FUTURE OF MANUFACTURING

AMS Automotive Evolution Europe

Session 9: Engineering the future of manufacturing

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SZ Tower Munich, Germany HALL 4 2022

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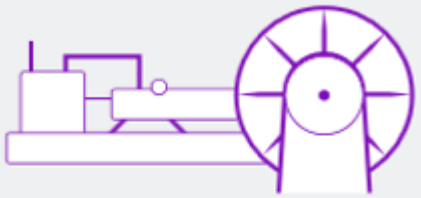
Content

1. Industry 4.0 / Internet of Things

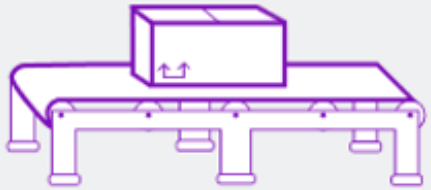


1.Industrial revolution

Evolution:
Using water /steampower

Revolution:
Production facilities, Infrastructure

End 18. Centry

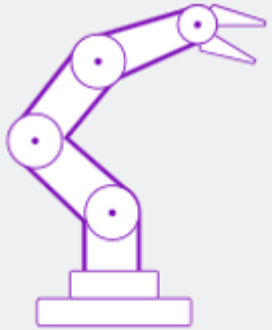


2.Industrial revolution

Evolution:
Using eletricity

Revolution:
Mass prodction with conveyer belt

Beginn. 20. Centry



3.Industrial revolution

Evolution:
Using eletronic and IT

Revolution:
Automatisation

Beginn. 1970s

4.Industrial revolution

Evolution:
Using complete digitalisation and net connection

Revolution:
Cyber-physical system

Todays

2011

[Industry 5.0](#)
EU

*Source - Internet

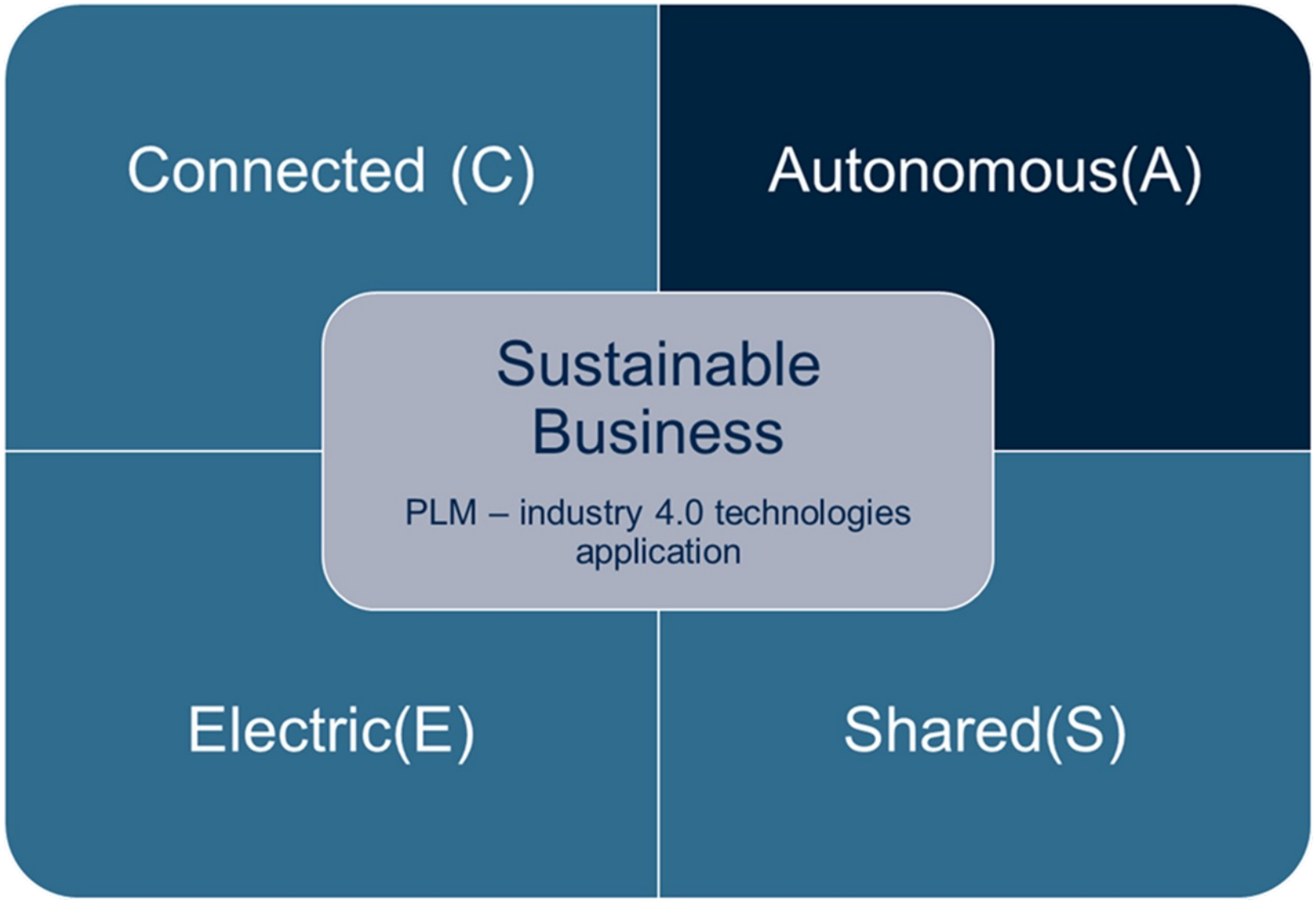
3. Industry 5.0 : What is It?

