



*Robotic tEchnologies for the Manipulation  
of cOmplex Deformable Linear objects*

**REMODEL**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870133

# The REMODEL Project

*Current situation, needs, challenges and  
approach for automation in the wiring industry*

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# The REMODEL Consortium

Started Nov. 2019 - Finish in Oct. 2023



MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE



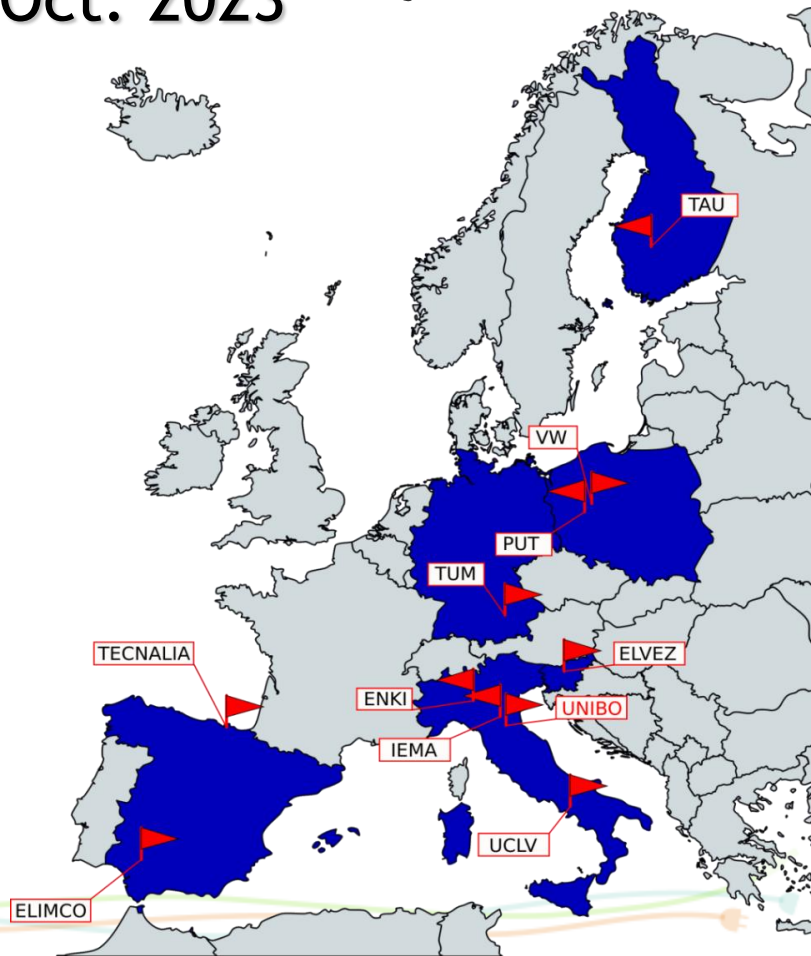
ELVEZ

## Advisory Board



UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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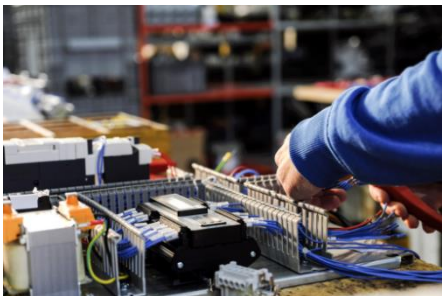


# Current Situation

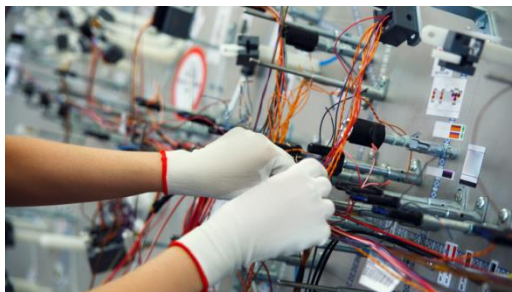
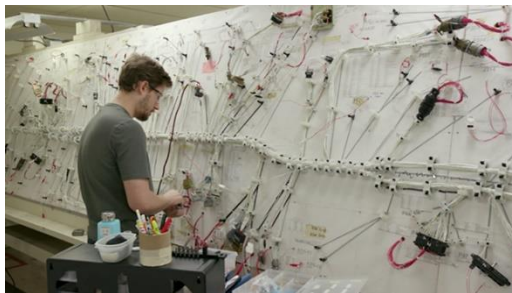


