



# International Conference On Emerging Fourth Industrial Revolution (4IR) Technologies For Sustainable Development

22 July 2021, China

## “AI+HPC+5G” based Digital Twins Platform and Open Source Eco-system for Smart Manufacturing and Integrated Precision Farming

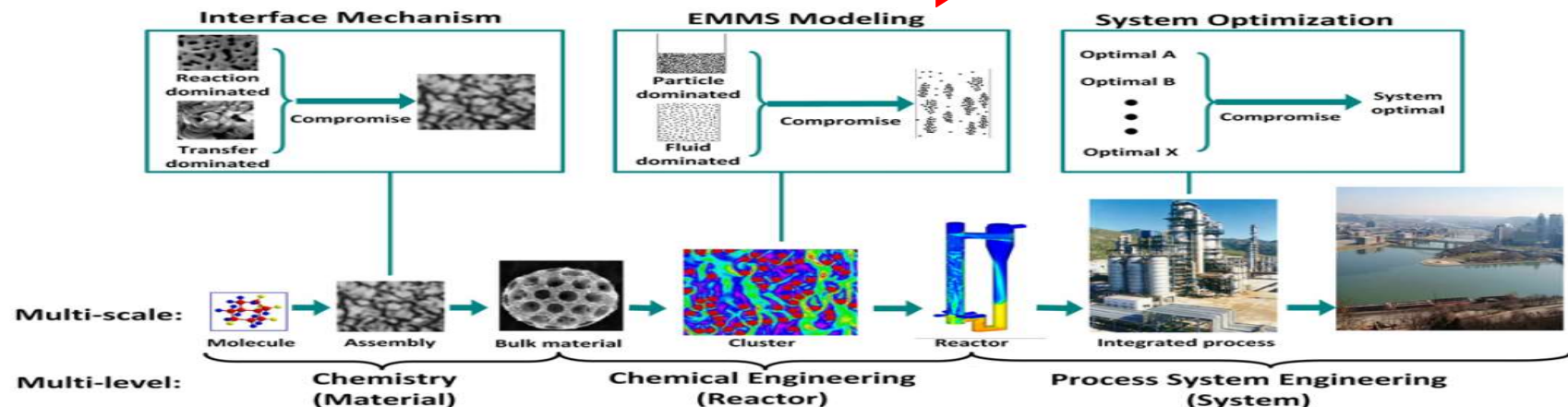
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**Molecules**  **Complex Systems**





# The 4th Industrial Revolution Driven by Innovation



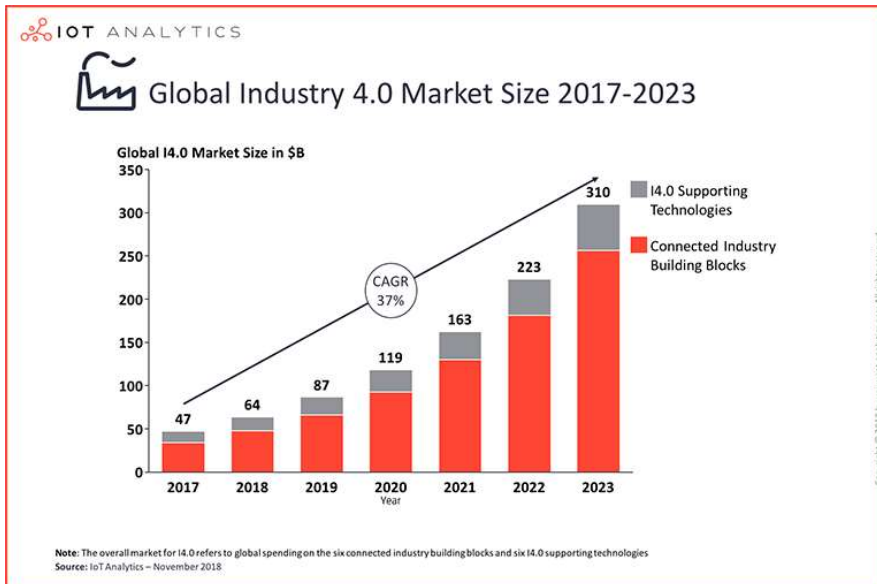
The 1st Industrial Revolution:  
Steam engines