It complements the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to

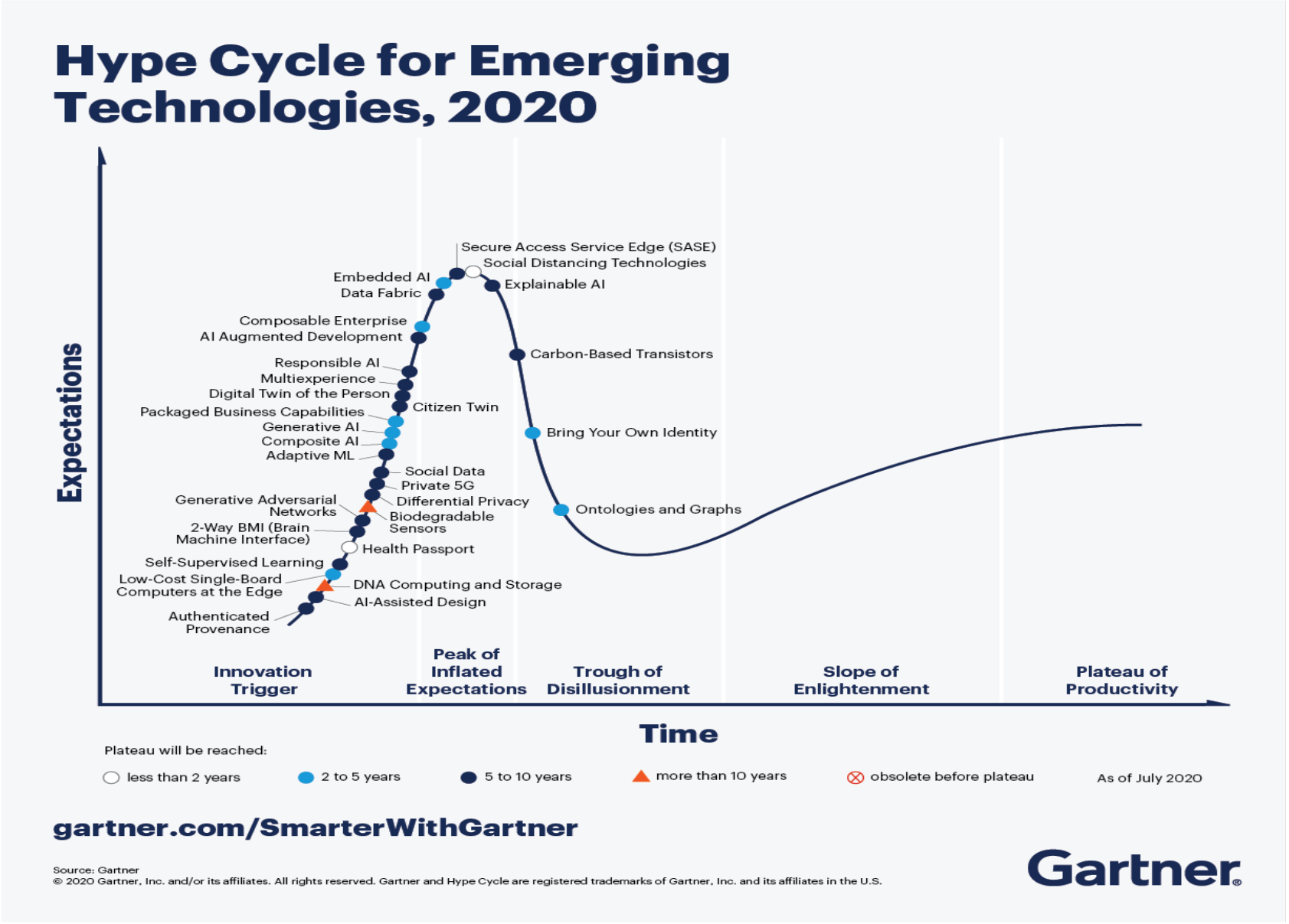
- a **sustainable,**
- **human-centric** and
- **resilient European industry.**

