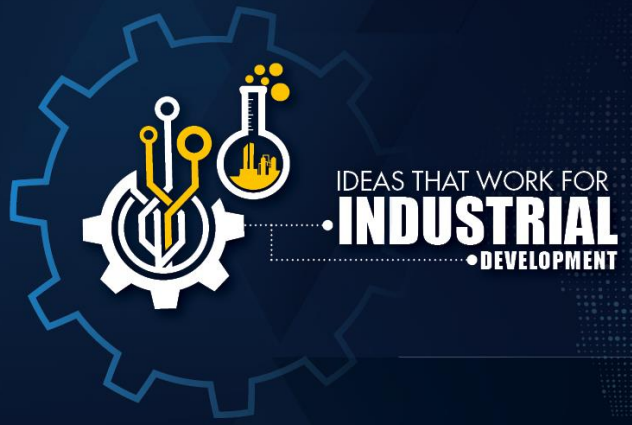
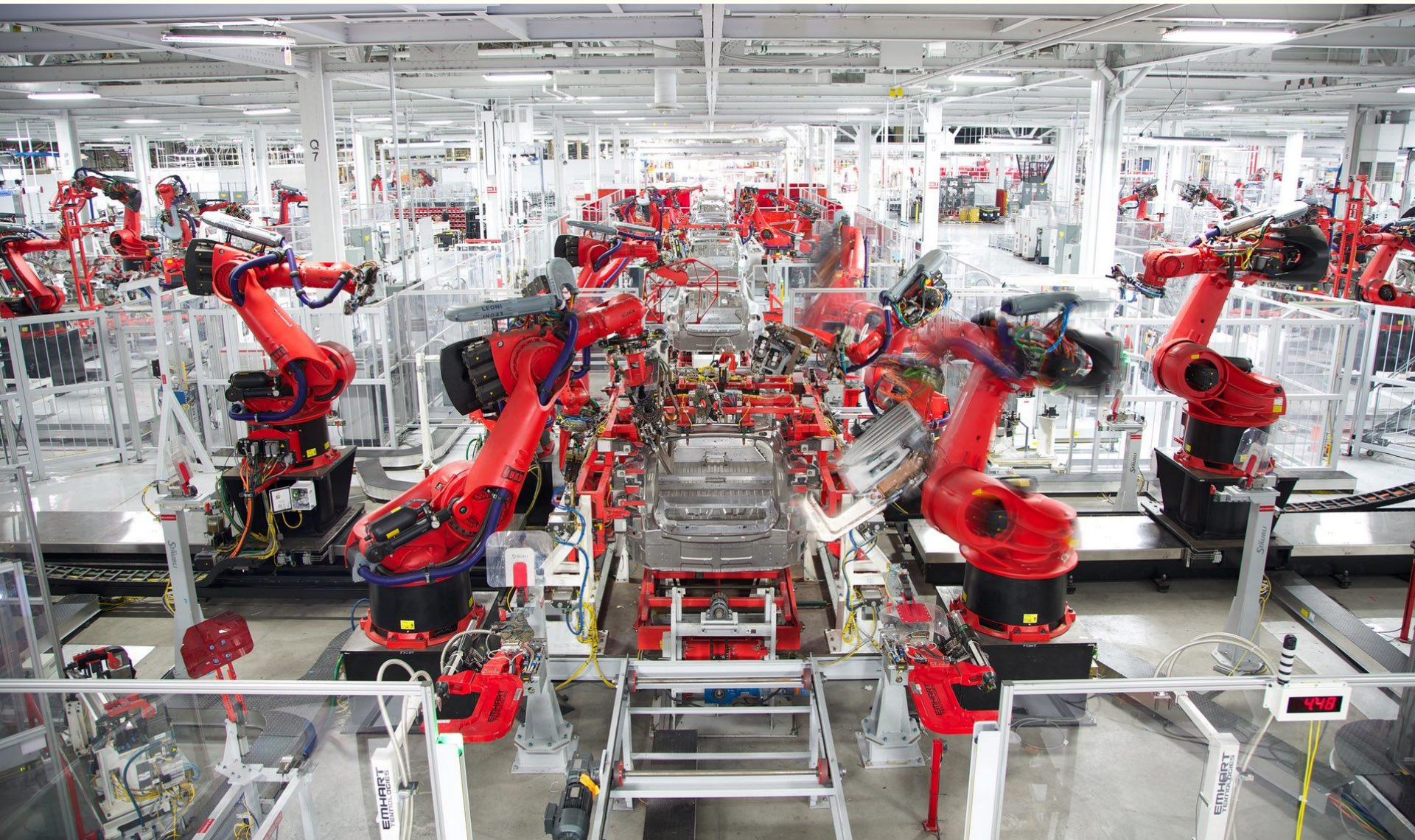


