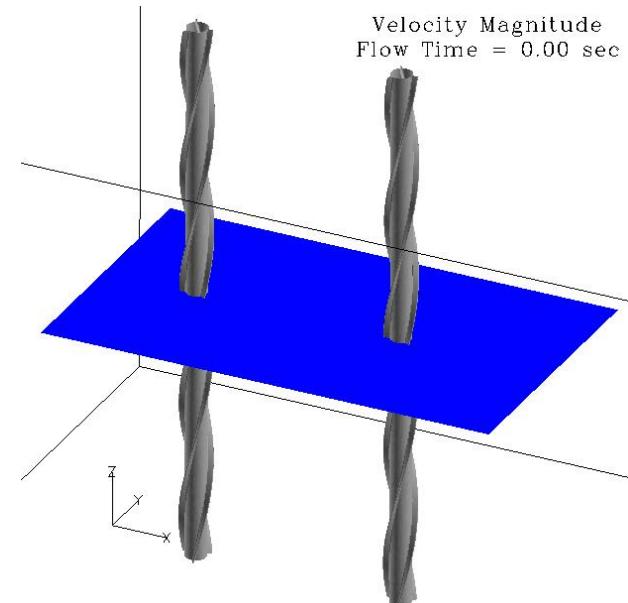
Key Benefits

- Supporting Technologies for I4
- Tutorials and Courseworks
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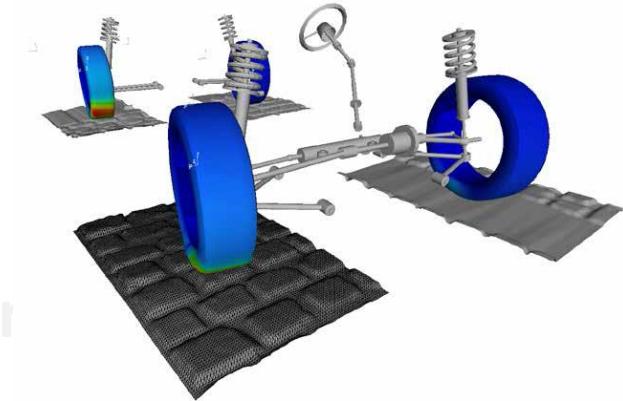
Key Benefits

- **Fast Production**
- **High Performing Prototypes and Productivity**
- **Real-time Inventory Monitoring**
- **Cost Reduction**
- **Close-to-reality Testing**
- **Market Success Predictability**



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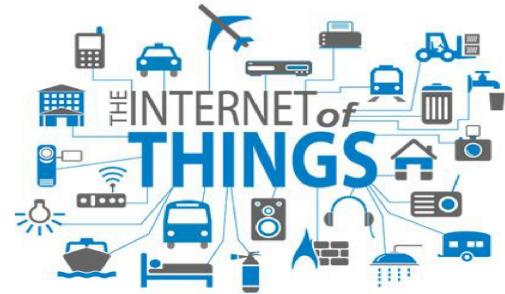
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- **Supporting Technologies for I4**



- Tutorials and Courseworks
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Supporting Technologies for I4

- Cyber-physical Systems (CPS)
- Internet of Things (IoT)
- **Big Data**
- Cloud
- Digital Twins^[3]

