PROJECT ROB2 SPRING 2020

THEME: MANIPULATORS & INDUSTRIAL ROBOTICS

PROBLEM: **ASSEMBLY OF CUSTOMIZED MOBILE PHONES ON AN INDUSTRY 4.0 PRODUCTION SYSTEM**

BACKGROUNG ON SMART PRODUCTION:

The Smart Production Lab is a “small factory” which:

- Is a Playground for companies, research partners, students to collaborate on a real, physical production setup is used to integrate results from AAU Smart Production.
- Is a “meeting point” for researcher from AAU Smart Production
- Is a platform for teaching in Smart production technologies
- Demonstrates how manufacturing companies can benefit from Smart Production technologies

The Smart Lab is based on hardware from Festo, Siemens, KUKA among others and software from SAP, Festo, Siemens and other third-parties.

THE PROBLEM DESCRIPTION:

This year in ROB2 we will look at one production task; how to assemble customized mobile phones using a cyber-physical, Industry 4.0 inspired facility with the means of a collaborative robot.

EVERYTHING STARTS WITH THE FESTO CP FACTORY

FESTO CP Factory also known as AAU SMART LAB (Fig. 1 & 2), consists of eight modules and serves as a demo production line for assembling black dummy smartphones. These smartphones consist of a top and bottom cover, up to two fuses, two or four holes and a PCB (see Fig.3). The modules of FESTO CP Factory are independent, meaning they can be programmed to do individual tasks and be rearranged without making any changes to what they are programmed to produce. Each module has a conveyor used to transport carriers between the modules. On each carrier a read-/writeable RFID tag is located enabling a flexible environment (Fig. 4). When a module reads an RFID tag, it asks the Manufacturing Execution System (MES) for what the modules should do with the part on the current carrier (Fig. 5).