CSIR R&D in emerging manufacturing technologies

Dr Neil Trollip

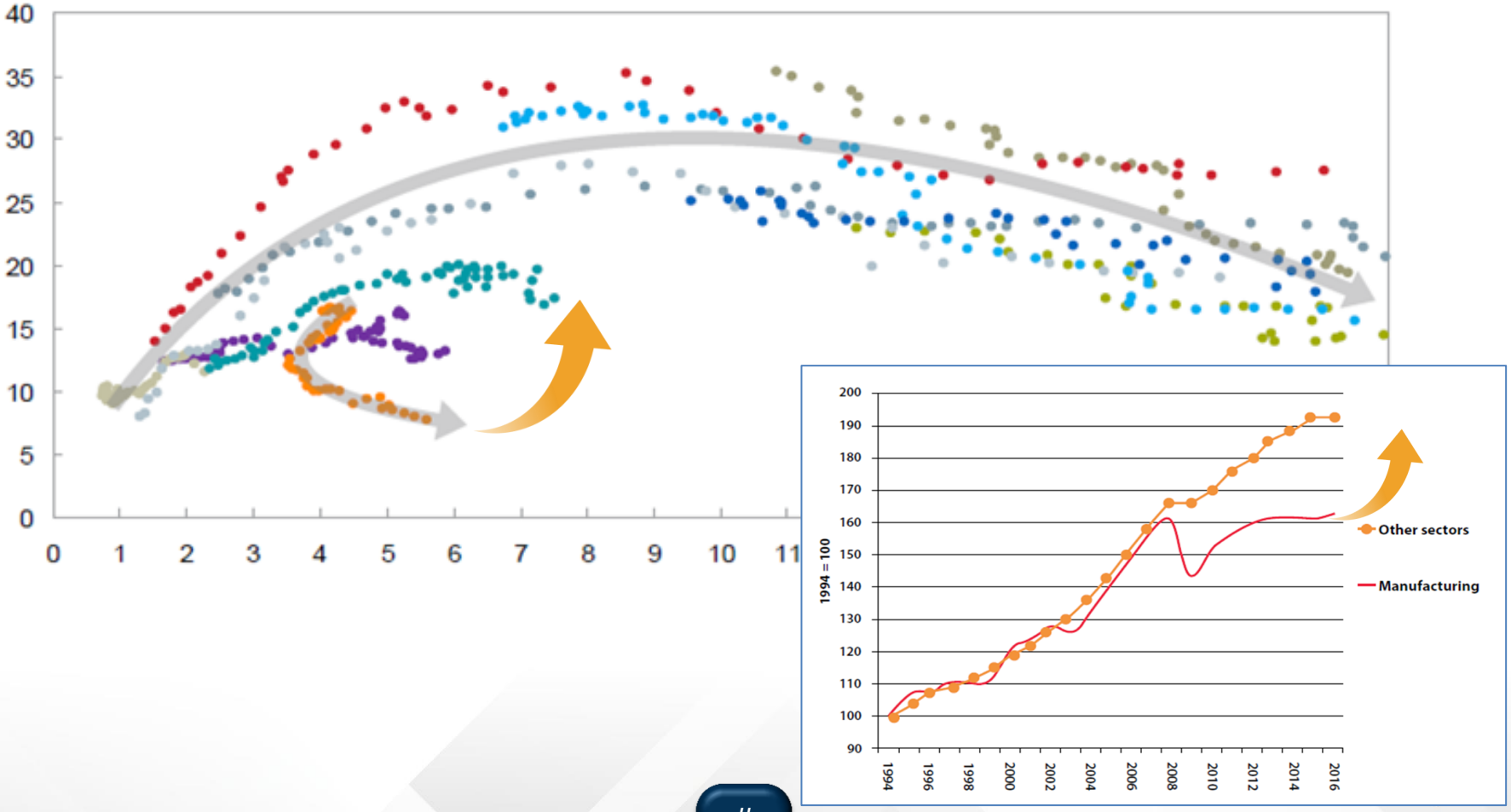
CSIR
our future through science

Tesla Production Line

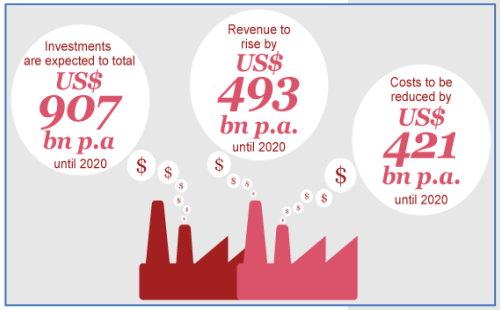


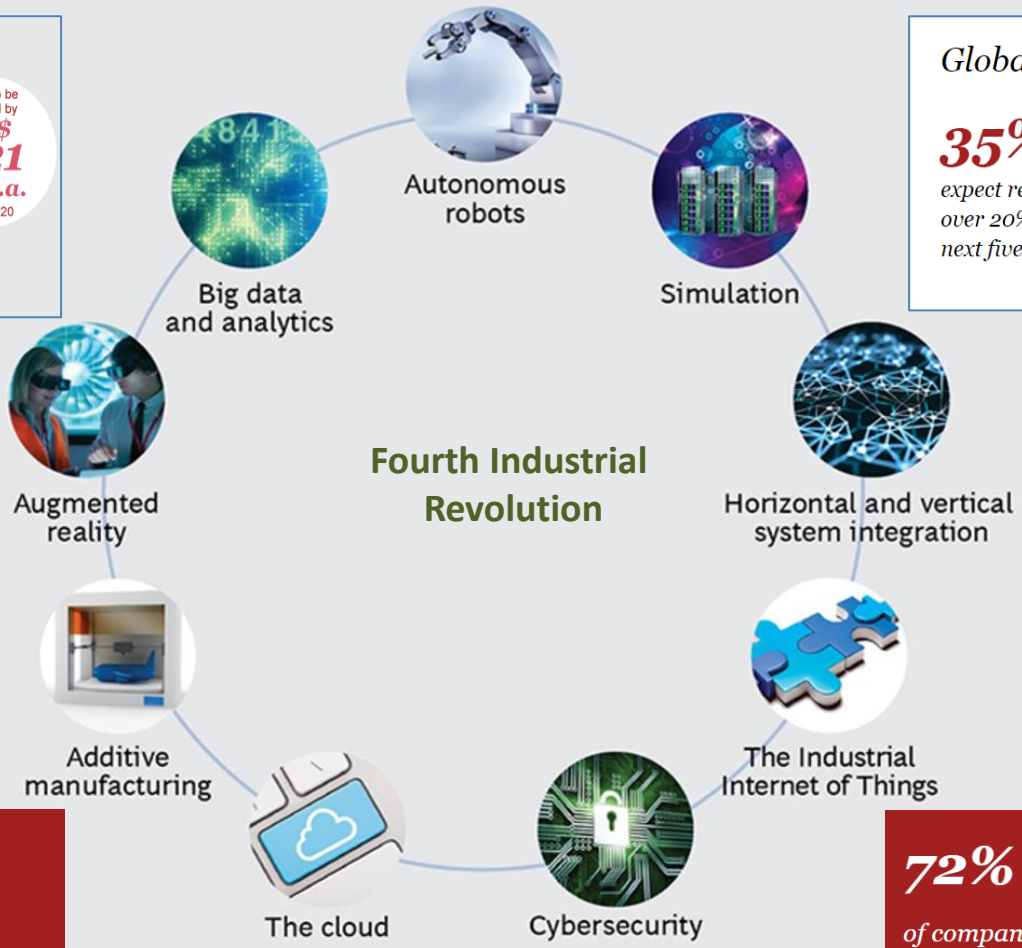
State of SA Manufacturing sector

CSIR Vision: Catalyse re-industrialisation



Technologies driving FIR / NIR





Global

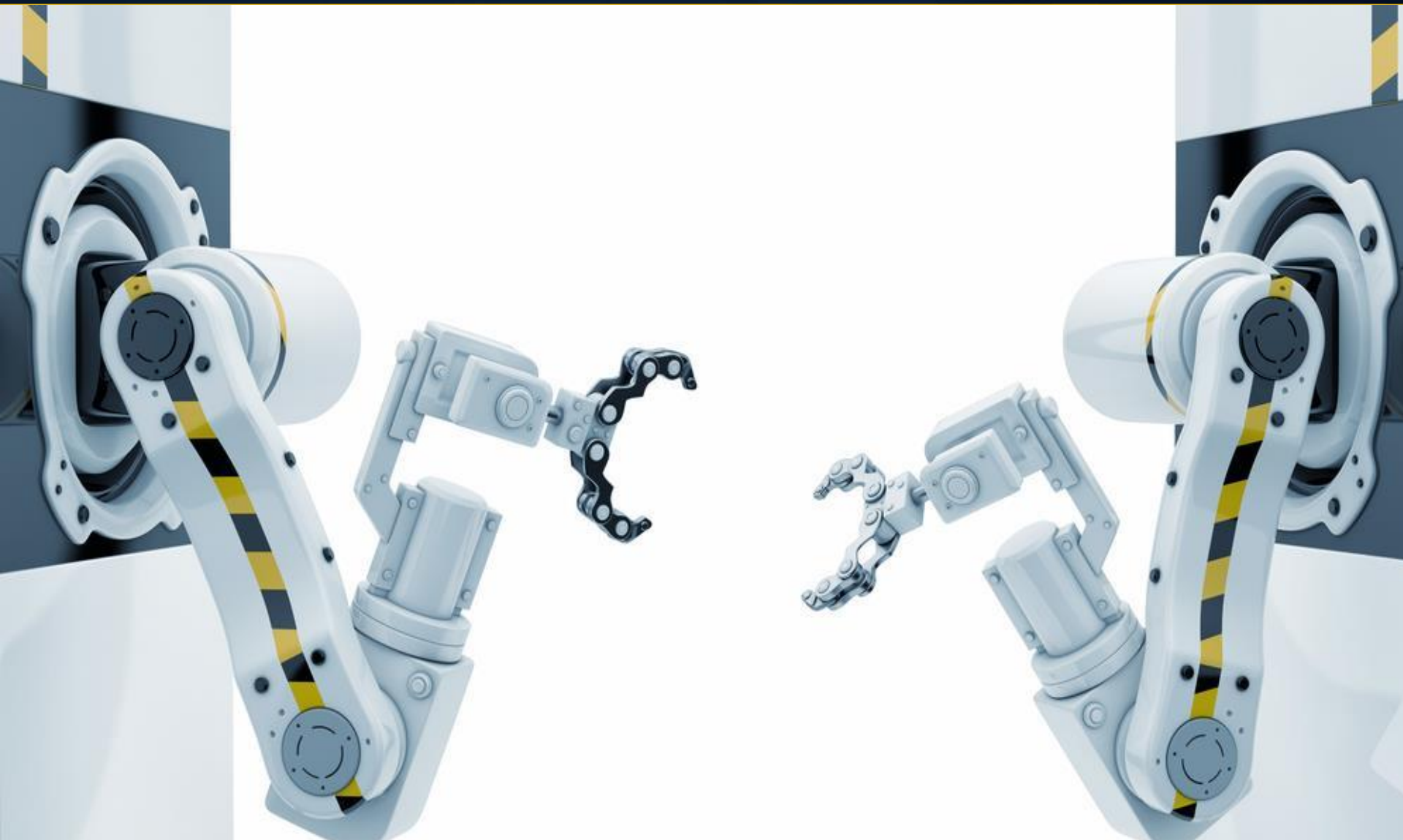
35% *expect revenue gains over 20% over the next five years*

43% *expect to lower costs more than 20% over the next five years*

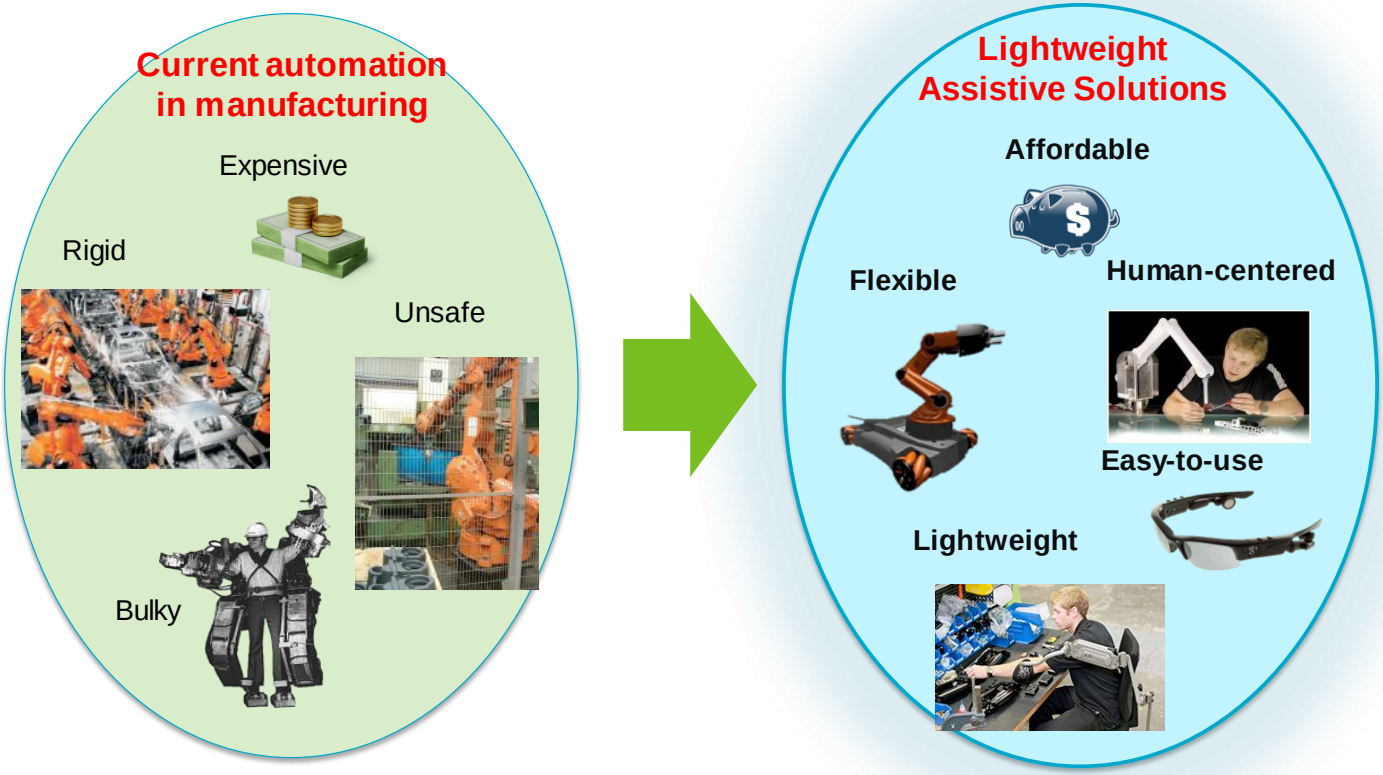
33% *of companies say they've achieved advanced levels of digitisation today*