Source : https://op.europa.eu/en/ublication-detail/-/publication/aed3280d-70fe-11eb-9ac9-01aa75ed71a1p (Dec 2021)

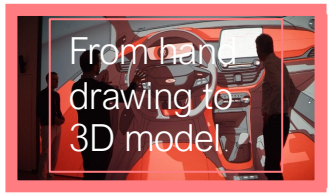
3. Automotive Industry Transformation: CASE

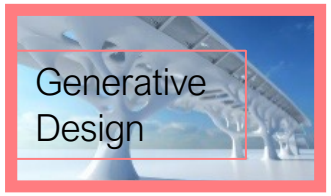


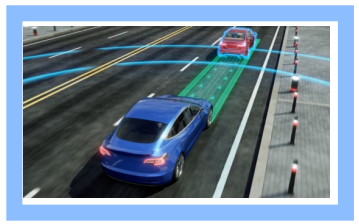
4. Technology Hype cycle

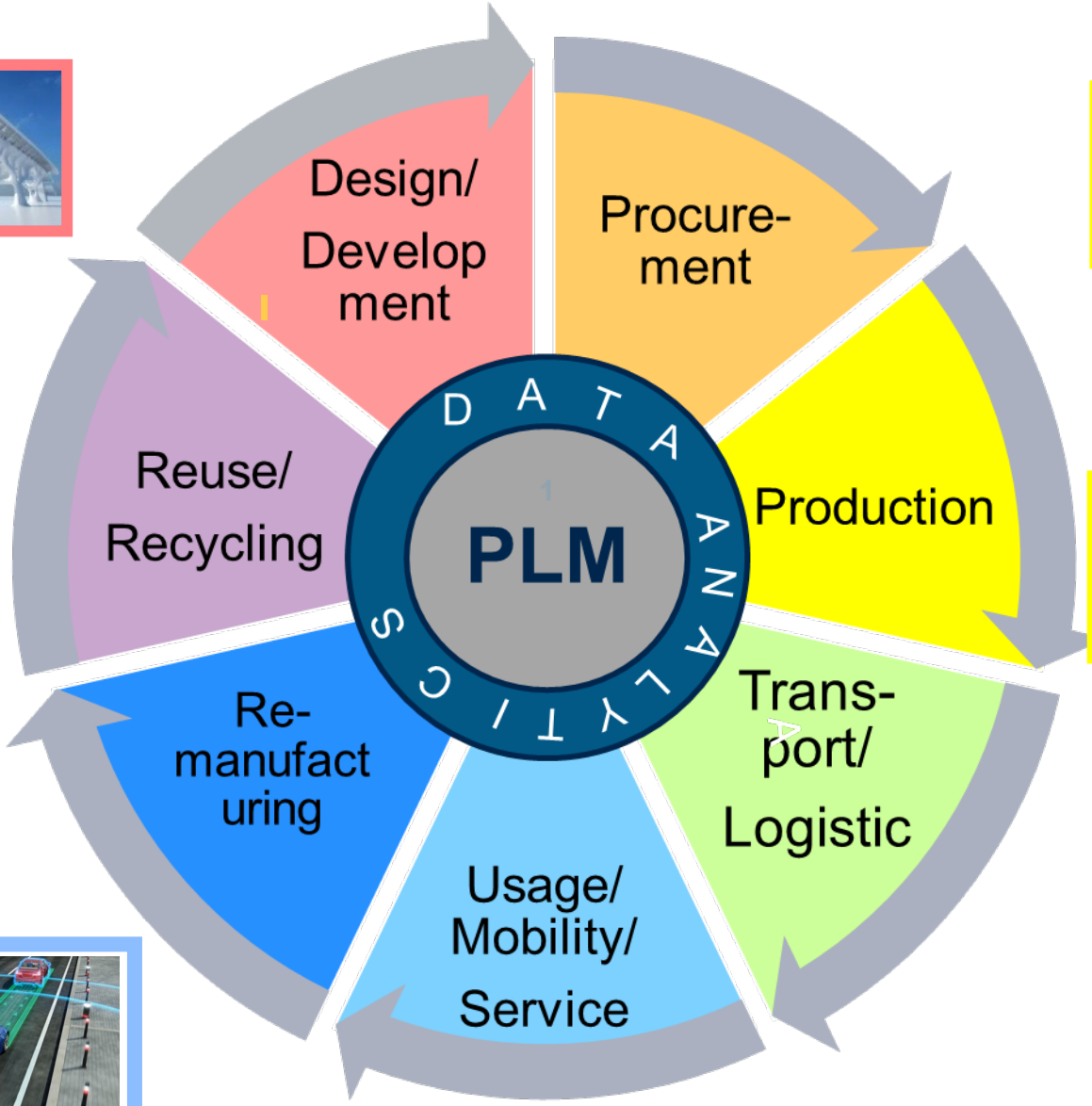


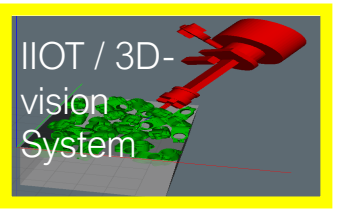
5. Product Lifecycle Management

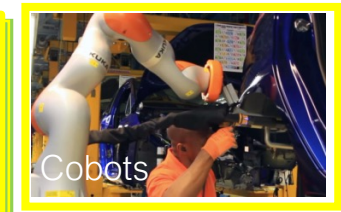












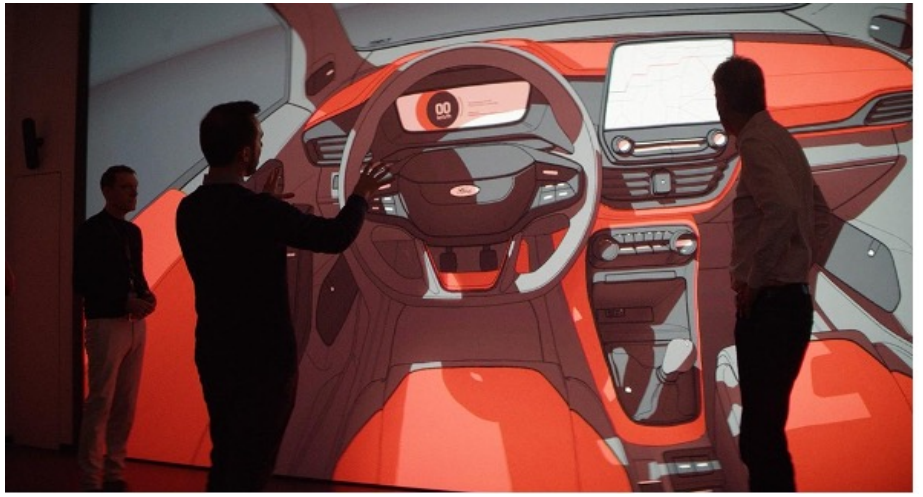
5.1. Design/Product development phase

NEW VEHICLE 360° SKETCHING

Traditionally, designers have produced 2D sketches that are then recreated as 3D computer-aided design (CAD) models.

Creating sketches that immediately enable designers to experience their work from the point of view of the driver or passengers underlines Ford's commitment to **HUMAN-CENTRIC DESIGN.**

360° sketching - possible to see the dashboard, doors, seats and console all together and to better understand how elements interact - the customer experience central to a vehicle's interior right from the start of the design.



