Robotic Manipulation for the Toy industry: The SOFTMANBOT project

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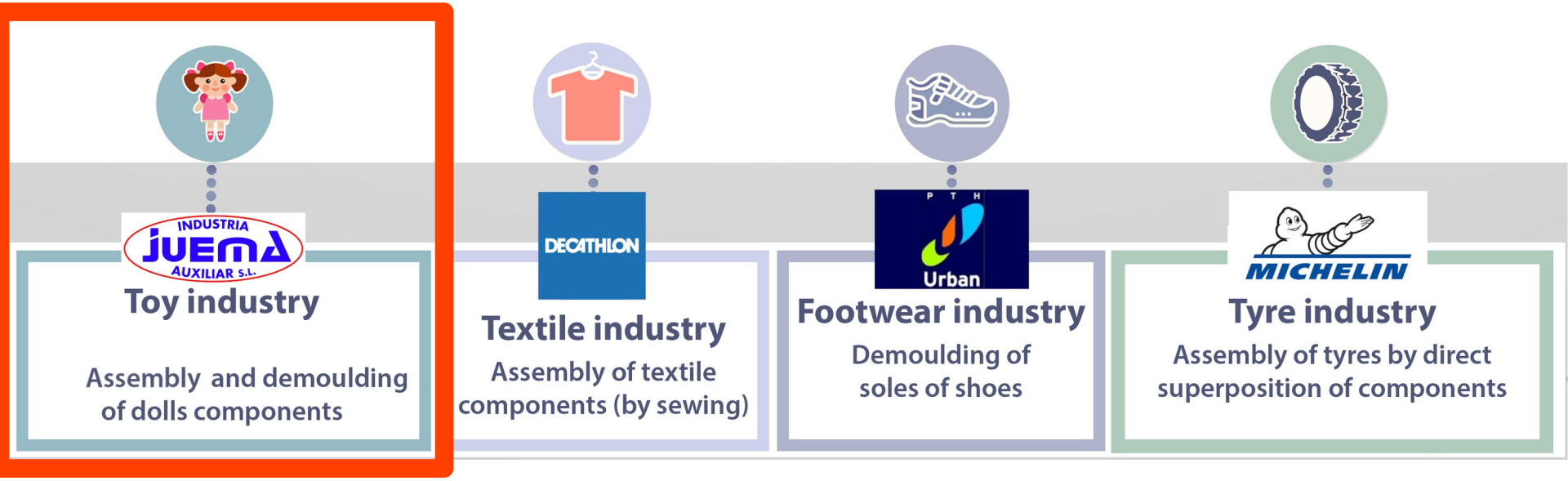
European Commission

Factories of the Future
Public Private Partnership

Current Industrial Situation

4 industrial sectors with similar problems:

- **Bring them back to Europe:** Production mainly in Asia
- **Complex handling** of multi-material flexible products
- **Human-centered** production: ergonomics and attractiveness



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Current Industrial Situation

- **End User:** JUEMA factory (Alicante, Spain)

- **Types of product manufactured:** Dolls manufacturing.
- **Raw materials:** Powdered and liquid polymers, soft plastic.
- **Manufacturing processes:** Rotational molding process for dolls manufacturing. The parts of the dolls are made in batteries of 10 to 20 molds and are then extracted and assembled manually.

https://youtu.be/fJn934xeeVk

https://youtu.be/5zpV3qhA2oc

https://youtu.be/YCA1D2GxffY

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Needs and specifity of a robotic cell in this use-case

Needs:

- To develop a robotic systems capable of obtaining **acceptable processing speeds** during the extraction and assembly of parts.
- There are a high set of molds mounted in a frame with a **no fixed position, different size, and forms**.
- The **force and the dexterity** needed to assemble the dolls may vary from one piece to another.
- **High variability** in parts quantity, colour and hardness.
- Workers‘ health problems due to **repetitive tasks**.

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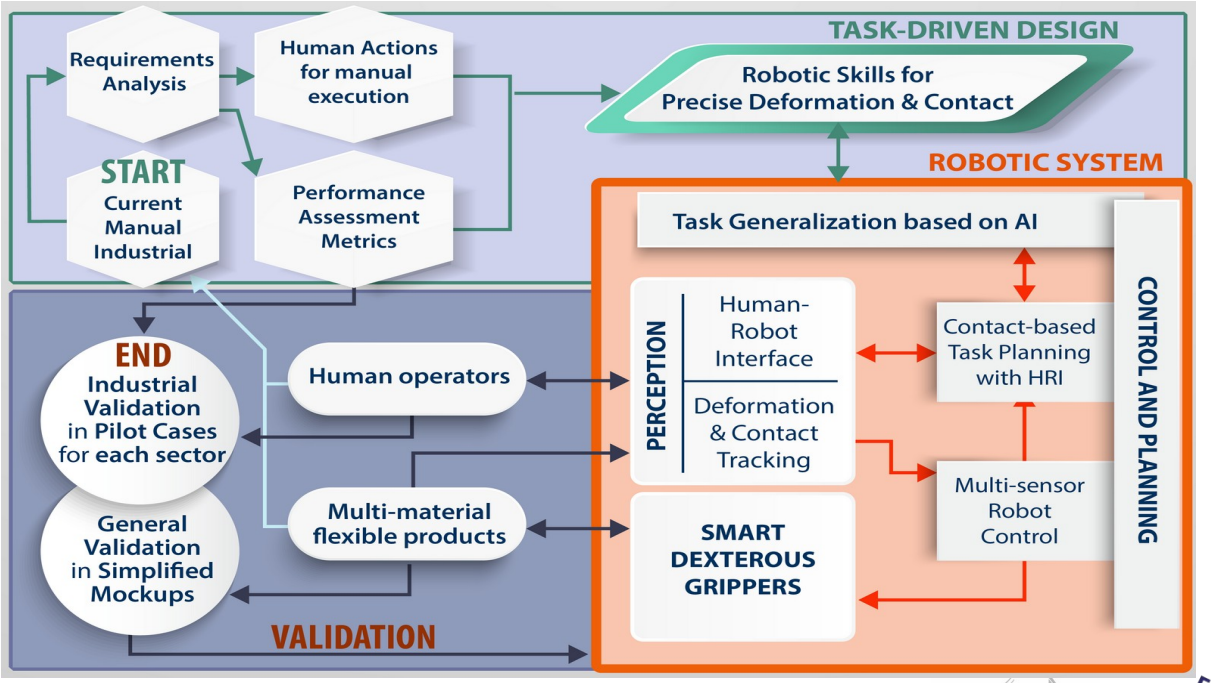
Technological challenges and proposed approach