72% *of companies expect to achieve advanced levels of digitisation by 2020*

CSIR in Advanced Robotics



Advanced Robotics



The cobot market could grow from just over $ 100m in 2016 to $ 3bn by 2020 (Barclays Capital)

Advanced Robotics (cont)

Reconfigurable Manufacturing Machines

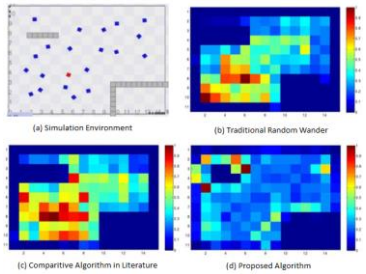
- Increased production agility for product families
- Mass customisation
- Lower CAPEX costs
- Interconnected and integrated systems

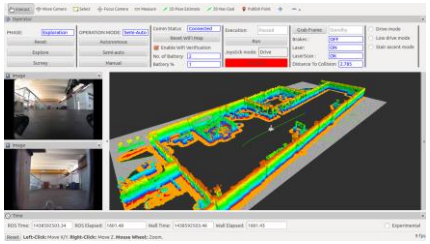
Assistive Robots

- Share a work area and interact directly with humans
- Perceive their environment with the aid of sensors and intelligent algorithms
- Communicate with people multi-modally
- Navigate autonomously and make decisions independently

Factories of the future will be adaptable, reconfigurable and allow humans and robots to work alongside each other

CSIR: Early stage research



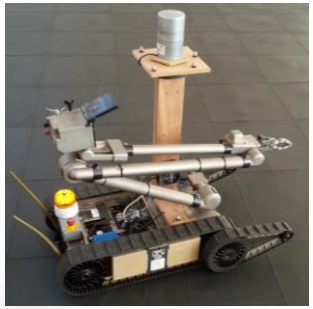


Mobile manipulation

- Adaptive, reconfigurable grasping
- Programming through demonstration or behaviour learning

Multi-robot systems

- Navigation and task execution using multiple robots
- Optimal resource allocation strategies



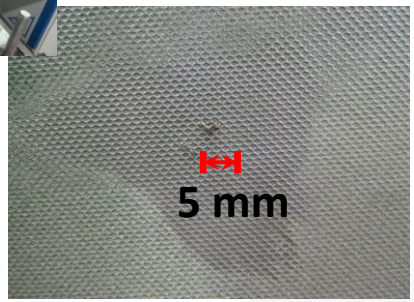
CSIR: Robotics in Maintenance

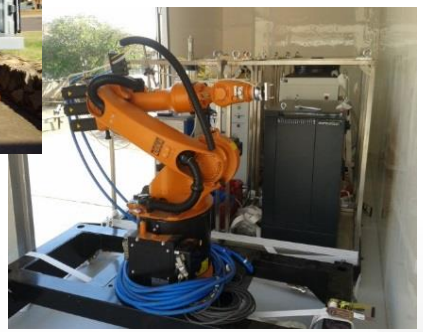
The Need

- 15 ton injection mould requiring surface repair
- Downtime cost of R120k per minute and 2 day travel time

The Solution

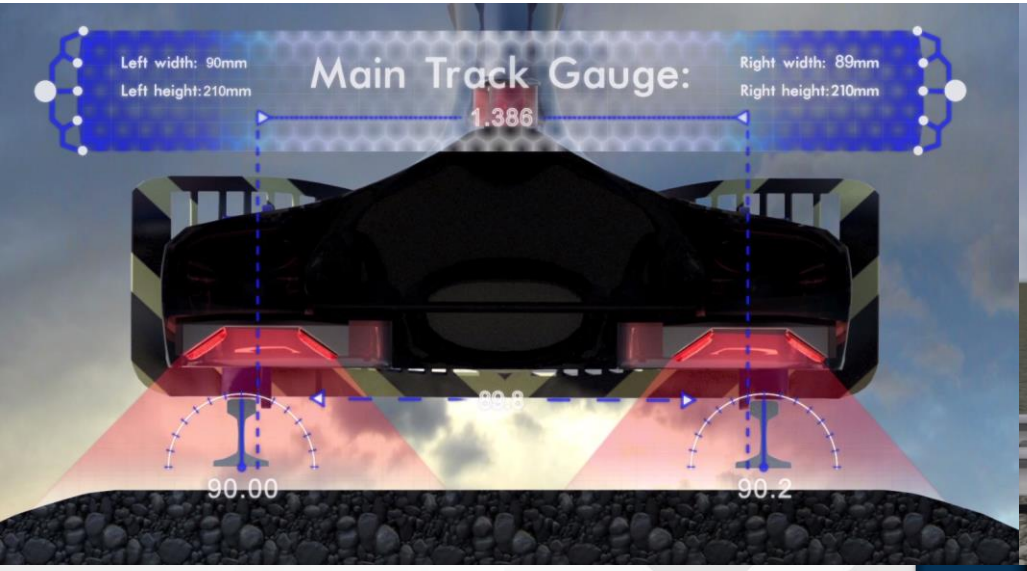
- Mobile industrial laser engineering solution
- Mould and die repair at the factory
- Increase agility and reduce costs associated with unplanned downtime