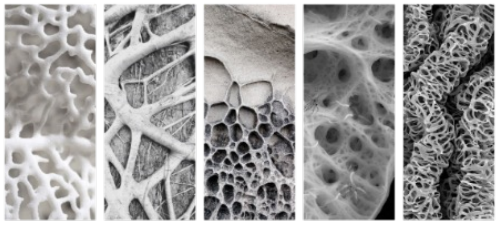
Inspiration for the sketching tool came from video game development. work with Gravity Sketch – a 3D virtual reality tool

5.2. Design/Product development phase: Generative design

Autonomous geometric design after specification and constraints.
Less Material and weight (**SUSTAINABLE** design)

TOPOLOGY OPTIMIZATION (SUBTRACTIVE)
Optimizing design removing not loaded materials of an existing user-defined geo based algorithm.

BIOMIMICRY:
Optimizing design based on the algorithm mimics behavior seen in nature like roots and branches in trees, or the bone structures, to optimize strength-to-weight ratios.



MORPHOGENESIS
Optimizing design based on the algorithm from how groups of cells respond to their environment. Cells actively loaded grow stronger.

SOFTWARE :

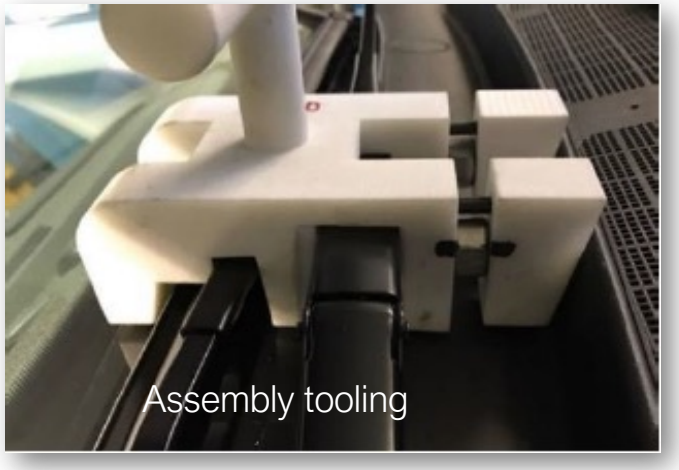
Ansys 3DSIM, Autodesk Netfabb, Dassault 3DExperience GDE, Desktop Metal Live Parts, Siemens NX Frustum