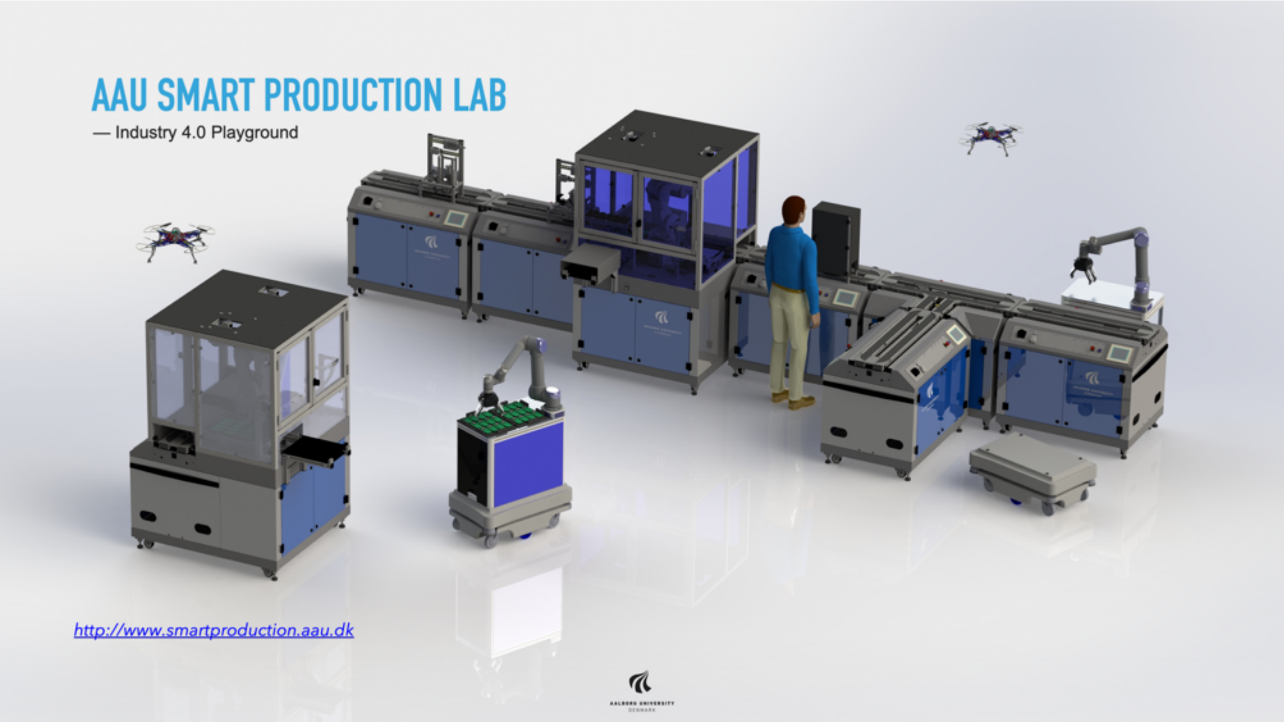


FIGURE 1 VISUAL REPRESENTATION OF THE SMART LAB

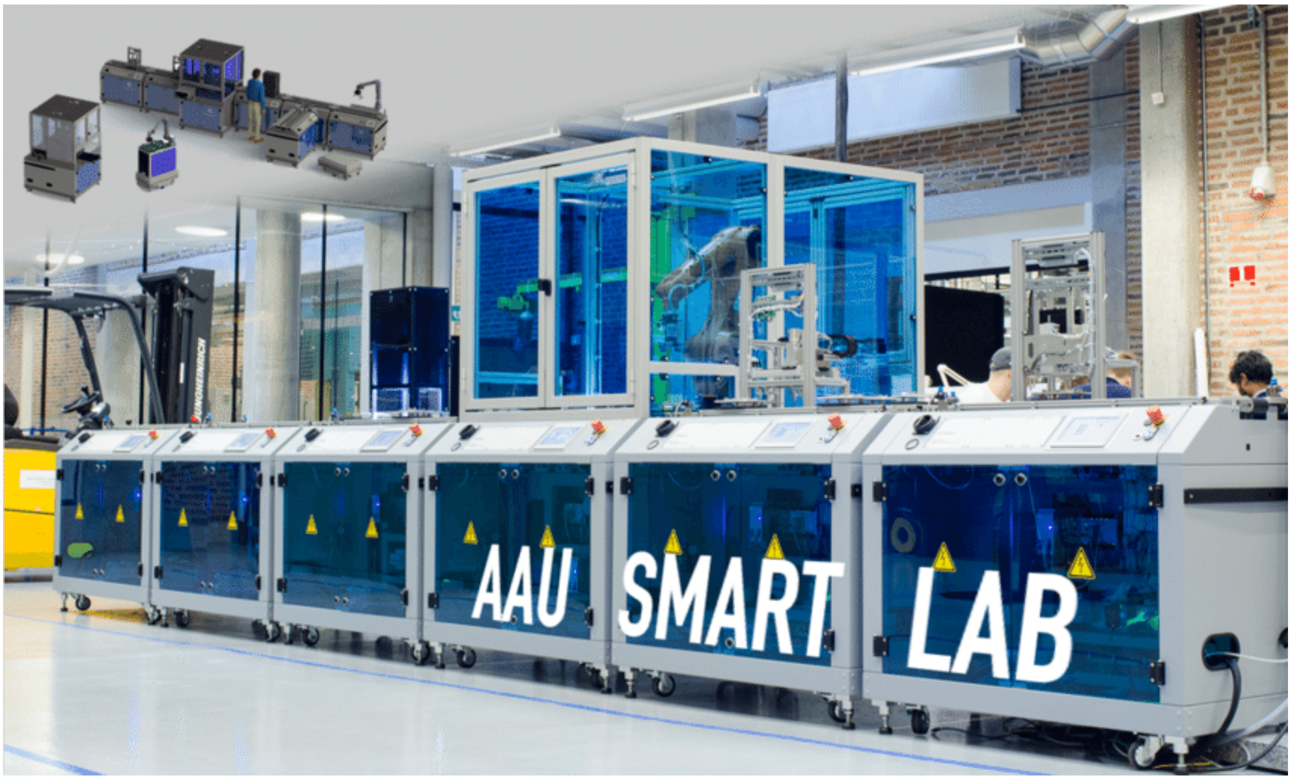


FIGURE 2 ACTUAL REPRESENTATION OF AAU SMART LAB