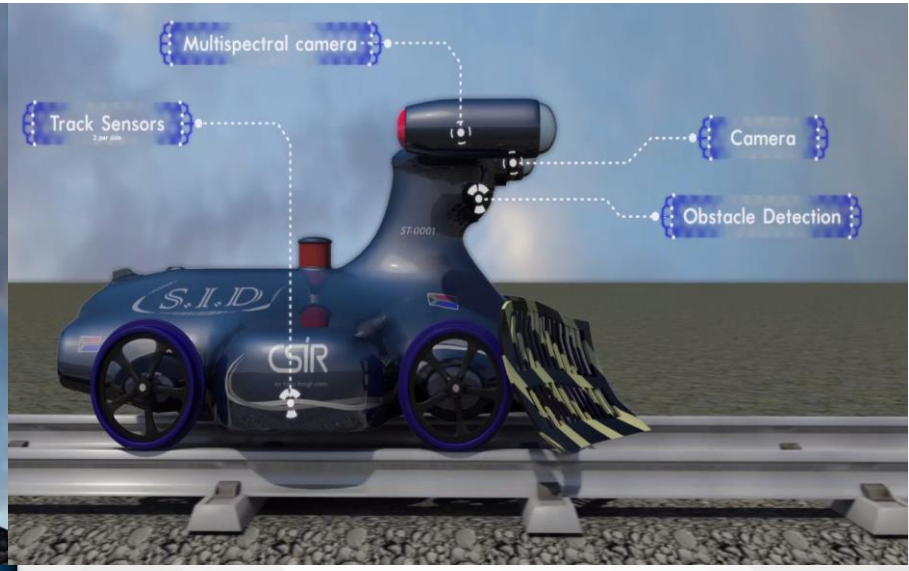




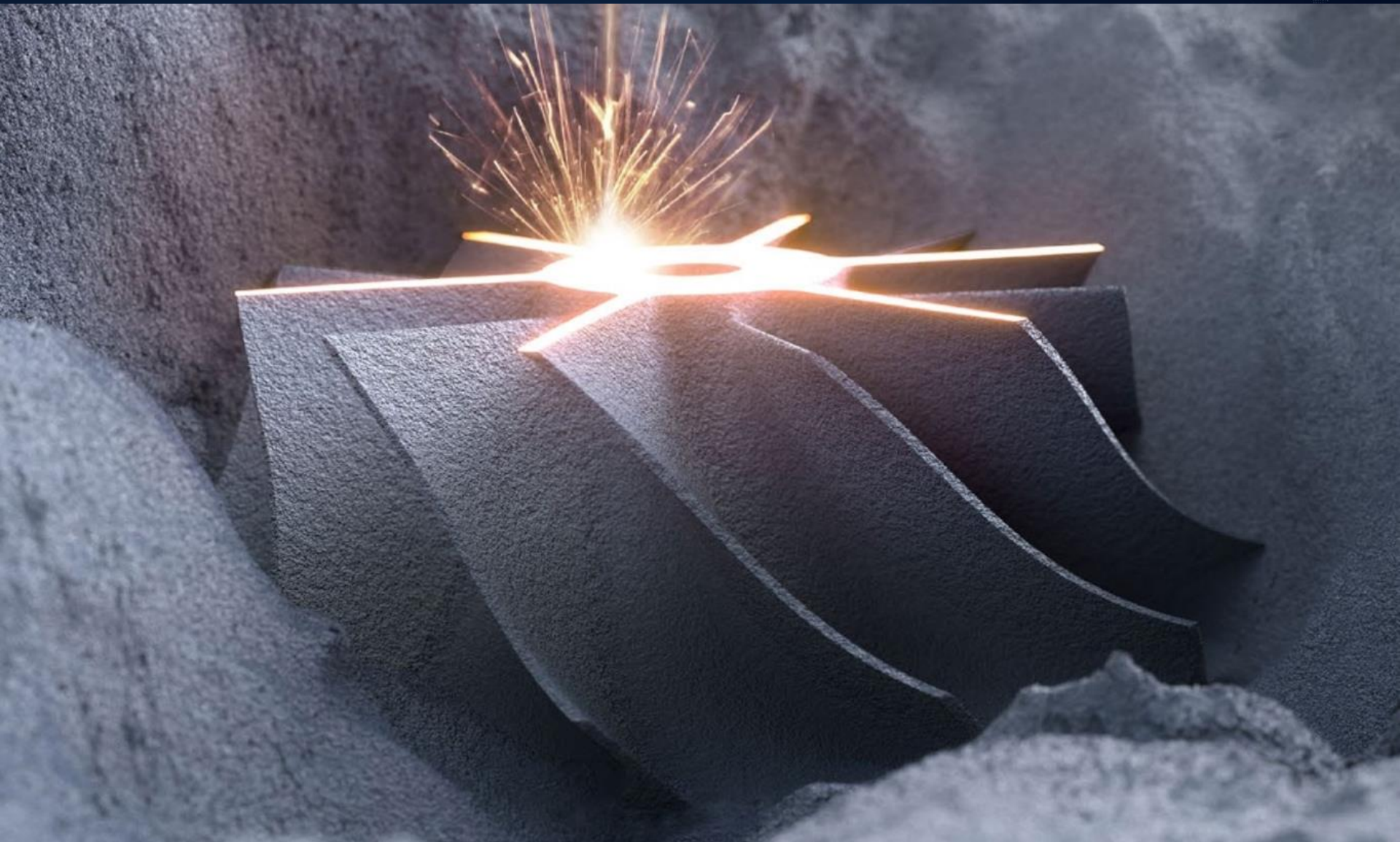
CSIR: Robotics as Inspection Systems

- Autonomous rail vehicle
  - Early warning system
  - Inspection system
- Different drive trains
  - latest - batteries & fuel cell technology
- Field testing in progress





CSIR in Additive Manufacturing



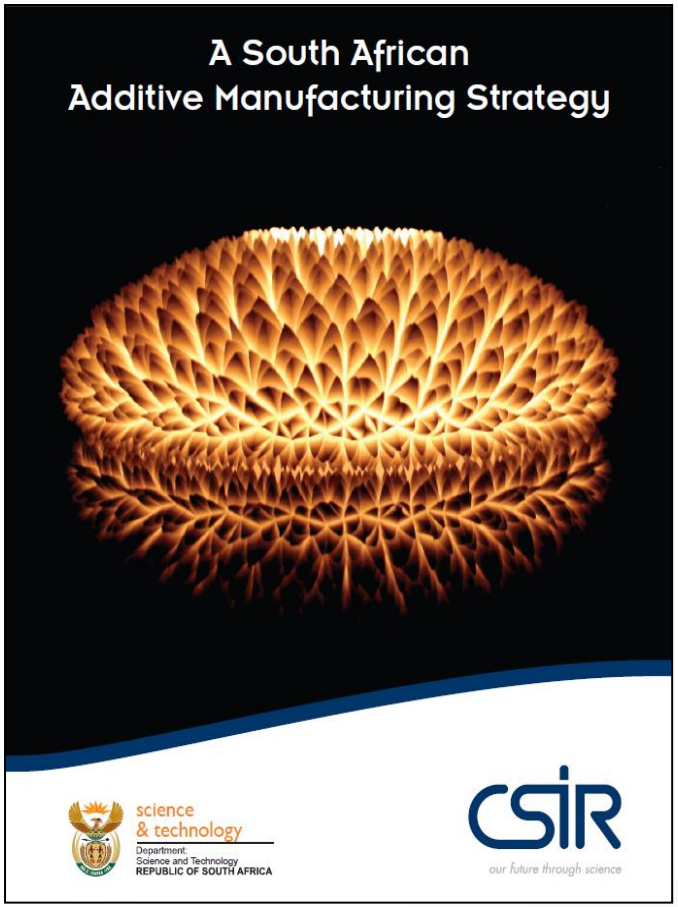
SA Additive Manufacturing Strategy

Priority focus areas

- Qualified AM parts for medical and aerospace
- AM in traditional manufacturing sectors
- New AM materials and technologies
- SMME development and support

Capacity development

Education and awareness



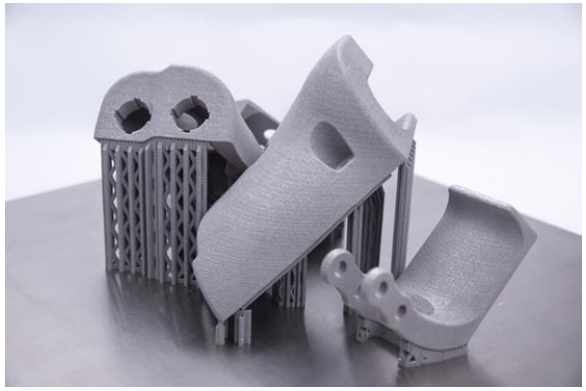
CSIR Additive Manufacturing Focus

Process development: Powder blown AM

- TiAl (aerospace applications)
- Ti6Al4V (CSIR produced powder)
- 17-4 PH (aerospace grade stainless steel)

Process development: High Speed Selective Laser Melting (HSAM)

- High speed AM process optimisation in dedicated process cell
- Alloy modification and optimisation studies for AM applications



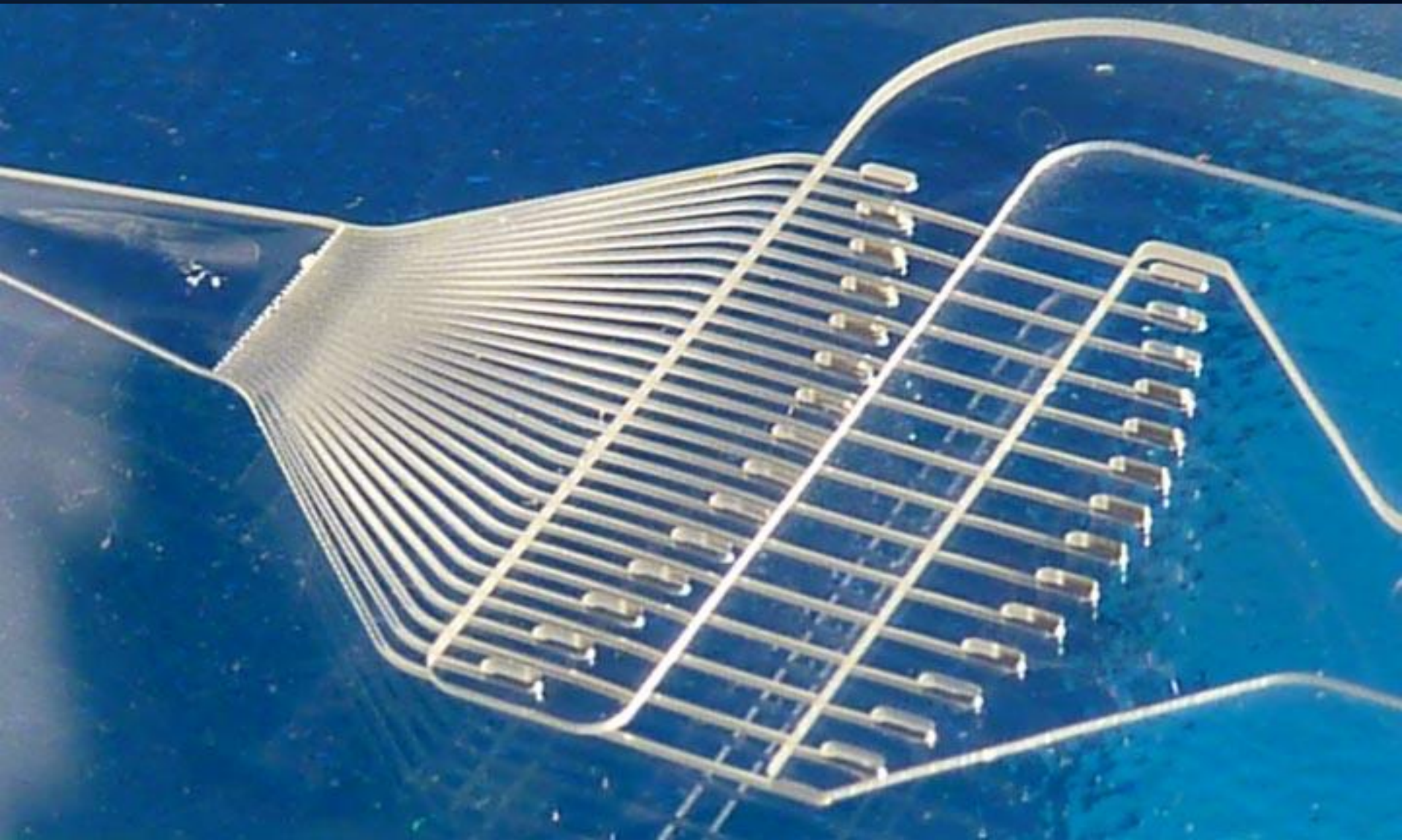
Application development

- AM applications in power generation industry (Eskom)

Aeroswift

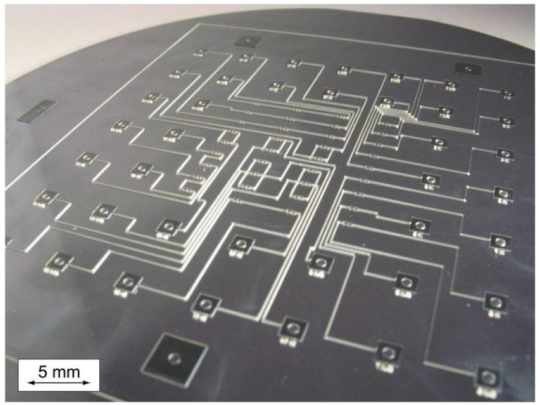
- Collaboration between Aerosud IC and CSIR to design and construct a large area, powder bed AM system, for metallic components
- High speed, versatile system for production of large metal parts (5 -10 x faster than best in class commercial systems)
- Build volume: 2m x 0.6m x 0.6m (scalable)
- Pre-heating and environmental control
- Materials: Ti-6Al-4V, stainless steel alloys, Inconel, other metals