*Many Variants + Unpredictable Shape + Complex Manipulation = Manual Assembly*

*Switchgear Cabling*



*Wiring Harness Manufacturing*



*Wiring Harness Installation*





# Human Factors

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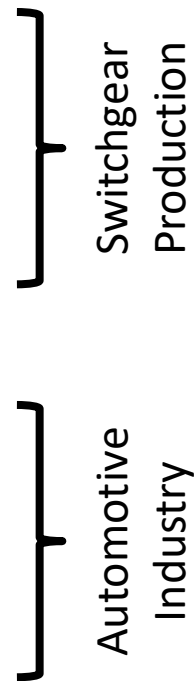
- All the use cases are characterized by:
  - Very repetitive and fast tasks
  - Continuous torsion and bending on arms and wrists
  - Standing position and forward bending
  - Production prone to human errors due to distraction and confusion





# Market Size and Requirements

- 10.8% CAGR during 2015-2020
- 19.2% of 2020 market in China (largest worldwide)
- USD 144.41Bn grow in 2021
  
- 12 million jobs in EU (€720Bn annual cost)
- Wiring Harness market size USD 93Bn by 2022 (5.1% CAGR )
- Majority of manufactures moved to low-labor-cost countries







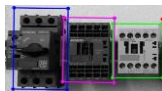
# Robotic *t*Echnologies for the Manipulation of *c*OMplex *D*eformable *E*Linear objects



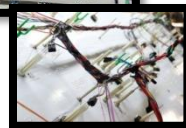
Worker Experience



Bimanual Manipulation



Detection and Tracking



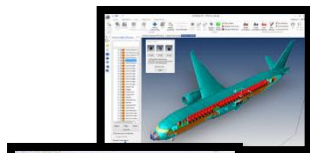
Semi-Finished Products



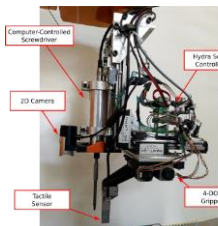
Human-Driven Manufacturing, Packaging and Inspection



Finished Products



Product Design



Mechatronics Tools



Action Segmentation, Classification and Storage



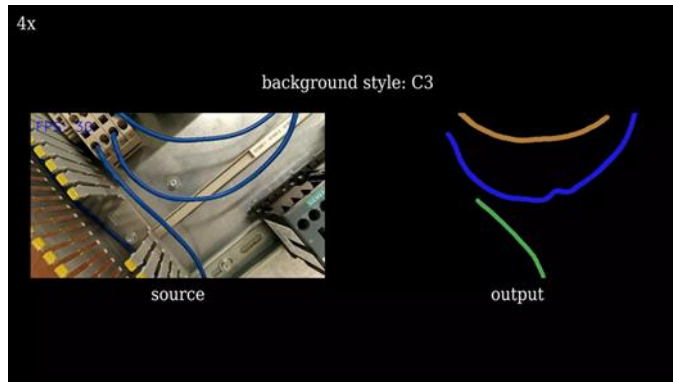
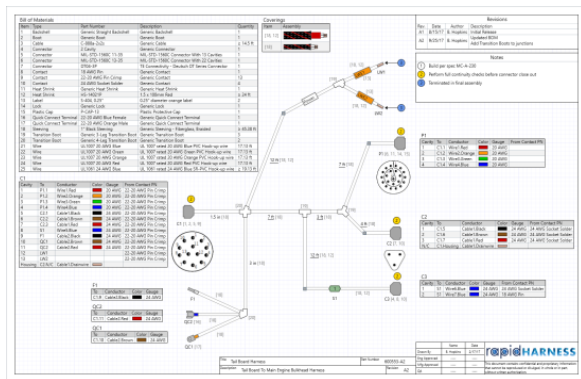