EXPLODED VIEW

FIGURE 3 PARTS OF THE DUMMY MOBILE PHONE

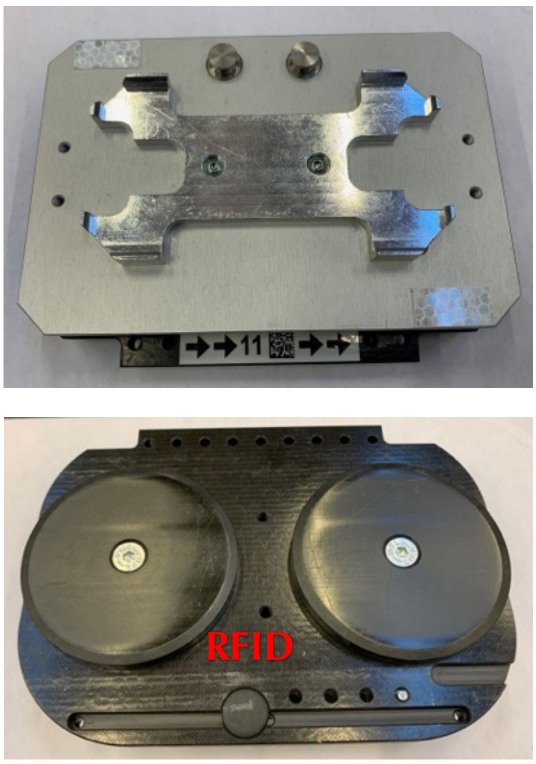


FIGURE 4 CARRIER TOP VIEW (LEFT) AND BOTTOM VIEW, WHERE THE RFID SENSOR IS VISIBLE (RIGHT)