CSIR in Micromanufacturing

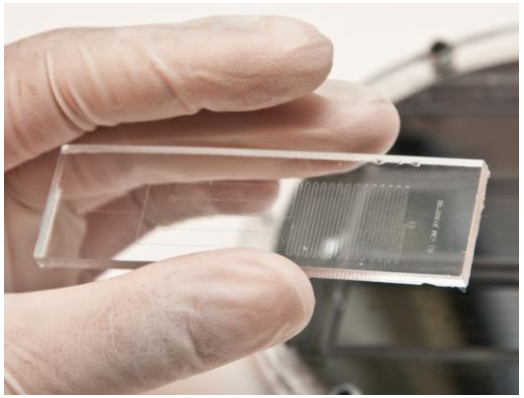


CSIR Cleanroom Facilities

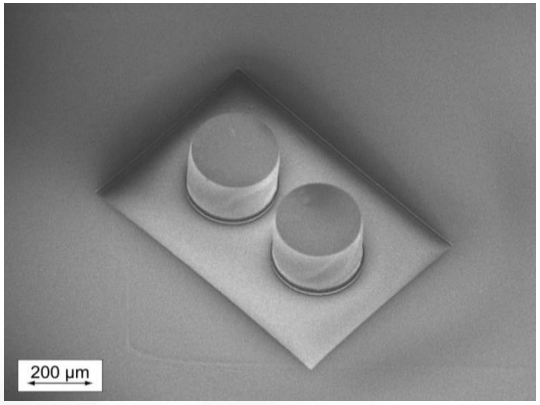
Cleanroom for soft lithography

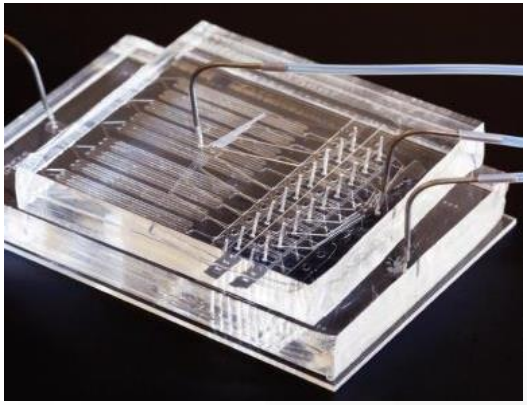


Microstructuring onto Si wafers



Microfluidic circuits in PDMS

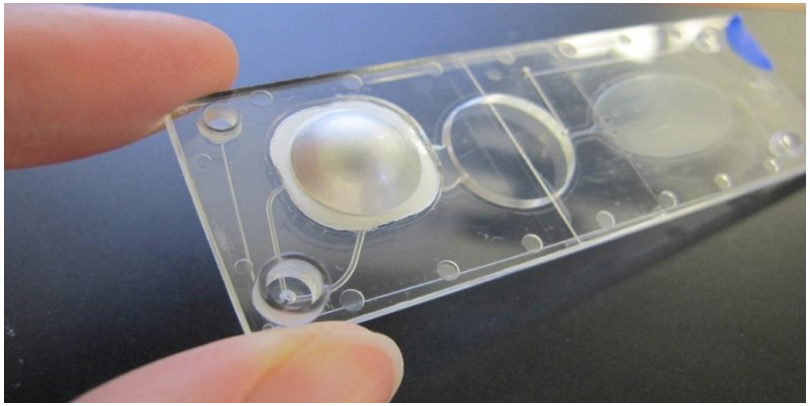




Cartridge-based Microfuidics

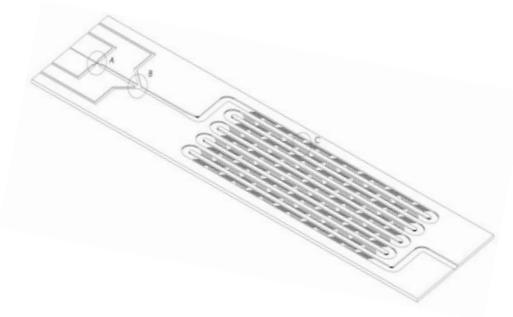
Microfluidics allows for the precise control of extremely small volumes of fluid

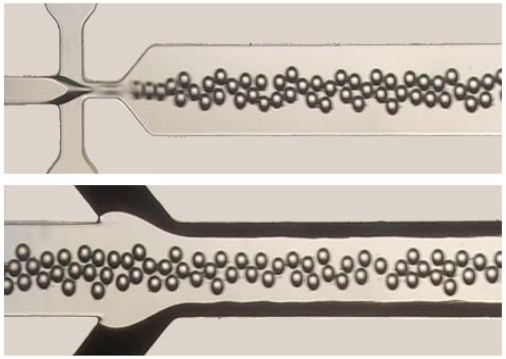
An ideal technology for development of point-of-care diagnostics and encapsulation techniques



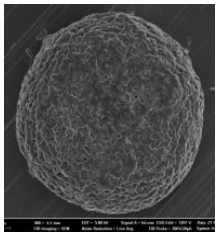
Microfluidic-based cartridge for blood counting applications developed at the CSIR

Manufactured with micro-milling, micro-injection moulding



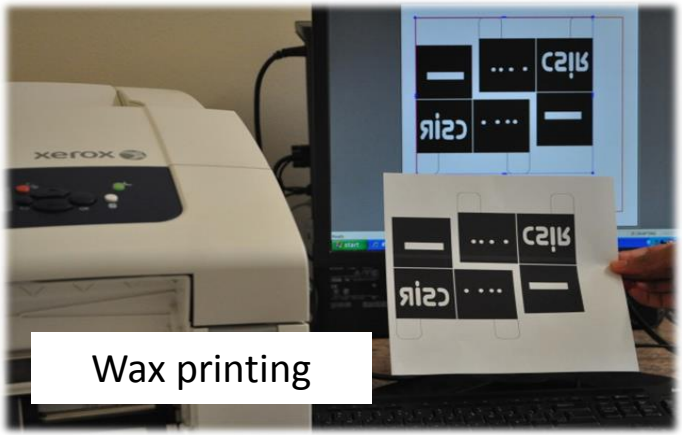


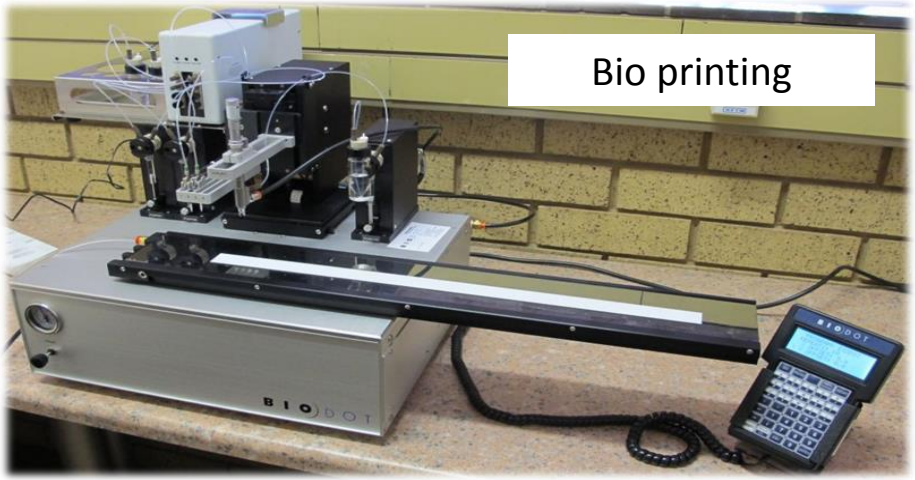
Φ 30µm

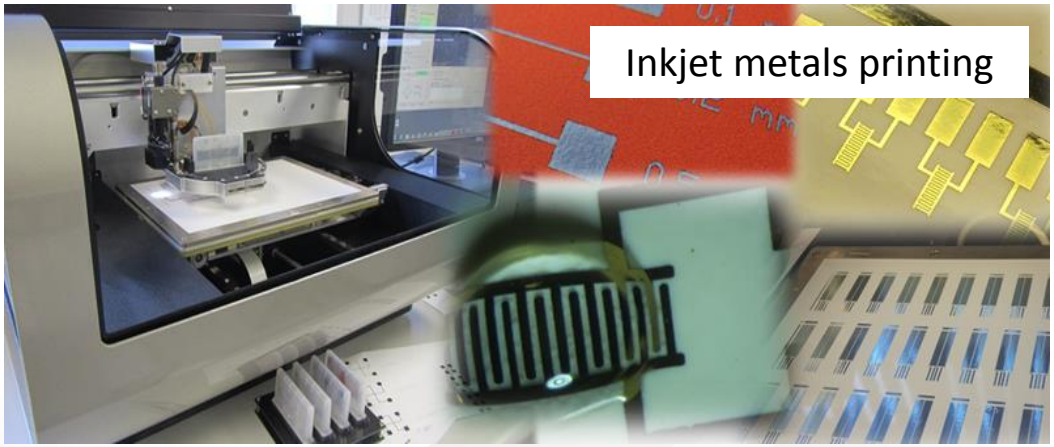


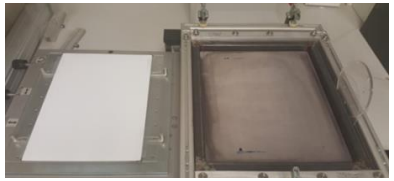
Microfluidic encapsulation and droplet fluidics