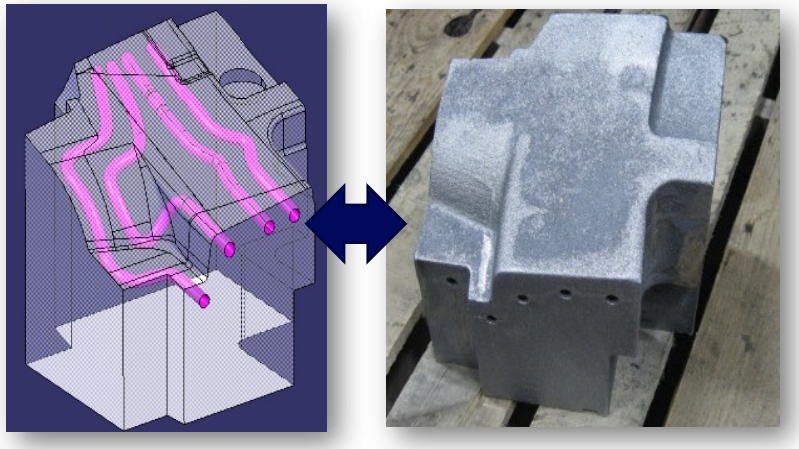
5. 3. Additive Manufacturing (AM)

Polymer additive manufacturing is state of Application

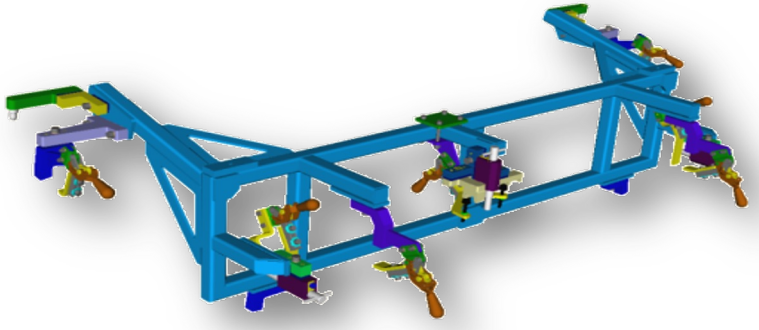
Metal additive manufacturing in progress and 4D printing is in research

Mainly used for Prototype, Tooling and low volume productions todays





Sand Printing Conformal Cooling Lines in Dies



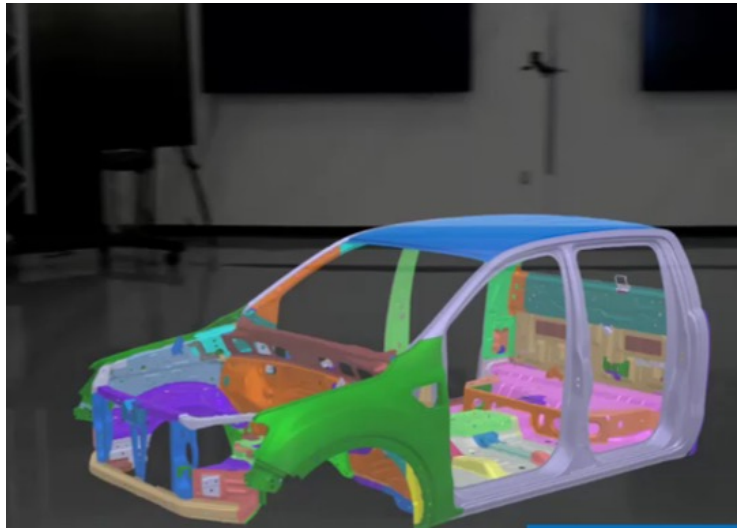
Tool Design for AM

Installing standard additive manufacturing configuration in all manufacturing location (synergy)

Moving from Tooling application to produce volume application for production part pending on process robustness, timing and cost.