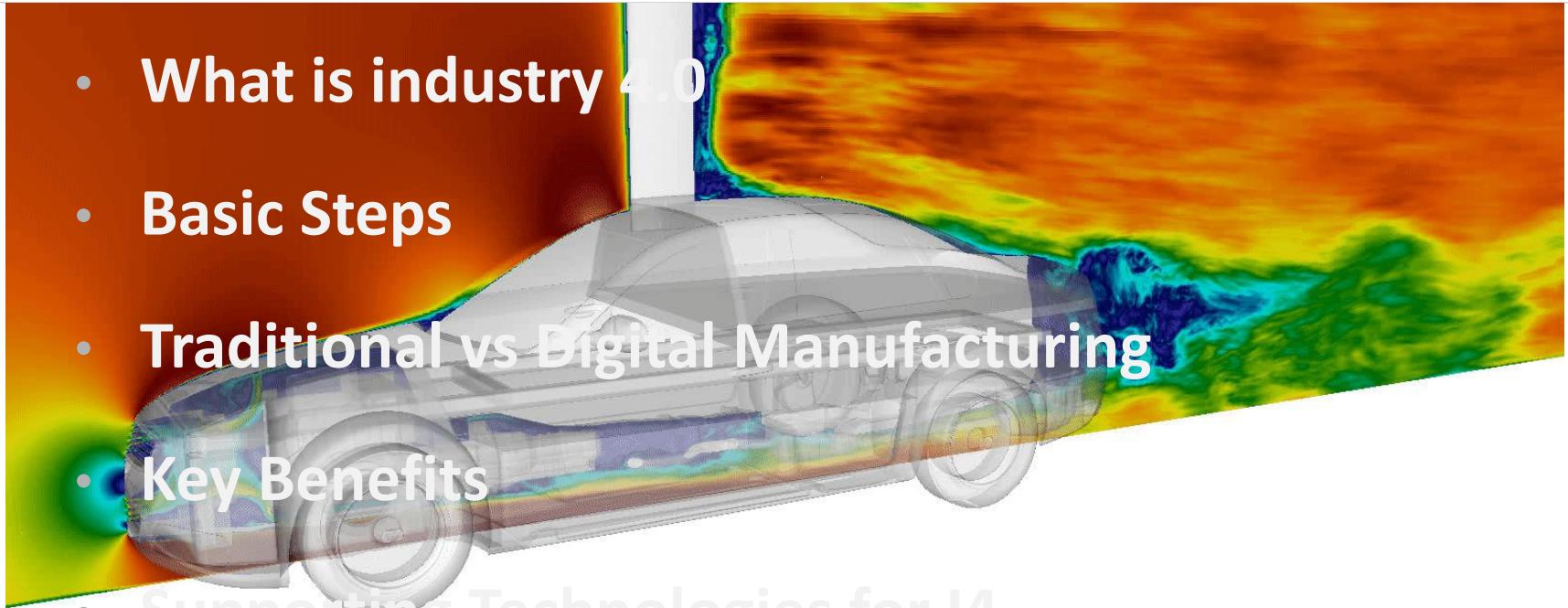


digital twin is a **real-time mapping** of all **components** in the product life cycle using **physical** data, **virtual** data and **interaction data** between them

- Artificial Intelligence (AI)
- High Performance Computing (HPC)

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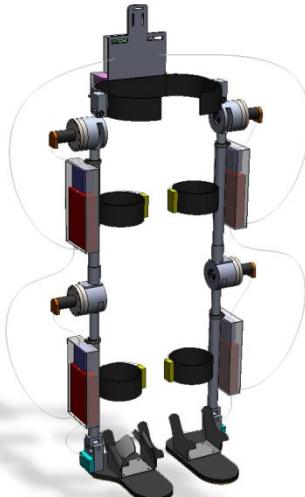
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Tutorials and Courseworks

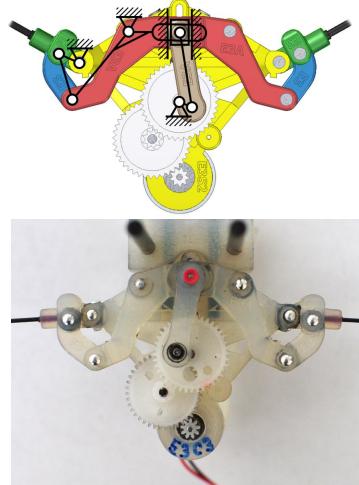
□ Tutorials

□ Courseworks: Prototyping Robotics via Digital Manufacturing (3 Case Studies)

- **Virtual Prototype** (CAD Tools, Solidworks, Ansys, etc.,)
- **Physical Prototyping** (3D Printing)



1 Exoskeleton



2 MAV



3 Social Service (CAD)



Courseworks

Industry 4.0 in Manufacturing Students Coursework Guide

Prototyping Robotics via Digital Manufacturing (3 Case Studies)