Printed Functionality Capabilities

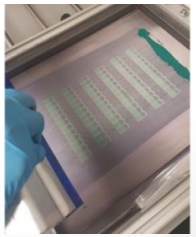






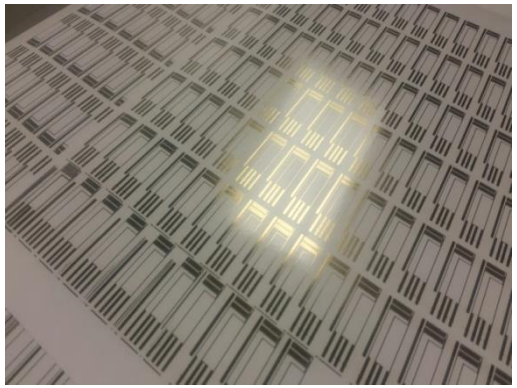


Screen printing



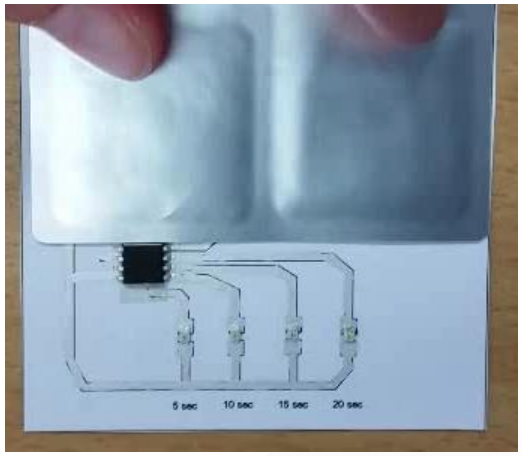
Printed Functionality Applications

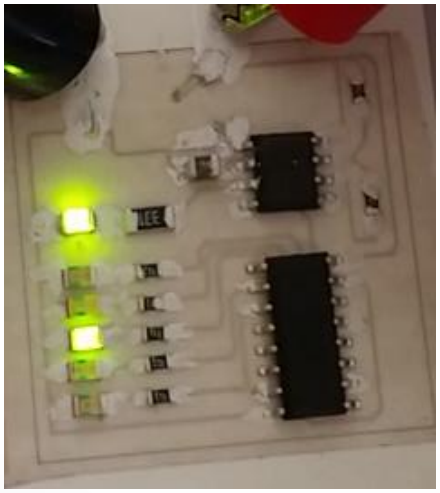
Lateral flow strips for medical diagnostics



Printed sensors

Printed batteries powering printed circuits



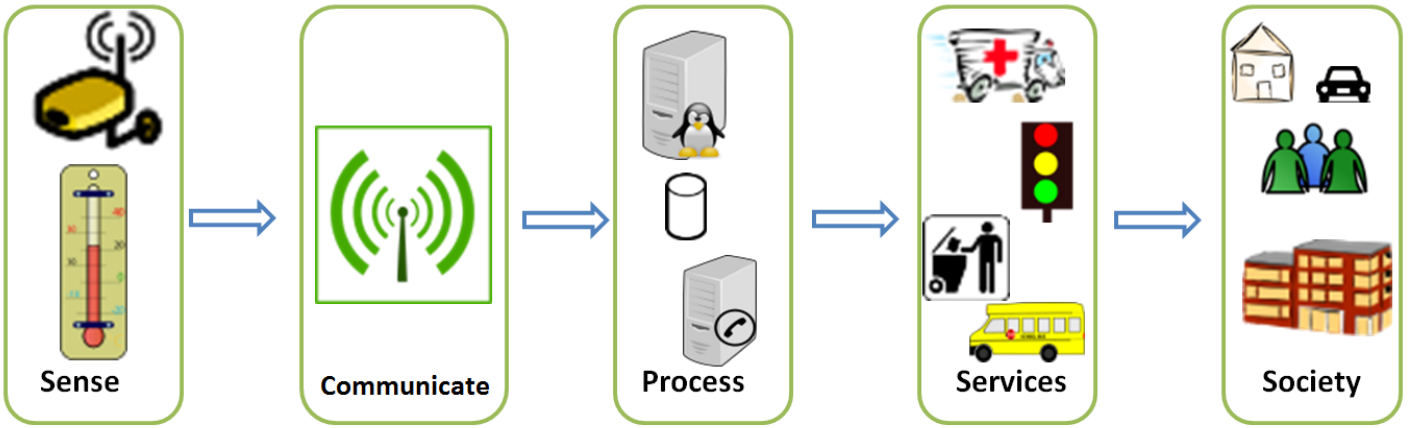


Printed electronics

CSIR in Industrial IoT

Internet of Things

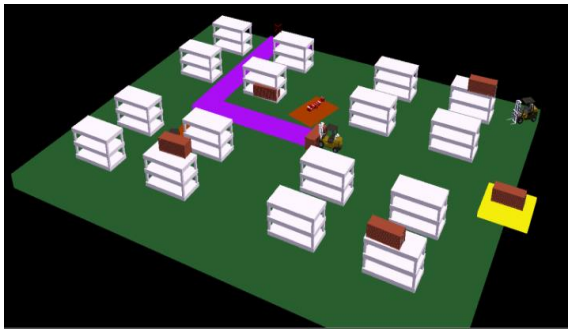
"Inter-networking of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data"



By 2020 there will be over 26 billion connected devices! *(Gartner)*

CSIR Industrial IoT Focus

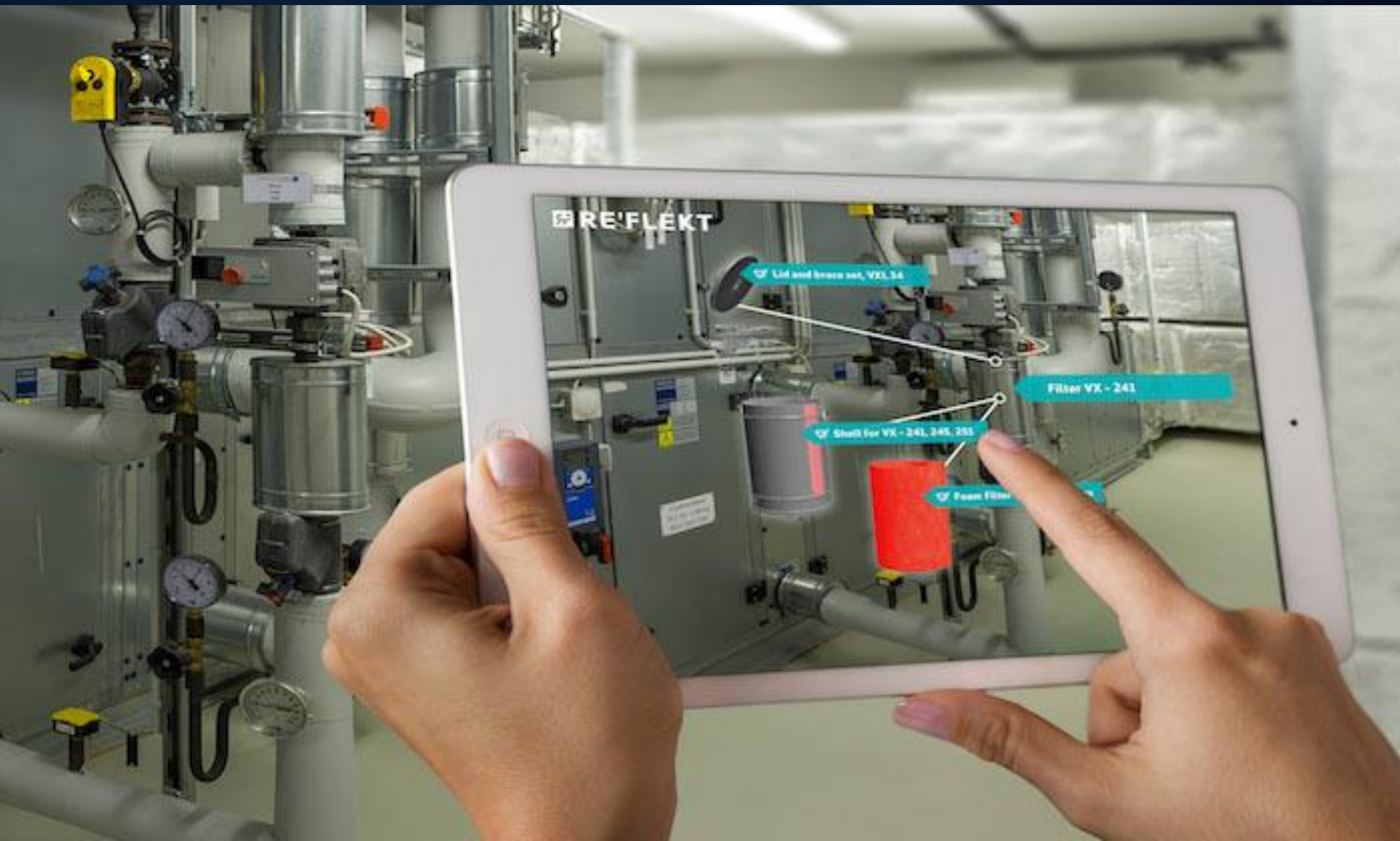
- **Smart warehouse**
  - Optimal routing and placement in simulated warehouse with 3D visualisation



- **IoT augmented awareness**
  - Activity and hotspot detection in a crowd environment