The 2nd Industrial Revolution:  
Large scale manufacturing



The 3rd Industrial Revolution:  
Industrial automation

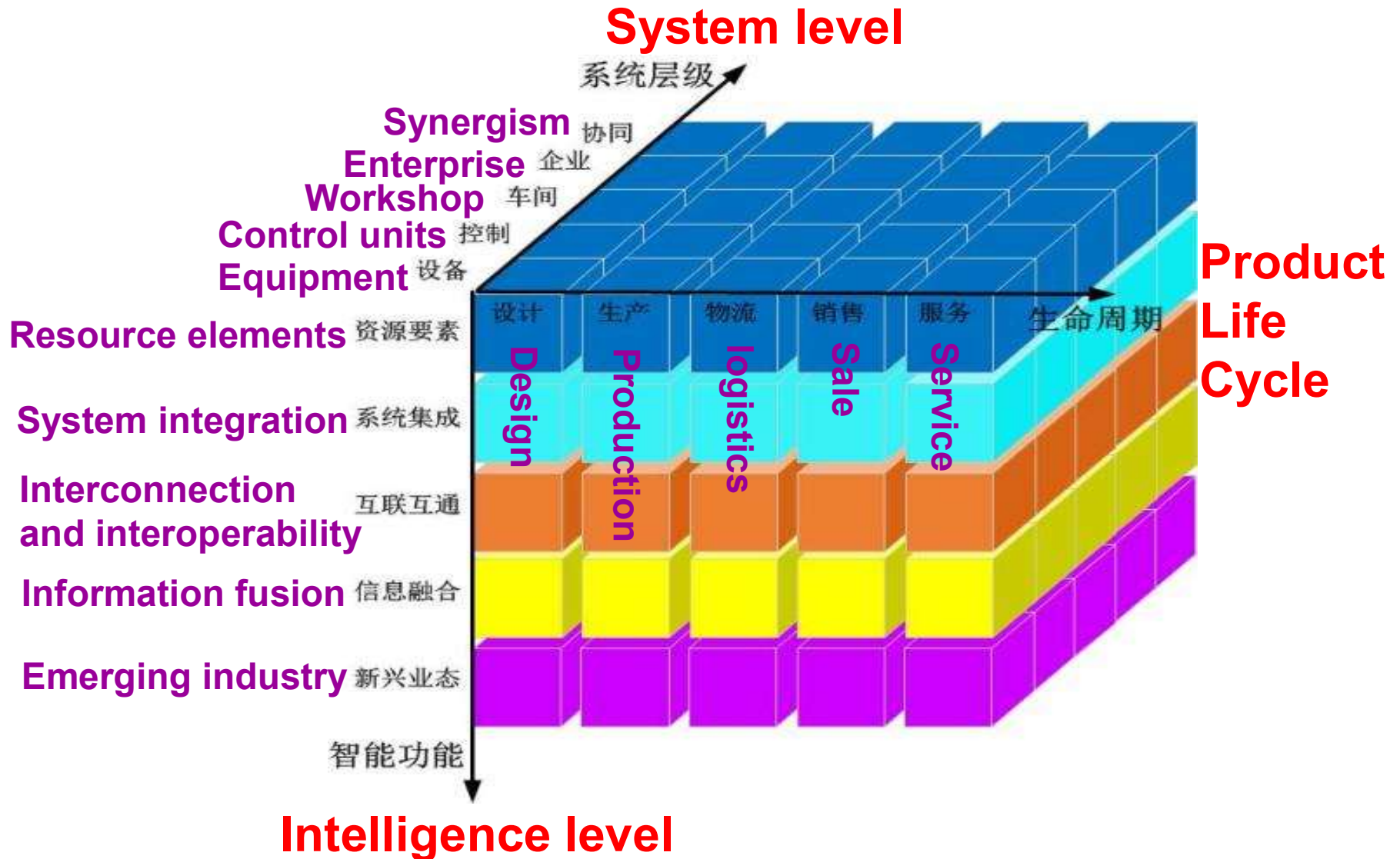


## The 4th Industrial Revolution

- Industry 4.0
- China Manufacturing 2025
- Industrial IoT +
- AI +
- 5G +
- HPC + ...