5.4 Virtual Reality/Augmented Reality

- Virtual Test with digital model during product development and production proces



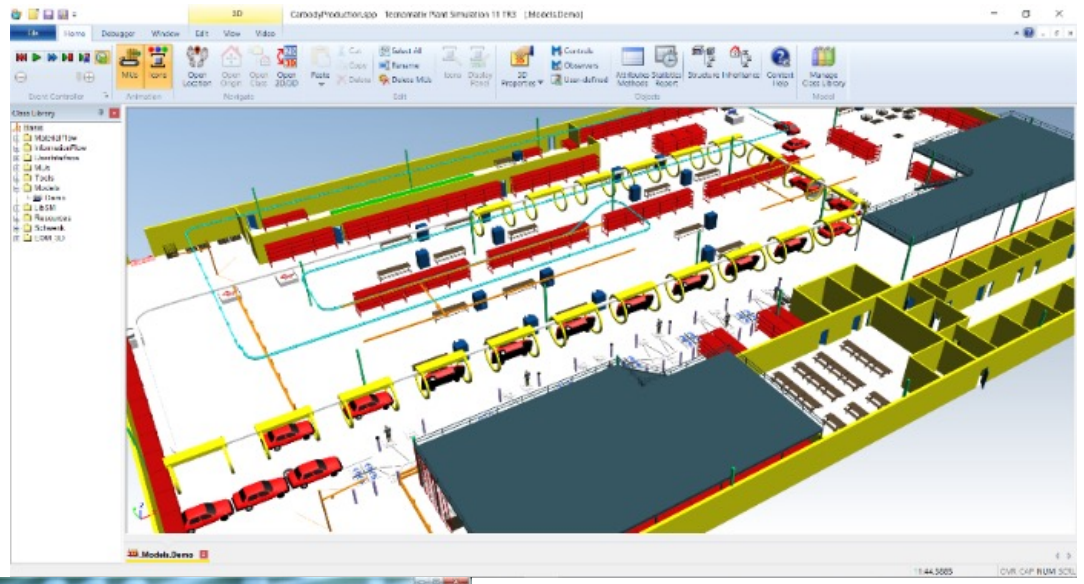
- Virtual Training and ergonomic assessment **(HUMAN CENTERED & RESILIENCE)**

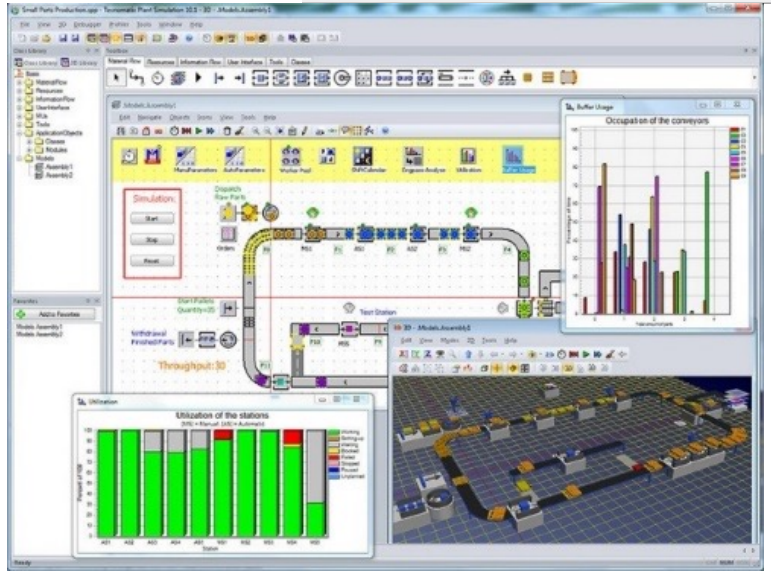
5.4 Virtual Reality/Augmented Reality

- Virtual commissioning : faster, easier and with less risk before physical commissioning (**HUMAN CENTERED & RESILIENCE**)

5.4 Virtual Reality/Augmented Reality

Work station readyness, dynamic plant simulation and base for digital twin





5.5. Cobots

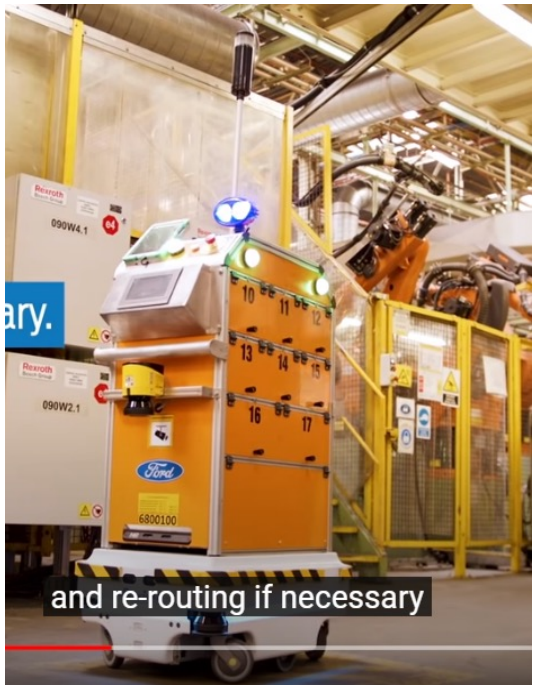
COBOTS: Collaborative Robots - Interaction Human and Machine