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1 Background

2 Tasks

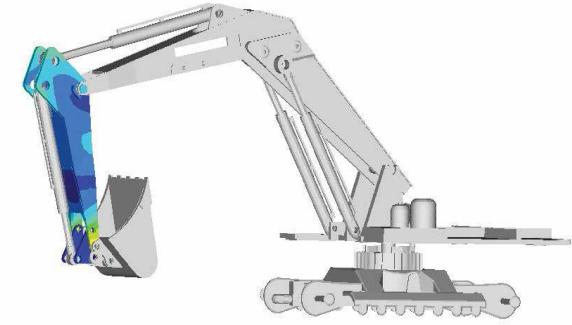
3 Assessment

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MANUFACTURING THE FUTURE

[1] https://en.wikipedia.org/wiki/Industry_4.0

[2]
<https://www.industryweek.com/technology/digital-manufacturing-factory-future-here-today>

[3] https://en.wikipedia.org/wiki/Digital_twin



"And now think of where we need to go; an economy based not on consumption and debt but on savings and investment; not on government spending but on entrepreneurial dynamism; not on one industry in one corner of the country, but on all our businesses in all our regions, with a new emphasis on manufacturing, exports and trade." — David Cameron, Prime Minister

£1.2 billion

EPSRC portfolio relevant to manufacturing research

£381 million

investment by EPSRC's Manufacturing the Future theme

344

research grants supported

1,104

collaborating organisations contributing a further £162 million

£3.4 billion

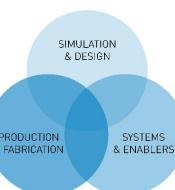
overseas funding for R&D in the UK in 2009

2000

doctoral students

£400 million

investment planned to 2015



"EPSRC builds an intellectual powerhouse for manufacturing wealth"
—The Manufacturer, May 2011

UK Manufacturing

Manufacturing is a key component of the Government's Plan for Growth,² as outlined in the Growth Review Framework for Manufacturing.³ Manufacturing comprises 13% of the UK economy. The UK is the world's seventh-largest manufacturer, with manufacturing providing just over 50% of the UK's exports.⁴

Drivers for Global Manufacturing

The UK is not alone in placing increased emphasis on the importance of advanced manufacturing. Our international peers, including the US, Germany, Japan and China, are revitalising and focusing their research base on areas that enhance economic competitiveness.

The drivers include:

- **Technological Change** – high-value manufacturing processes are increasingly moving towards flexible, intelligent production systems that use advanced materials, incorporate modern ICT, require skilled technical knowledge, and co-located human and automated systems.
- **More than production**. It is R&D, design, prototyping, production, distribution, service and support provision, and end-of-life repair, recycle or reuse. Value can be extracted from each stage of the process.¹
- **Differentiated**. High or low volumes, long or short life-cycle, mass-market or customized production.
- **Highly-skilled**. It involves the inter-play of novel technologies, in-line analysis, dual working of people and automated systems, and precision engineered products and systems.
- **Material and Energy Security** – availability or scarcity of key material or energy resources is a competitive issue, driving investigation into alternative production routes for new and established products and processes.

INNOVATIVE MANUFACTURING RESEARCH CENTRES

Evolving from the EPSRC Innovative Manufacturing Initiative of the 1990s, the Innovative Manufacturing Research Centre (IMRC) portfolio comprised eighteen separate centres, largely based at single universities, each addressing a series of manufacturing challenges. A total EPSRC investment of £192 million was supplemented by £207 million of industrial support from over 700 collaborators. The IMRC programme has created over 1,300 doctoral level manufacturing engineers to support UK industry. An investigation of the economic impact of 10% of the IMRC programme (32 separate case studies) showed that this IMRC work had generated;

- £70 million of additional sales for industrial partners
- Cost-savings of at least £17 million to the public sector, and £10 million to the private sector
- 20 new technologies and products brought to market

Available:

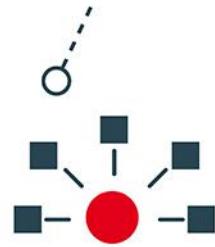
[1] <https://github.com/LeoYiChen/Industry4.0-An-Introduction>



INDUSTRY 4.0



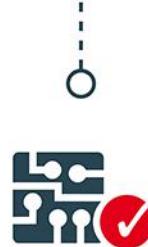
AUTOMATION



CONNECTION



CLOUD COMPUTING



IOT



BIG DATA



SYSTEM INTEGRATION

in Manufacturing

- an introduction

END



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