# A System Architecture of “Made in China 2025”

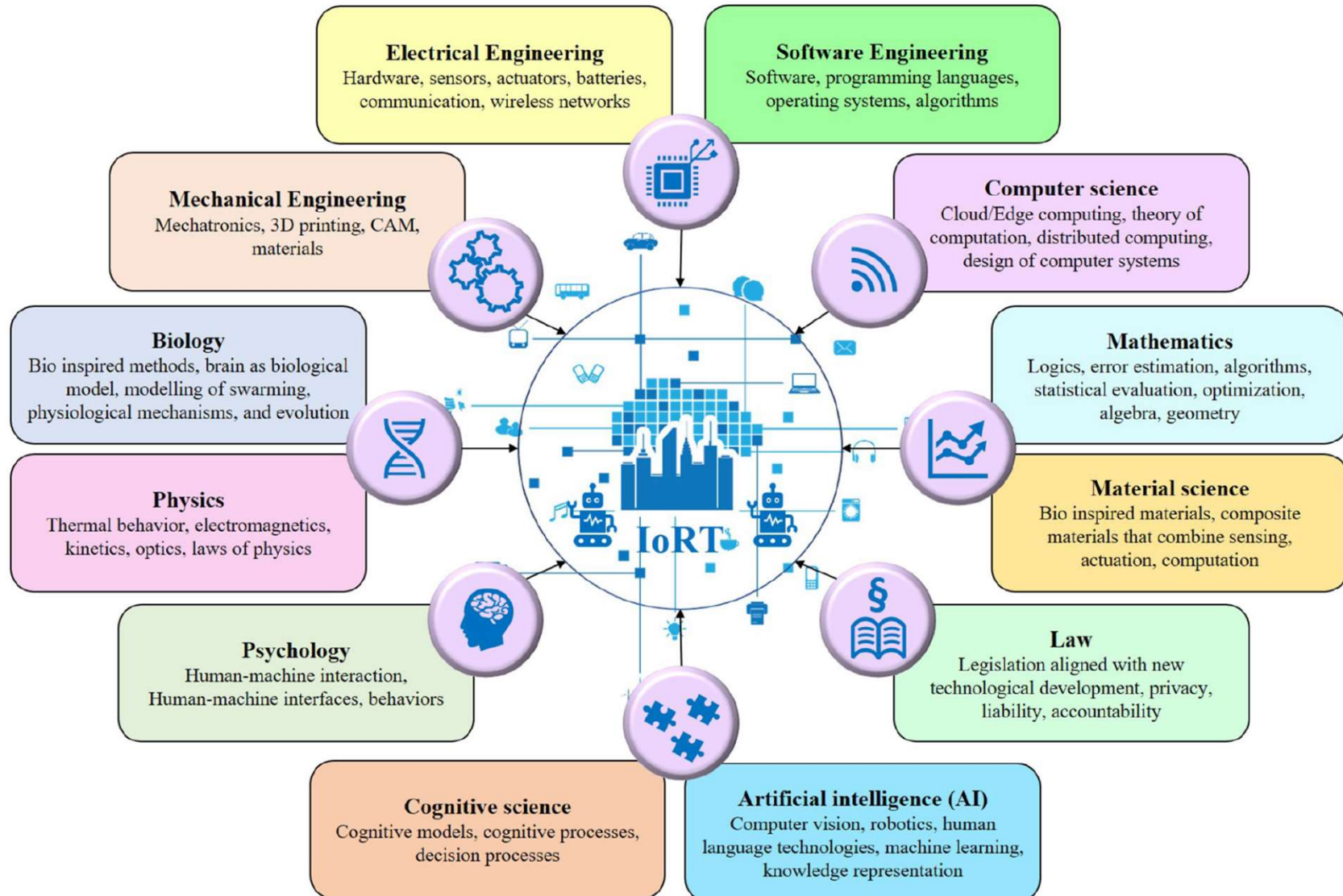






# From IoT to IIoT and IoRT (Internet of Robotic Things)

O. Vermesan *et.al.* Frontiers in Robotics and AI, 7, 104(2020)





# An Integrated Cyber Physical System



**Physical Platform**  
Analytical and Measurement  
to reveal systems dynamics  
at various time and length  
scales, Distributed  
Manufacturing Systems



**FULLY  
INTEGRATED  
Cloud HPC +AI  
PLATFORM**



**Simulation Platform**  
Modularized simulation tools  
for multiple scale modelling of  
complex systems with  
molecular, mesoscopic and  
continuum dynamics



**Big Data + AI Platform**  
Data and text mining,  
Machine Learning, seamless  
data flow of various types  
between physical and  
simulation platform and big  
data analytics tools