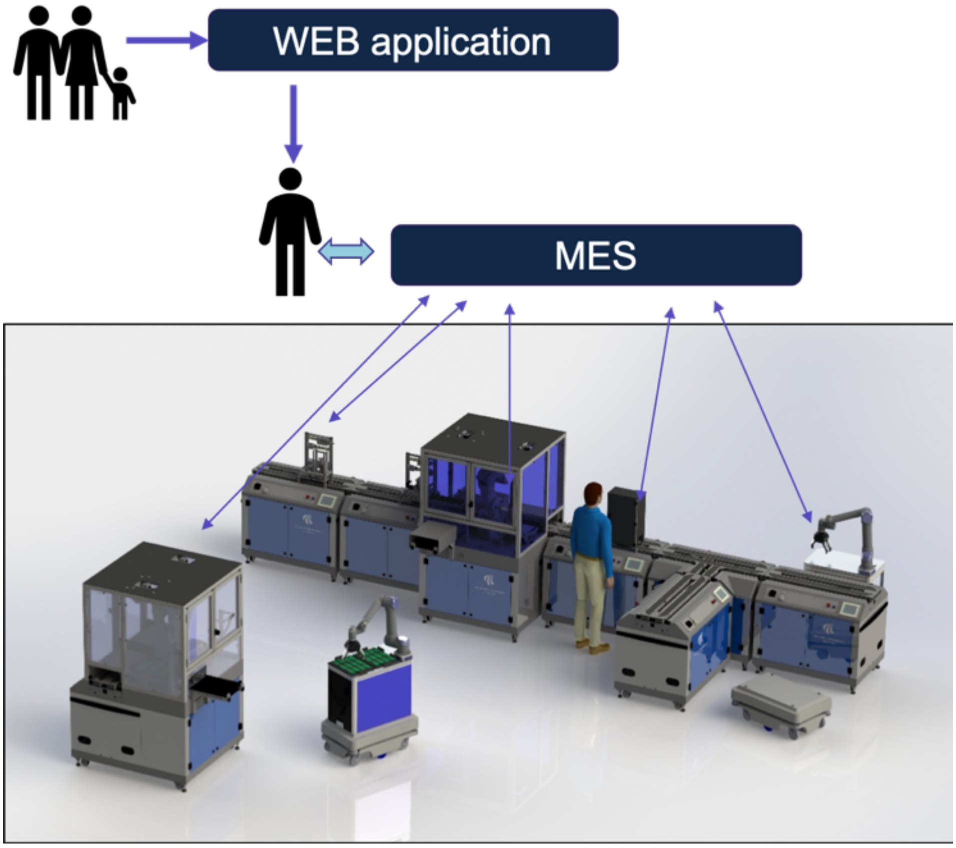
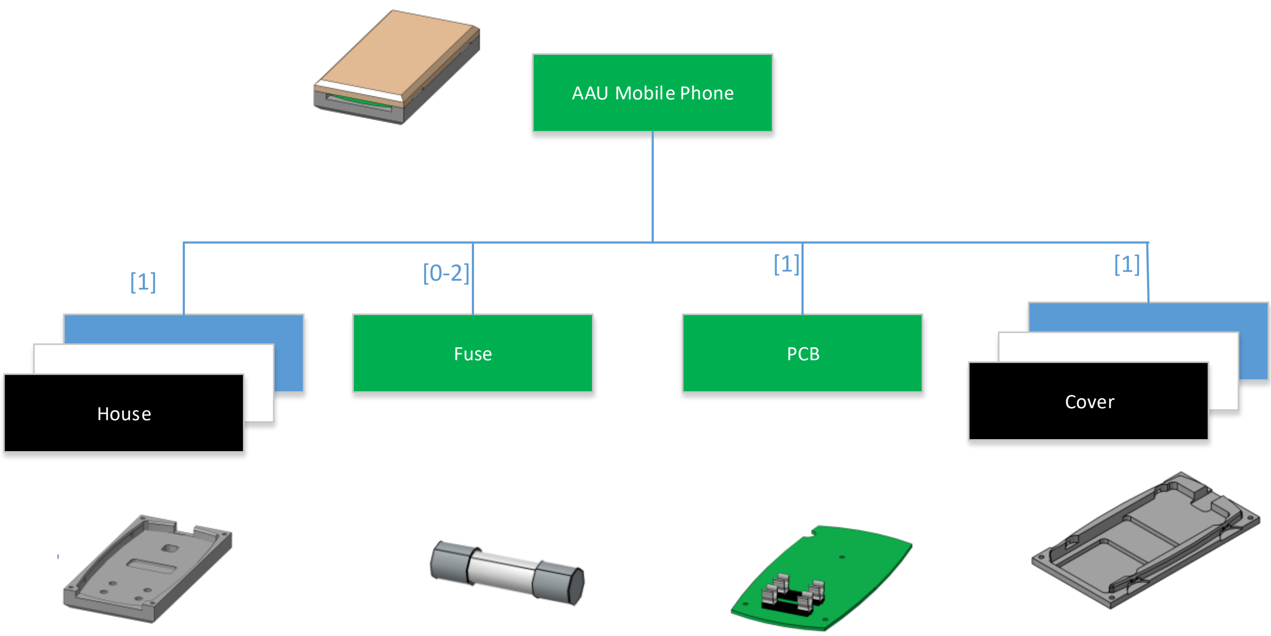