- **Energy saving**
  - Sense consumption and actuate device to optimise usage

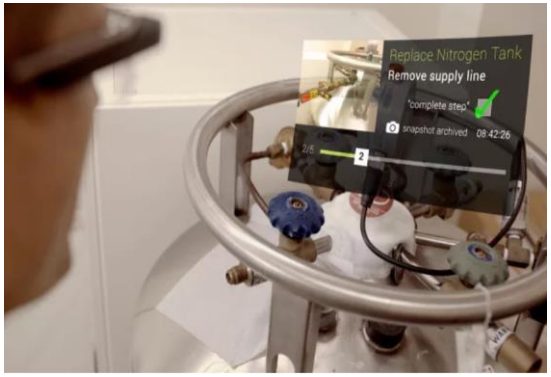
CSIR in Augmented Reality



Augmented Reality

A technology which enriches the real world with digital information and media such as 3D models and videos

- Complex assembly
- Maintenance
- Quality assurance
- Expert support
- Training
- Augmented intelligence



"We've only begun to scratch the surface of what augmented reality can do for manufacturing" – Engineering.com

Product Life Cycle Management (PLM)

IDEAS THAT WORK FOR INDUSTRIAL DEVELOPMENT

PLM touches all phases of a product's life and the entire value chain

Portfolio Management

Planning

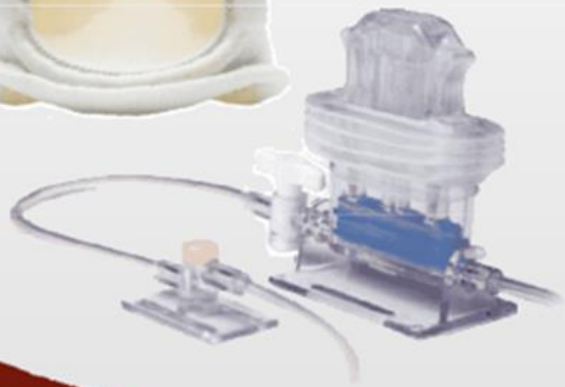
Conceptual Design

Product Engineering

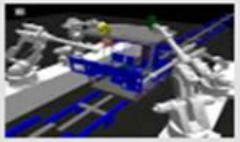
Manufacturing Engineering

Simulation & Validation

Requirements



Build and Produce



Test & Quality

Sales & Distribution

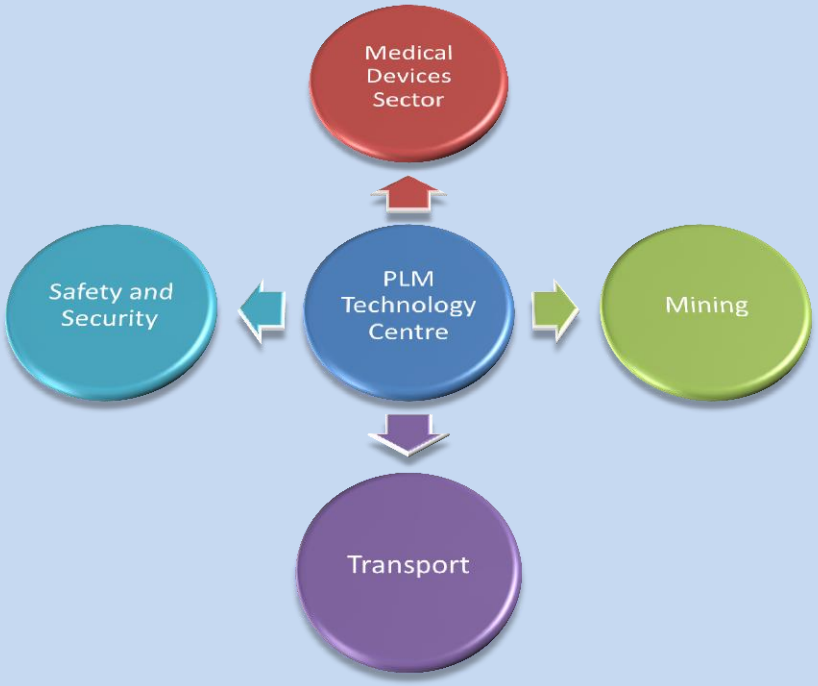
In-service Operation

Maintenance & Repair

Disposal & Recycling

CSIR and PLM

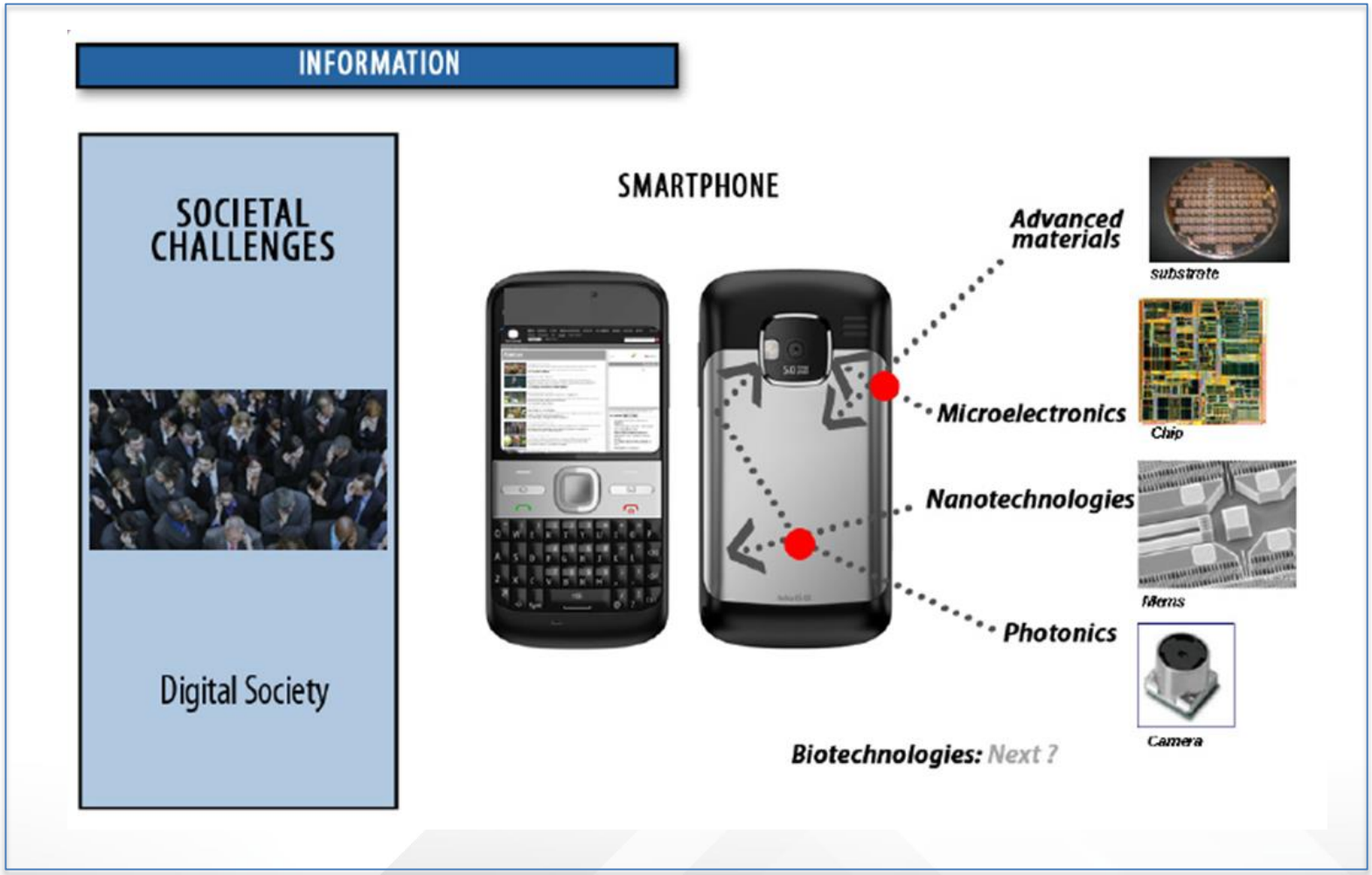
Product Life Cycle Management Technology Centre



PLM Benefits

Benefit	Improvement
Reduce Time to Market	~ 30%
Reduce Product Development Cost	~ 20%
Reduce Product Cost	~ 20%
Reduce Cost of Quality	~ 20%
Reduce Change Management Cost	~40%

Technology convergence & integration



Technology convergence & integration

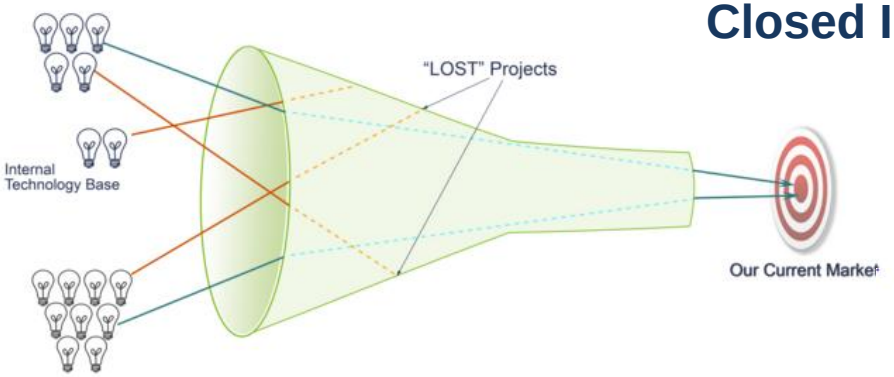
CSIR: Corocam / Multicam

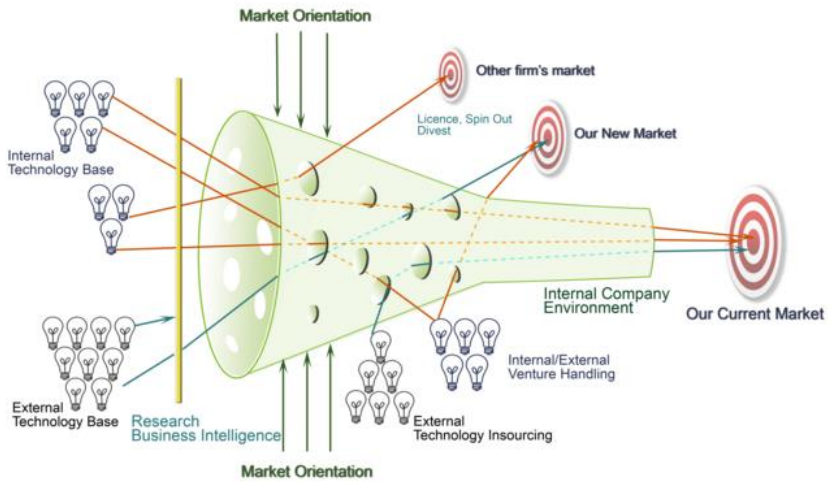
Next generation Inspection System

- Internet of Things
- Miniaturisation
- Augmented Reality
- Others?

