



Lean Intelligent Assembly Automation (LIAA)

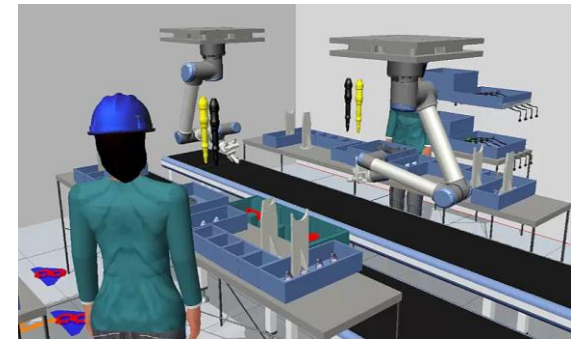
2nd Review - Motivation for LIAA from End-User PoV

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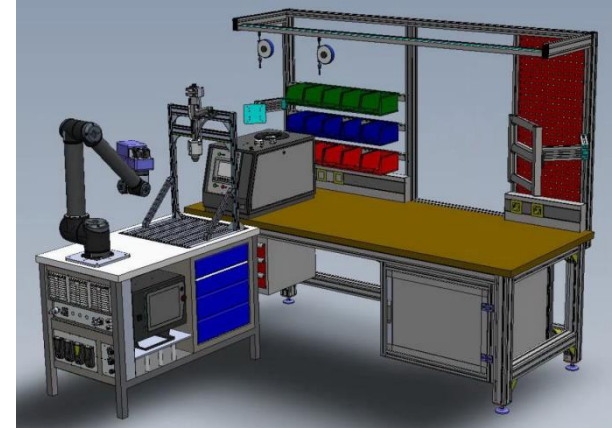


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- **Challenges**
 - **Shorter product lifecycle and increasing product variety**
 - Assembly: High percentage of manual labor
- **Benefits**
 - **Improved ergonomics**
 - Improved quality
 - Lower unit cost
- **Portability to other areas**
 - Result of first considerations: Portability is hard to achieve as assembly operations in powertrain assembly are very variable.
 - General learnings on robot-human interaction will be transferred

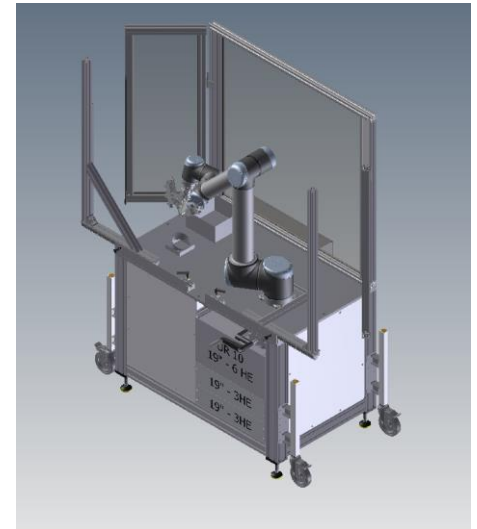


- Motivation and expected Benefits from Hybrid Workplaces:
 - **Optimize the assembly process** without spending a lot of money on expensive equipment
 - **Gather knowledge** in dealing with robots and
 - Establish automation also in other processes in the company
 - **Improve safety at work**
 - Relieve people at **ergonomically** difficult tasks
 - Establish automation of **small series** through the use of flexible equipment
 - Worker can carrying out other activities during robot is riveting
- Short cummings of current commercial solutions:
 - Rivet gun is very heavy
 - Only male workers at this station
 - Repetitive and boring task -> prone to errors