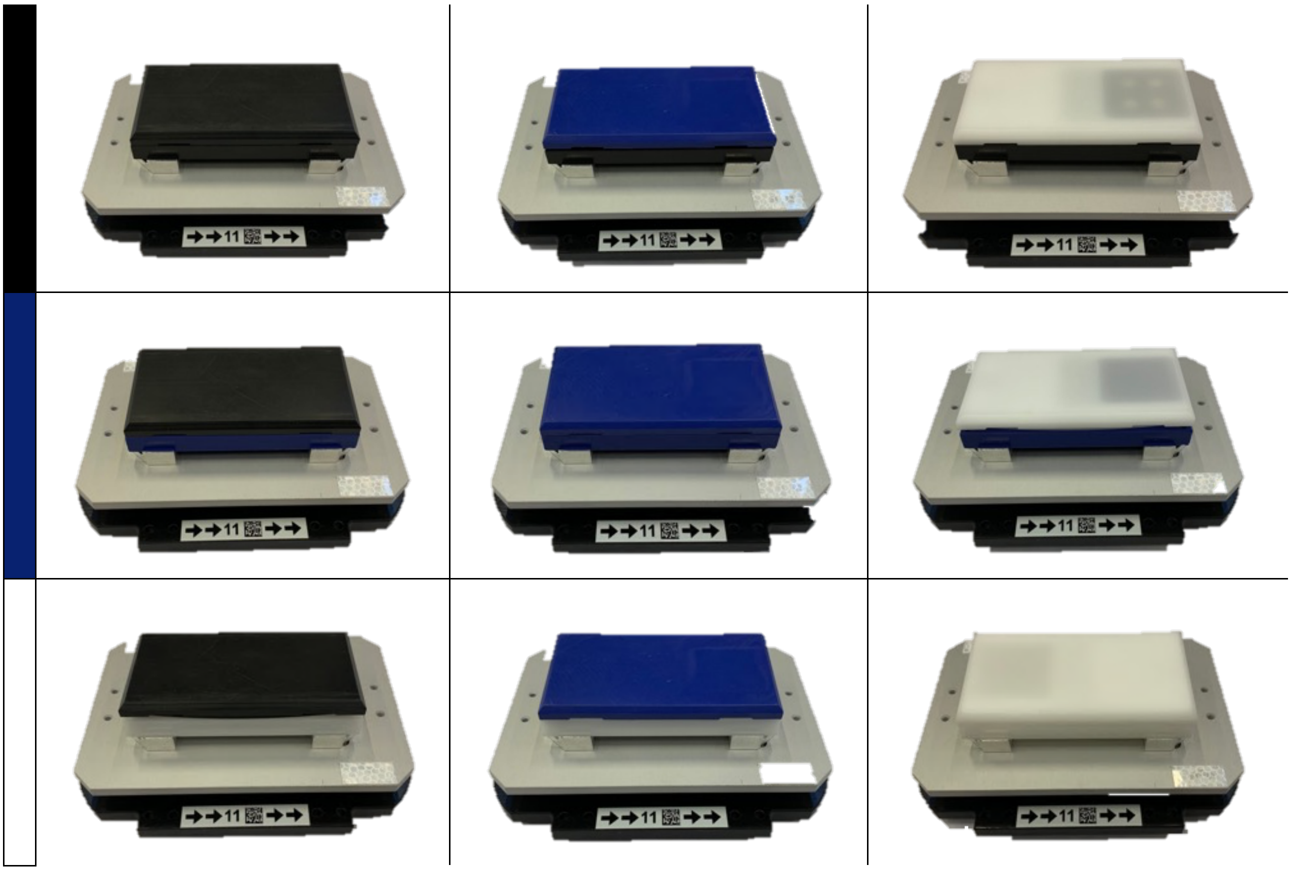


