

## Smart worker in Industry 4.0

- Technology Integration : Smart workers use IoT, AR/VR, wearables etc. to interact with interconnected systems and enhance productivity.
- Data-Driven Decision making : smart workers can use real time data that is analysed to optimize production and help in predictive maintenance leading to a safer environment to work in.
- AR/VR integration : workers can access virtual instructions, real time data, and remote collaboration through AR/VR.
- Enhanced safety : By using real time data and sensors hazards can be predicted earlier on leading to predictive maintenance and ~~less~~ more safety in workplaces.
- Skill development : leads to continuous upskilling via personalised training → to adapt to new technologies.

## Augmented Reality (AR)

Definition : AR overlays the digital world / digital content onto the real world hence enhancing user's perception.

Properties : combines ~~the digi~~ virtual and real world elements, offers real time interaction and registering virtual objects accurately.

## Applications :

### 1) Interactive

training : helps in skill learning  
(lays digital content onto the real world)

### 2) Maintenance

and repair : helps technicians visualise a real world problem / provides visual guides.

### 3) Marketing and entertainment : Engages consumers through immersive campaigns.

① training → visual guides.

② upskilling → digital content

③ entertainment → engaging consumers in immersive campaigns.

## Virtual Reality (VR)

Definition: immerses users in a fully computer-generated virtual environment.

Unlike AR → augments reality.

feature: immersive interactive experience

Applications : 1) Training and simulation: for high-risk scenarios such as aviation.

2) Gaming: offers immersive gameplay.

3) Therapy and Rehabilitation: used for exposure therapy.

## Industrial Applications

- Maintenance : AR helps technicians troubleshoot by overlaying real time data and diagnostic on the equipment while VR helps in immersive maintenance training.
- Assembly : AR helps by giving a step by step guide for assembling hence improving the quality and efficiency while VR helps in allowing workers to practice in a virtual environment.
- Collaborative operators : AR allows remote experts to assist on-site workers in real time while VR is used for virtual meetings for the distributed teams.
- Training : AR offers real time training ; VR provides safe immersive solutions.

## Additive manufacturing (3D printing)

process : → 3D printing → builds objects layer by layer from a digital model → allowing rapid prototypes and production.

Advantages :  
1) Design flexibility : enables complex designs.  
2) Reduced waste : uses only required materials  
3) Customisation : Allows for tailored products without extra costs.

## Applications :

- 1) **Automotive**: Rapid prototyping of custom parts, light weight, better fuel efficiency.
- 2) **Aerospace**: painting of complex components such as turbine blades etc.
- 3) **Medical**: surgical guides, patient specific implants etc.

## Environmental impact:

- ↓ material waste
- ↓ transportation emission
- uses sustainable materials.

## AR vs VR in industry 4.0

- AR: best for
- Real time collaboration
  - Real world augmentation
  - helps in maintenance and training

- VR: best for
- immersive simulations
  - training for hazardous scenarios
  - training in a safe virtual environment
  - social interactions.

## Digital - to - physical (D2P)

Definition : → converting of digital information into physical objects

ex: 3D printing, CAM - computer aided manufacturing.