- Wide applications across the plants
- Future development : Recognise gestures, language processing,
  AI interface and mobility => Robotics

HUMAN CENTERED

5.6. AGV

- Applications cross the plant to transport production and non-production materials
- Example - Valencia Body shop AGV – recognize the moving and standing
  obstacles and re-routing if necessary **RESILIENCE**



5.7. Drones

DRONES :

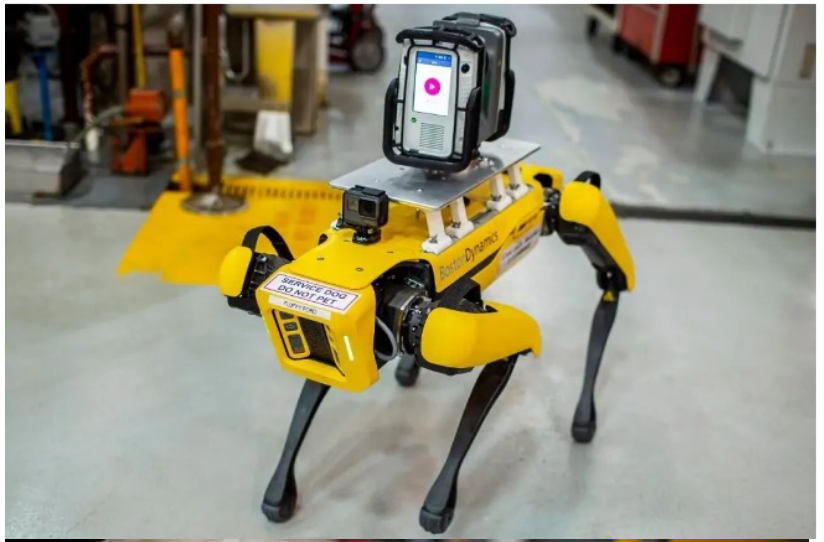
- Machine/conveyor Inspection of high bay
- Roof or water tower inspection
- Asset temperature with infrared camera
- Dagenham Engine plant example
- Future – Drone Transport

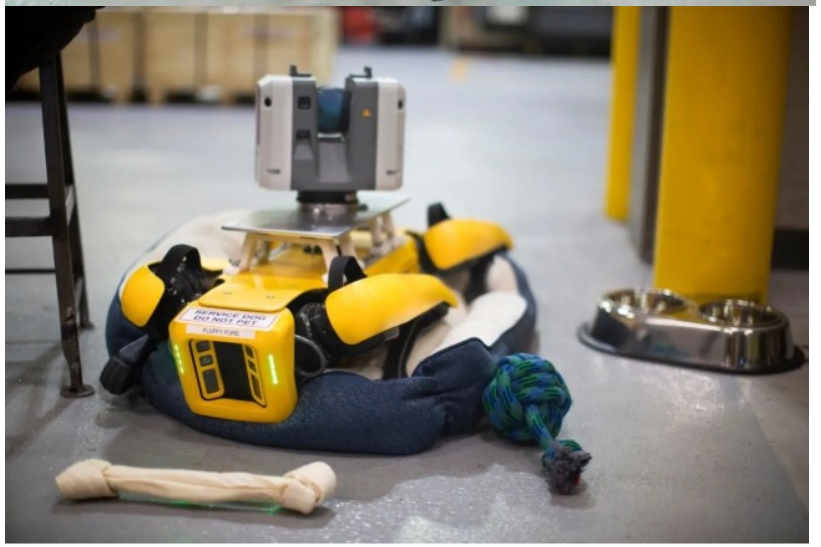
HUMAN CENTERED -SAFETY

5.8. Robotics : Fluffy and Spot (Ford+ Boston Dynamics) :

- Use at the Ford Van Dyke transmission plant in the US.
- 30 kilograms & Extremely agile
- Perform 360-degree scans
- Manage gradients of up to 58 percent, and even climb stairs.
- Equipped with five cameras
- If they fall, the robots can stand up automatically.
- Moved at up to 5 km / h for almost two hours to scan the system floor and provide the engineers with the data required to update the plant to create a new design model

Also used in areas of the plant that are particularly difficult to access. Inclines of up to 58 percent, which corresponds to 30 degrees, are also not a problem.