FIGURE 5 COMMUNICATION WITH THE MES SYSTEM

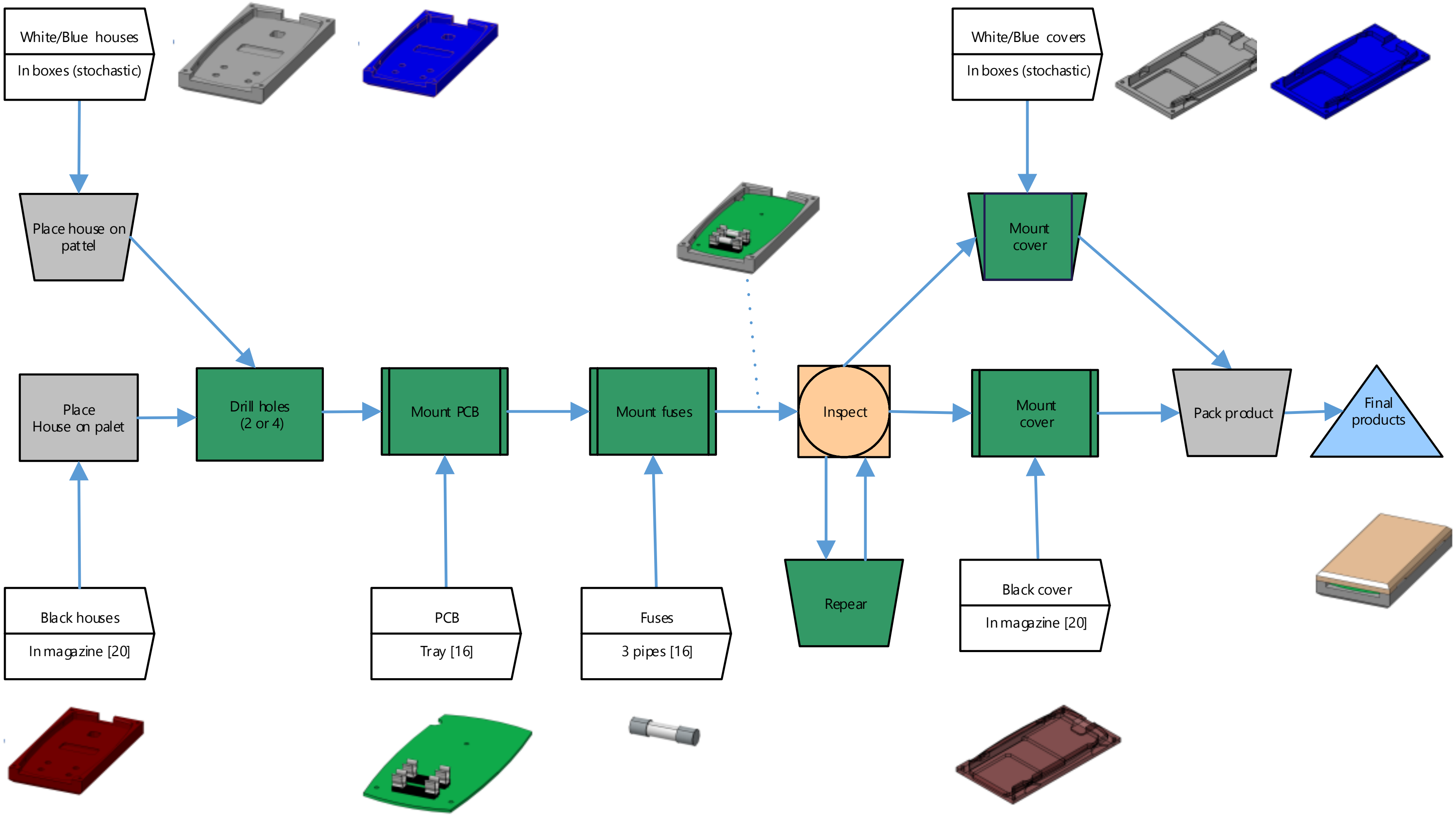
BILL OF MATERIALS (BOM)