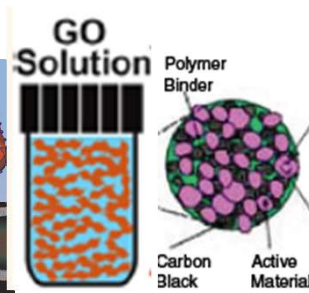
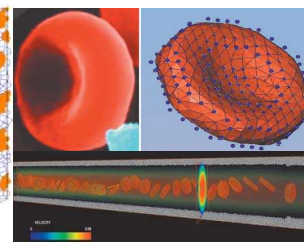
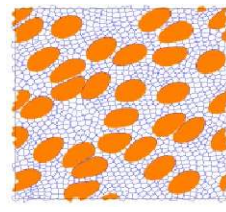
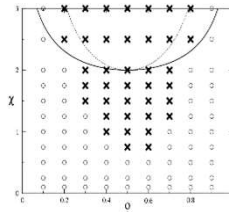
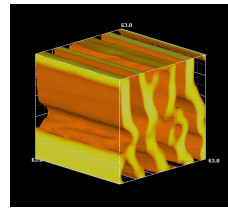
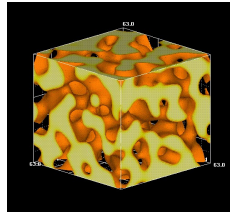
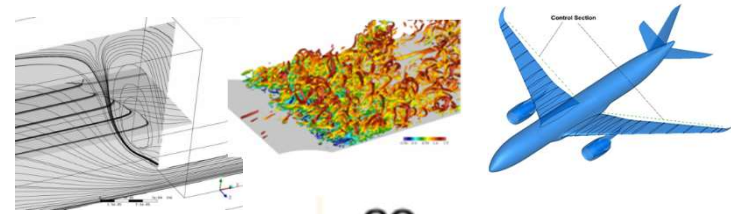
# An Integrated Multiple Scale Simulation Platform

Length

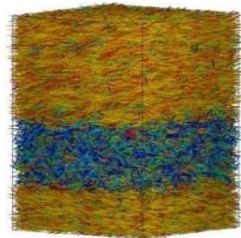
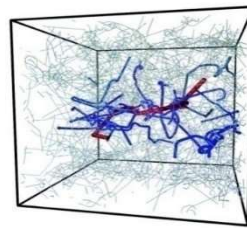
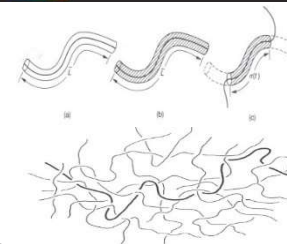
$10^{-3}$  m

$10^{-9}$  m

Immersed Boundary Method  
 Two-fluid Model  
 Microscopic kinetic models + LBM.  
 Lagrangian-Eulerian-Stochastic Method



Two-fluid Model (SCFT+Reptation)  
 Stochastic Entanglement Dynamics  
 Lattice Boltzmann Methods (LBM)  
 Smooth Particle Hydrodynamics (SPH)



Theoretical approach: SCFT  
 Kinetics of signalling and metabolic pathways  
 Coarse-grained Monte Carlo (MC) and Molecular Dynamics (MD) and Non-equilibrium MD  
 Car-Parrinello MD, Quantum MC