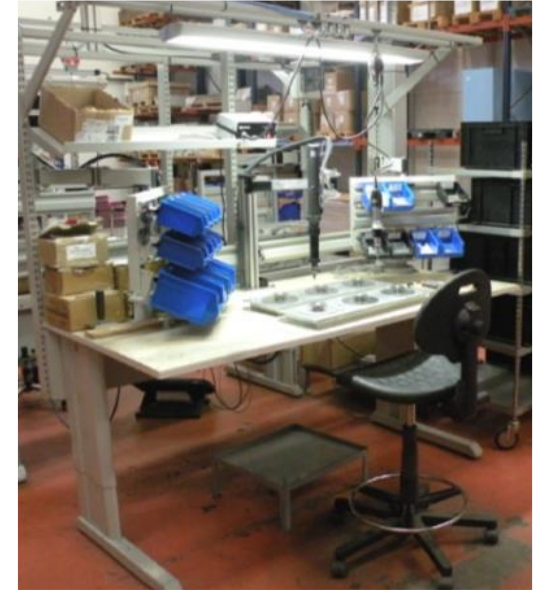


- Motivation and expected Benefits from Hybrid Workplaces:
 - Automate hand soldering process in a **flexible** way
 - Use the same robot cell for different products
 - Make robot automation **cost effective for small lot sizes**
 - Get the best of both worlds: humans do the parts they are good at (assembly), robot the **quality critical parts**
 - **Gain experiences** how worker and robots can collaborate
 - Have less trained people manufacture products so far only a skilled worker was capable of
 - **Simple and cost effective reprogramming** of the robot cell to support a new/another product
 - **Robot as a 3rd hand**

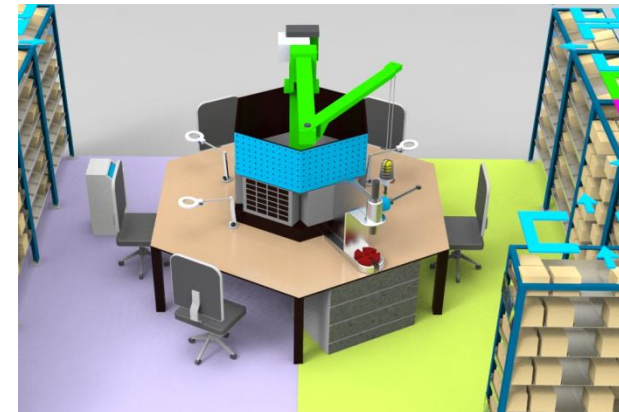
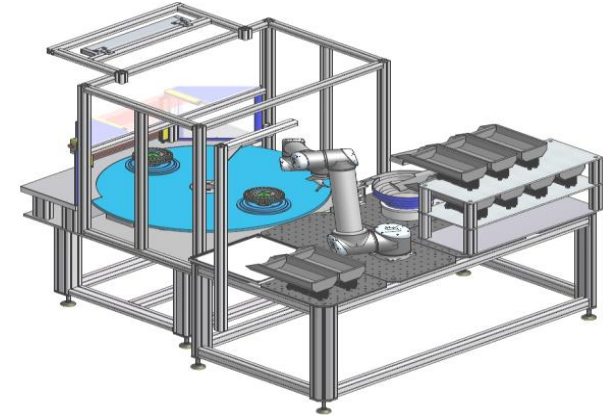
- Short cummings of current commercial solutions:
 - Hand soldering is the most prominent source for quality problems
 - To keep the error rate low only a few workers are allowed to manufacture certain quality sensitive products
 - Automation requires large lot sizes and works for one product only (no flexibility)
 - A flexible solution is not available



- Motivation and expected Benefits from Hybrid Workplaces:
 - The **variety** of antenna models is very big and the manufacturing size is very small, so high flexibility process is needed and traditional automation can't be used
 - The manufacturing process is currently 100% manual and very complex to be automated, then manual and automated operations has to be merged
 - The product is **under continuous evolution** and requires continuous changes in the process, so flexibility and quick and cheap adaptation of process is needed
 - Human can make some complex operation easy than a robot meanwhile the robot can do repetitive and accurate operations
 - Manufacturing time has to be reduced to reduce costs and increase productivity
- Short cummings of current commercial solutions:
 - To feed rivet machine is very slow
 - Repetitive work that makes to loose attention on quality
 - Ergonomic problems: repetitive movements on a static position



- Motivation and expected Benefits from Hybrid Workplaces:
 - Experimental verification of the main bearing assembly variability, in different batches and different types of bearing reducers
 - Repeatability of flexible cells in various configurations of human-robot, and direct connection to the testing of selected functional parameters in the process
 - **Increasing the productivity** for assembly works of main bearing by 100%
- Short cummings of current commercial solutions:
 - High share of manual work representing 100% of the unit assembly time
 - Risk of mistaking the tolerances of rollers (for other types)



- **In Summary:**

- End-user are interested in hybrid workplaces due to the following factors:
 - ***Ergonomics***
 - ***Quality***
 - and to a lesser extent ***Cost***
- Current automation solutions do not meet their requirements, due to the following challenges:
 - **Flexibility**
 - Small series production
 - Continuous adaptation to evolving product
 - **Cost effectiveness**
 - Too slow
 - Too expensive
 - **Safety of Worker**

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Thank you for your Attention!

Questions?



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