# Main Outcomes

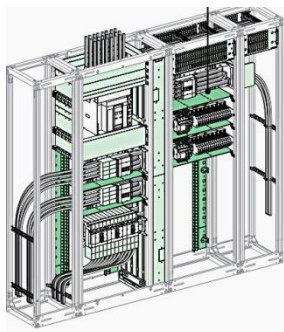


## Scene Perception and Interpretation

### Design Interpretation



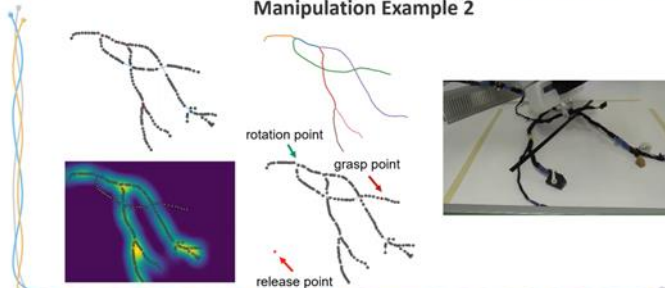
## Task and Manipulation Planning



Robotic Technologies for the Manipulation of Complex Deformable Linear Objects



### Manipulation Example 2

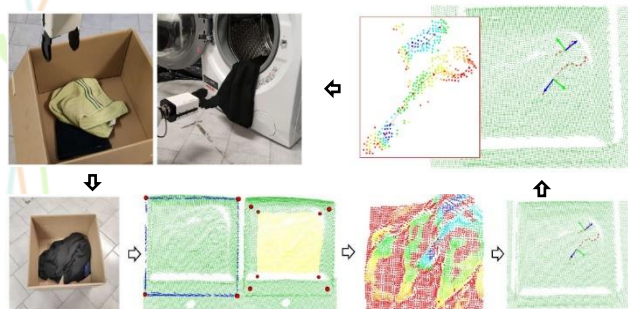




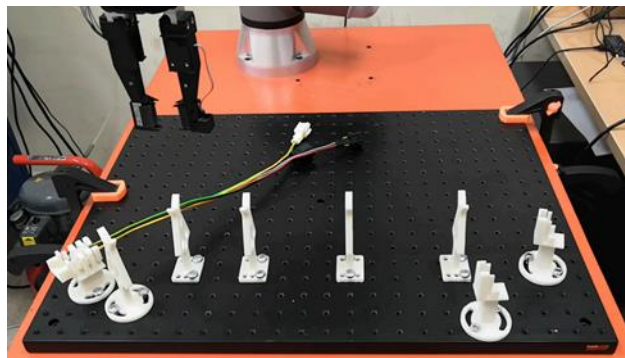
# Main Outcomes (2)



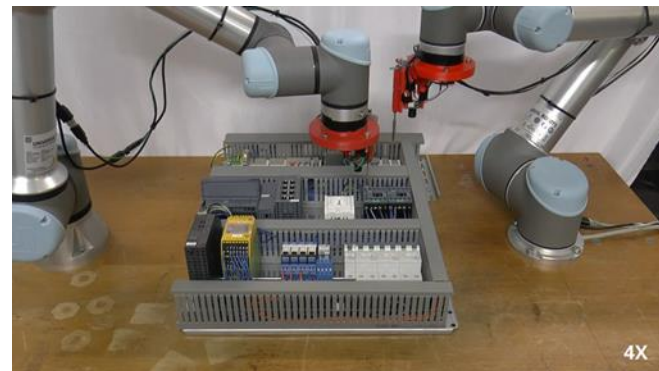
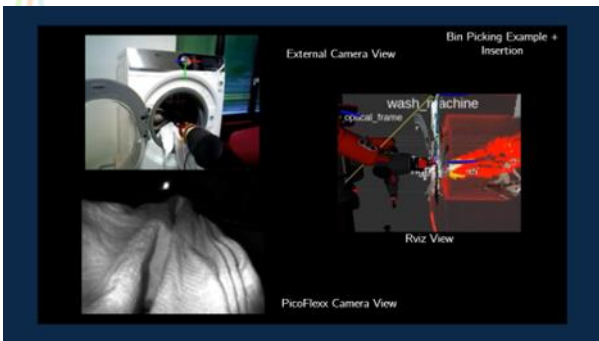
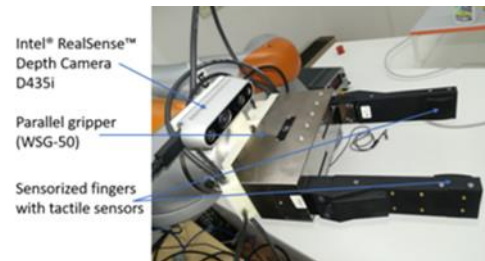
## Behavior Prediction



## Manipulation Capabilities



## Mechatronic Tools



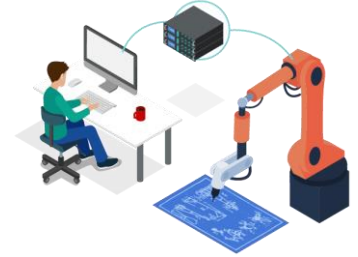




# Technological Challenges

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- Review of the design chain and integration with workers experience
- Low-level technology improvements in sensors and grippers
- Theoretical and methodological advancements in modelling and perception
- **Missing standardization for the implementation in industrial settings**



~~STANDARDS~~



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