$10^{-9}$  sec

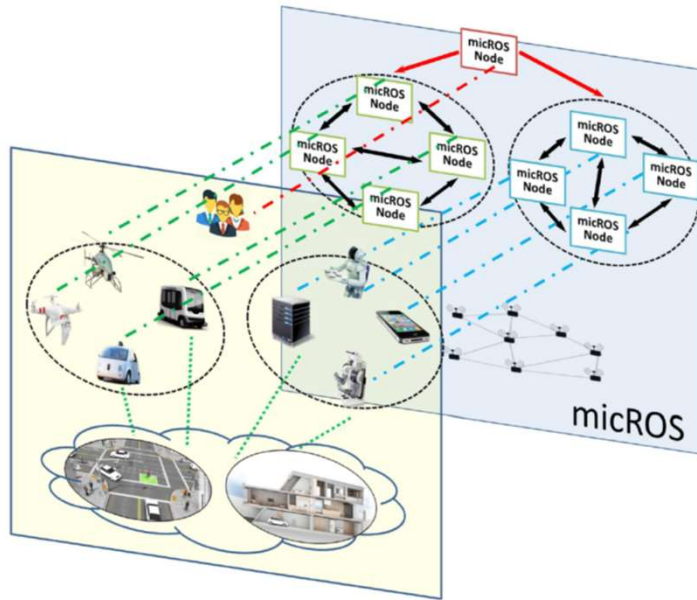
Time

$10^3$  sec





# “AI+HPC+5G” based Digital Twins Technologies for Intelligent Manufacturing



Heavy-load Robot



7-axis Collaborative Robot



High-altitude Electrical Maintenance Robot



Robotic Welding Workstation



Patrol Robot



Mobile Collaborative Robot



Footwear Adhesive Application Robot

## Applications

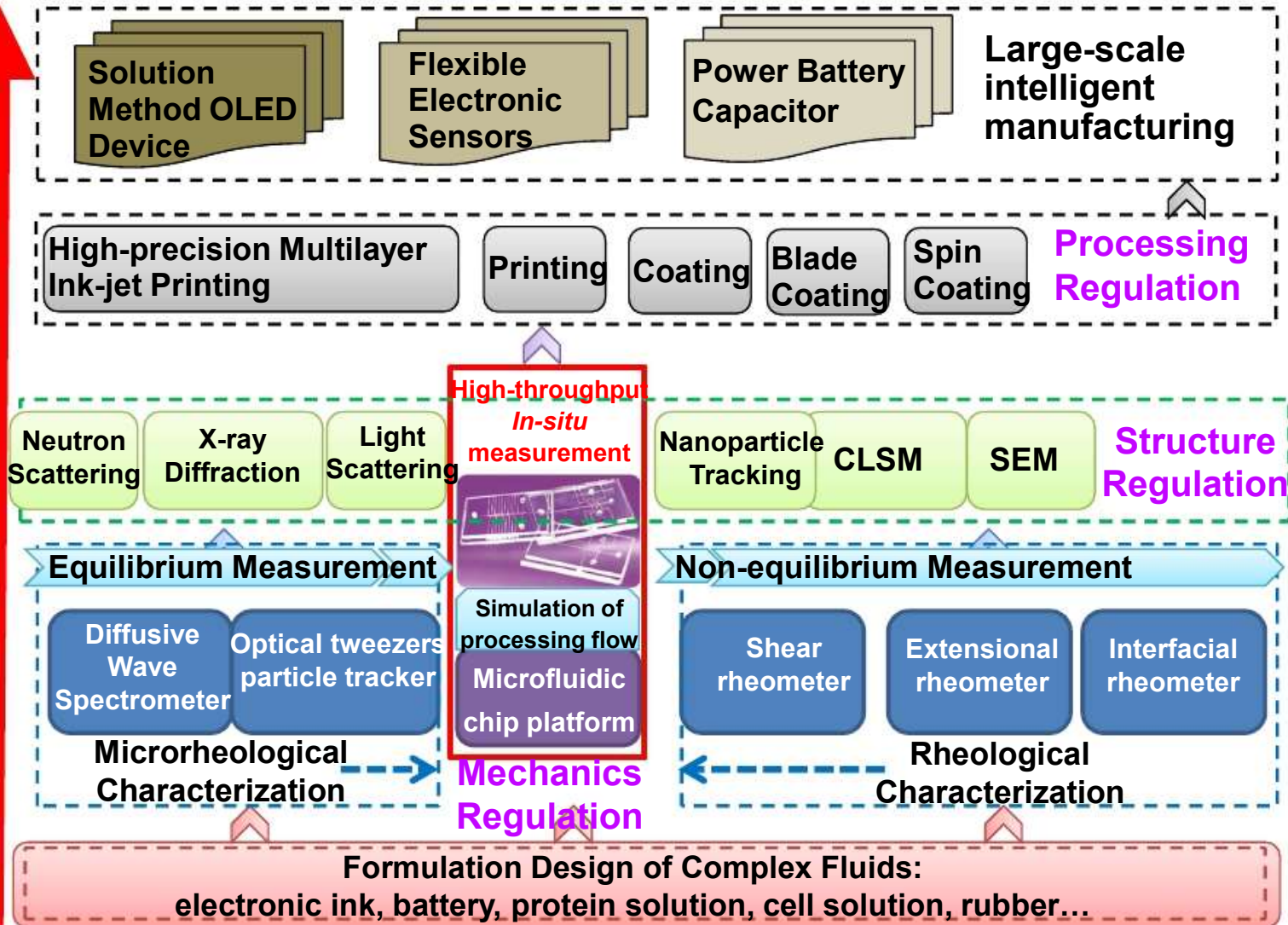
- Intelligent Industrial Robots
- Intelligent Unmanned Aerial Vehicles (UAV)
- Intelligent Unmanned Ground Vehicles (UGV)





# Intelligent Manufacturing of Electronic Devices by Systems Rheology

Dynamic regulation in the multi-process from materials to electronic device







# “AI+HPC+5G” based Digital Twins Technologies for Integrated Precision Farming





# APRIKNET-4IR as an Integrated Platform for Innovation Collaboration in Asia-Pacific Region



## Asia-Pacific Regional Innovation Knowledge Network - 4IR

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**Thanks  
for your attention!**