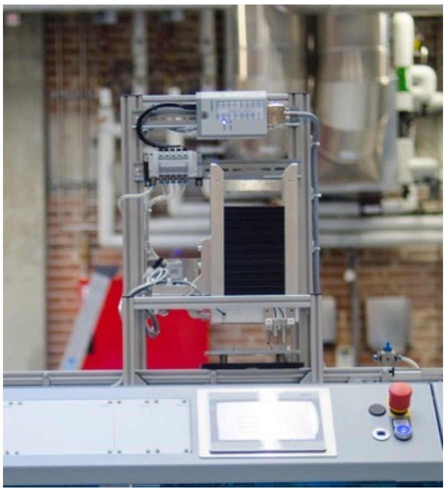
AVAILABLE VARIATIONS



ASSEMBLY FLOW



PROCESS DESCRIPTION

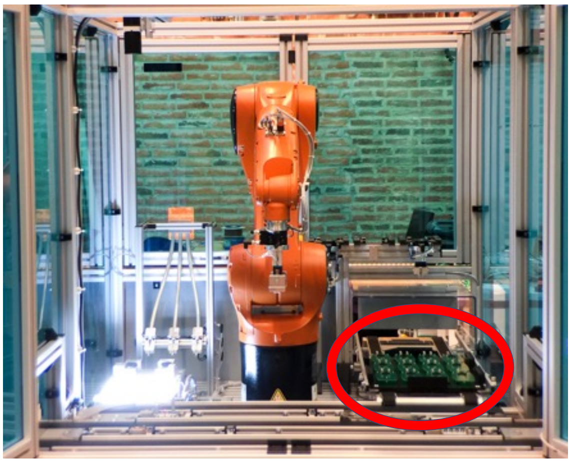


1) Bottom cover dispenser

The assembly flow starts at the bottom cover dispenser. Here the dispenser will place a bottom cover on a carrier. The orientation does not matter as long as the bottom cover is placed on its back and correctly fits the carrier.

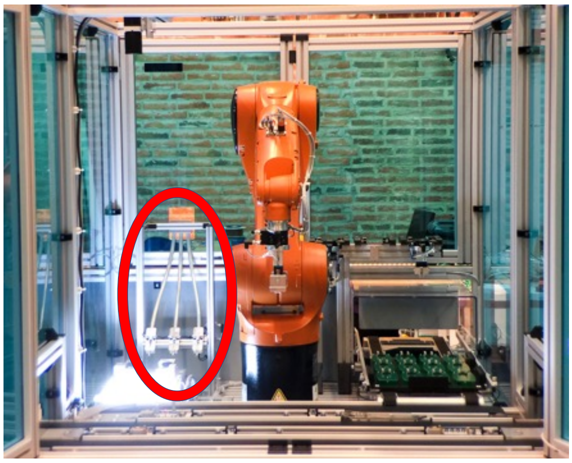
2) Drill machine

Here the FESTO CP Module will drill holes in the bottom cover according to the respective order.



3) PCB assembly

Entering this module containing a KUKA manipulator, the carrier will go onto a side conveyor, so carriers not supposed to have work done by the KUKA manipulator, can pass. The KUKA manipulator places the cover on a backlit plate to check the orientation. It will then pick up a PCB and place it on the bottom cover.

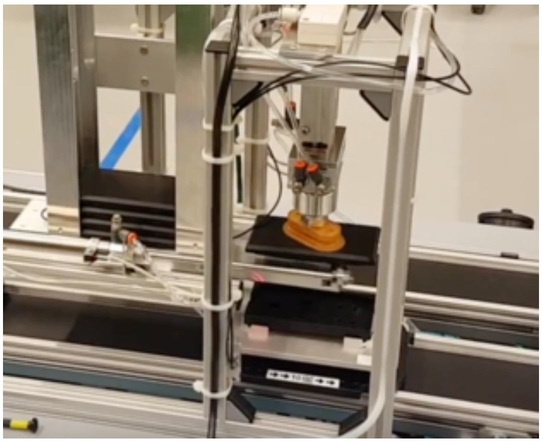


4) Fuse dispenser

The KUKA manipulator picks one or two fuses and places them on the PCB. The KUKA manipulator will then move the bottom cover, containing the PCB and fuses, back to its carrier. The carrier will be passed on and merged in to the main conveyor.

5) Fuses quality control

To ensure that the fuses are correctly placed on the PCB, an image quality control is performed.



6) Top cover dispenser

A station is dedicated for a feeder to place the top cover. Note, that here the orientation of the top cover is important.