CSIR Approach: Open Innovation

Closed Innovation

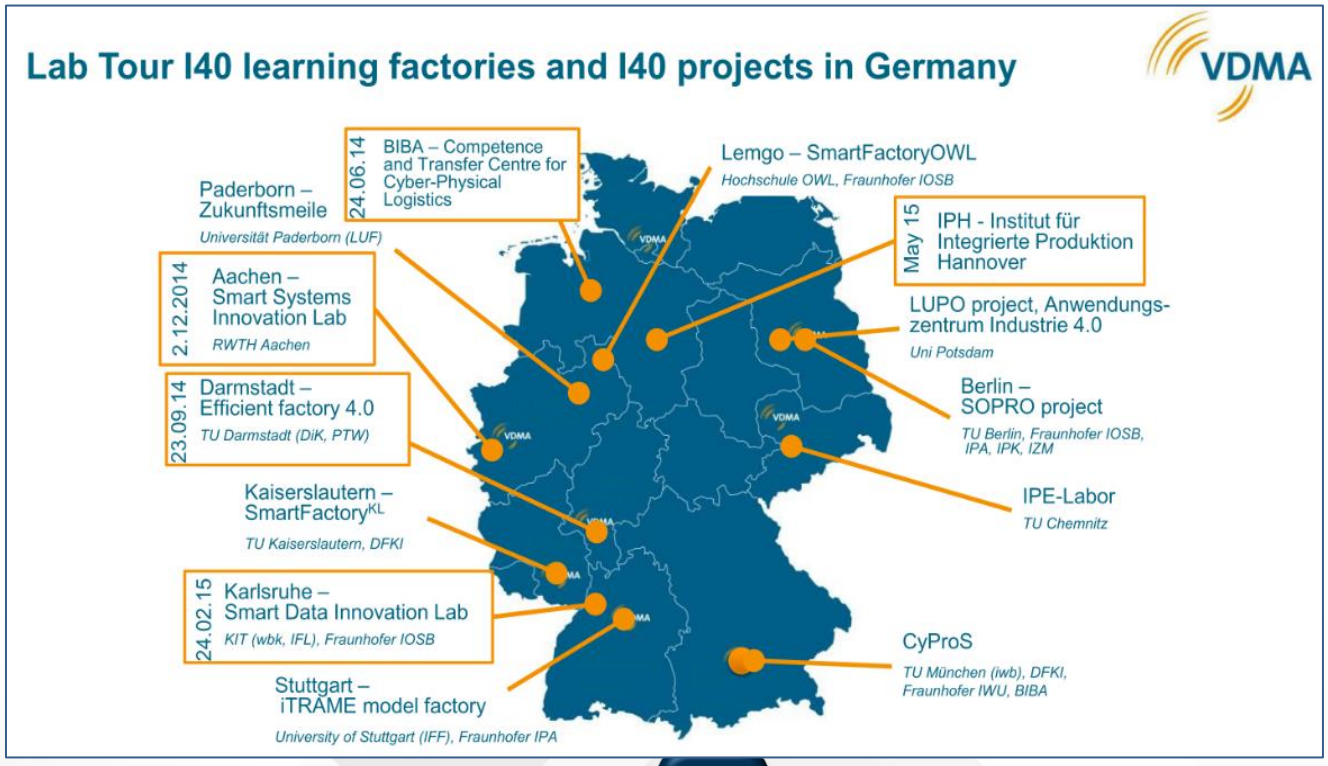




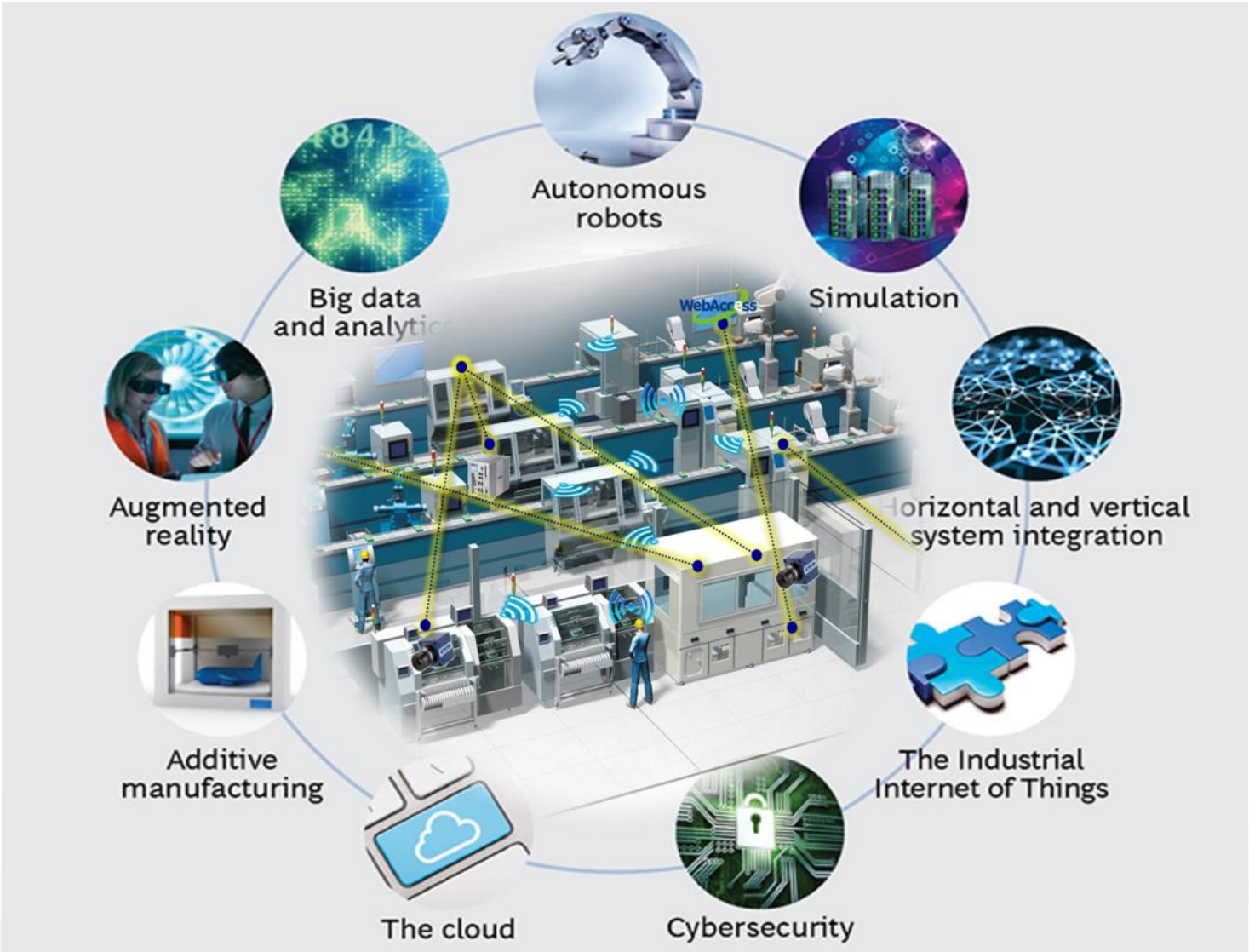
Open Innovation

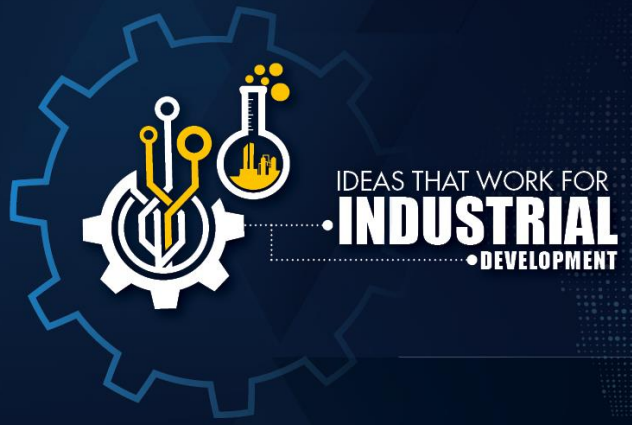
Demonstration/Learning Factories

- Demonstration platforms for firms interested in FIR
- Experimental platforms where FIR concepts can be tested
- Collaborative product development spaces
- Facilities for technical skills training and hands-on experience



CSIR Learning Factory Concept





Thank you

CSIR

our future through science