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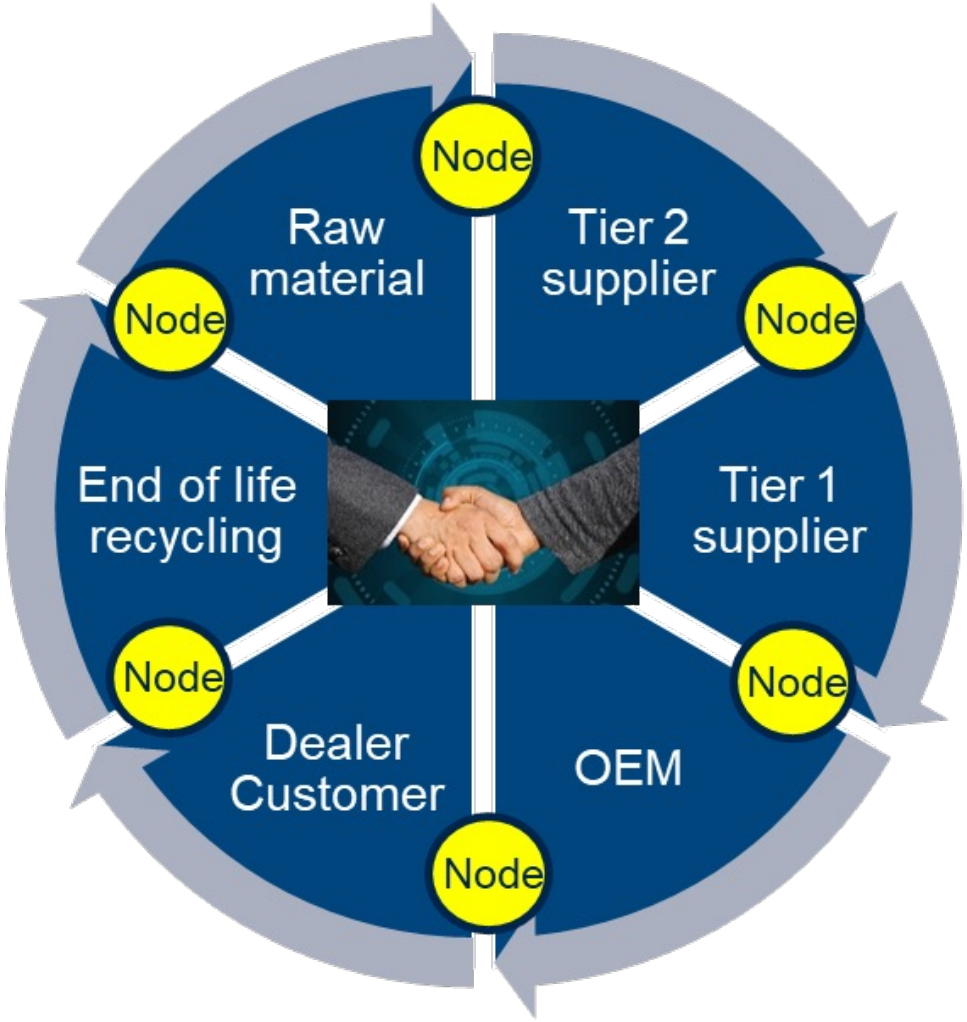
5.9 Blockchain

- Used in bit coin at the beginning. All participants in the value chain approve their legers. – digital finger printing
- Clear and safe documentation
- Still need very high computer capacity
- AI and Blockchain combination makes **Product life cycle management** possible
- Example project – supplier chain management with IBM Blockchain



RESILIENCE, SUSTAINABLE

5.10. Wireless factory communication

Wireless communication technologies

- WiFi 5, WiFi 6 (10 times more capacity)
- Cellular (4G, 5G, CBRS)
- LoRaWAN- Low power, typically battery devices
- Blue tooth
- Others – 900MHz, ZigBee, DART, LiFi

5G

- Real time communication :10 Gbits/s (100 times data rate and 1000 times capacity) - very low latency times <1 ms mobile communication hardware (antenna technology) and communication protocol
- Complex industrial applications- flexibility, mobility and convertibility - Autonomous vehicle, AGVs, Robotics
- 4 transmit and receive units in a 4G/LTE antenna vs. 64 in a 5G antenna - more stable connections with low latency
- Research projects in Valencia plant and in UK, US – AGV, robots, Equipment capability to communicate via 5G with defined 5G area and which applications have business case

6. Factory of Tomorrow

- Integrated Planning and execution with Real time Track and trace – connected customer order, product production plan , supplier chain management, logistics, production plant and distribution and receiving customer
- self-monitoring and self-adaptive logistics : Technology – GPS, barcode ,dataMatrix code, RIFID(radio frequency identification), EDI(electro data interchange), internet, telematics, on site and cloud architecture and software
- Intra logistics : Smart shelves and Autonomous/remote driving within plant and logistics chain after vehicle finished, facilitating inventory monitoring and automated re-ordering,
- wireless communication
- Production – AI optimized build flexible and integrated production plan and execution, Predictive Maintenance and predictive quality (closer to zero failure), high efficiency through real time monitoring and controlling
- Digital twin – IOT(real time data), Cloud connected and Edge computing
- Integration AI and Human interaction
- Robust product life cycle management with Blockchain and AI – sustainable Business

HUMAN CENTERED, RESILIENCE, SUSTAINABLE