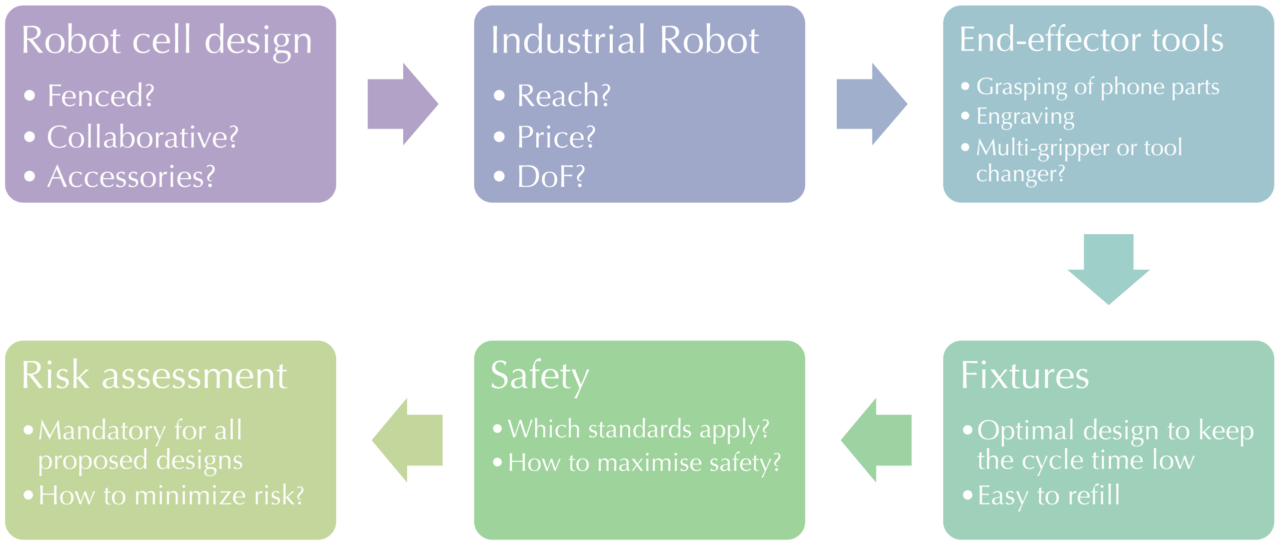
7) Manual pick up

At the end of a production, a mobile robot module is dedicated for manually picking of the finished smartphone.

8) Manual station

This is the only manual station with an operator where he/she can receive a light signal from the system and then repair a broken part.

CONSIDERATIONS FOR THE PROPOSED SOLUTION



CONSIDERATIONS FOR THE DESIGN OF A COBOT CELL

- Establish the physical limits (3D) of the cell or line, including other parts of a larger cell or system
- Manual intervention - Tasks that require manual intervention should be possible to perform from outside the safeguarded area
- Loading and unloading the workpieces
- Exchange gripper to enable grasping of all components
- Include a tool for engraving
- Requirements for and location of emergency stop devices and possible zoning of the cell (e.g. local stops or full cell stop)
- Requirements for and location of enabling devices
- Attention to the intended use of all components

PRELIMINARY SPECIFICATIONS

❖ Focus on one dummy phone at the time, but prepare your production for customizations.
❖ Design a module in the end of the line which can assemble all 9 variations.
❖ Input to the cell:
  ➢ Subcomponents placed on fixtures
❖ Output from the cell:
  ➢ Customized dummy mobile phone
❖ Cycle time: The total time it takes for all these processes is 243 seconds. If the carrier is doing a round on the FESTO CP Factory without doing any operations, it will take 140 seconds.
❖ Currently the slowest process in the system is the robot PCB assembly that takes 80 secs.
❖ The suggested robot cell should complete its pick and place tasks in less than 20 secs.
❖ No scratches are allowed to the product.

- The top cover has to be positioned with the correct orientation in order to fit.
- A risk assessment and general safety should be considered of utmost importance when industrial robots are utilized to work so close to humans.