Technological challenges → Proposed solution

- To develop handling systems for extracting pieces and their assembly → **Specific grippers**
- To identify the mold/pieces and locate them over the mold frame/assembly table → **Generalization**
- To control pieces deformation while manipulating them → **Multi-modal** perception and control (vision+force+tactile)

Proposed approach:



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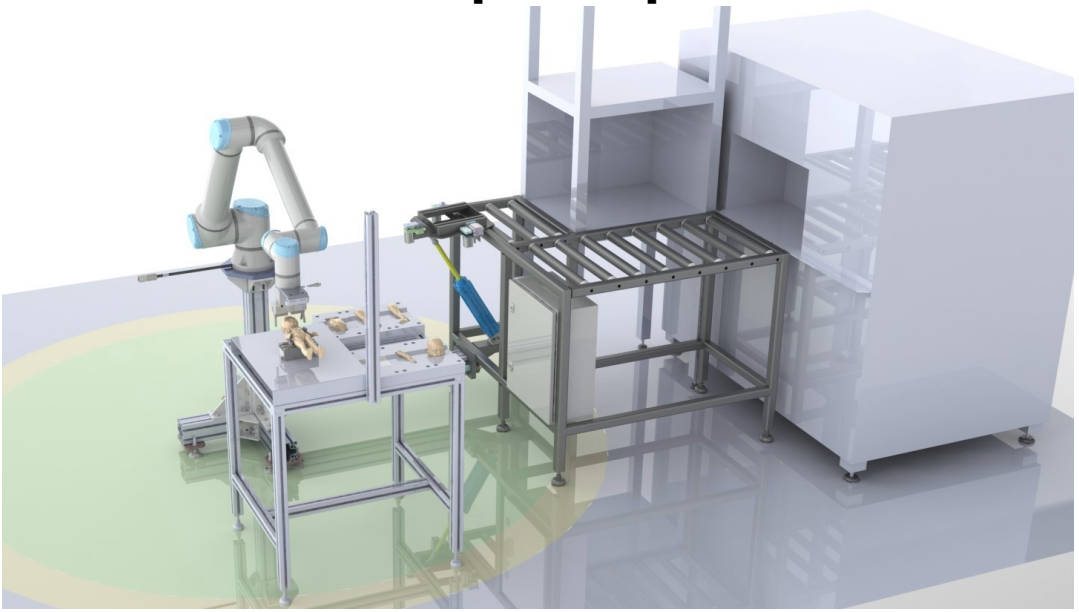
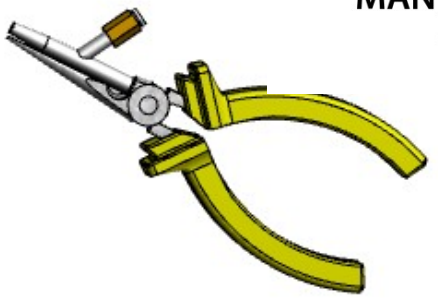
Technological challenges and proposed approach

Current Mockup (Simplified scenario)



Design of a robotic cell with all the environment elements: furnace, molds...



Specific gripper: pliers with vacuum

Learning from human demonstration: vision+IMUs

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Elements that can be applied to other cases

Definition of robotic skills common to several use-cases

[T1] Soft Material Sheets Manipulation		[T2] Demoulding		[T3] Soft pieces assembly
Michelin	**Decathlon**	**Juema**	**Plastinher**	**Juema**
[T1.S1] Precise positioning of a 2D layer with minimum deformation Reconstruction, Grasping, Shape control		[T2.S1] Optimize grasping configuration for pulling motion, avoiding sliding Reconstruction, Grasping		[T3.S1] Optimize grasping for pushing one doll component inside another Reconstruction, Grasping
		[T2.S2] Detaching operations for introducing air in the mold, avoiding sliding Reconstruction, Shape control		[T3.S2] Pushing-rotating one component inside the hole of another (with opening motion) Reconstruction, Shape control
[T1.S2] Wrapping a 2D layer around a 3D support Reconstruction, Shape control		[T2.S3] Pulling while minimizing deformation and avoiding sliding Reconstruction, Shape control		Reconstruction, Grasping
[T1.S3] Precise joining of 2 layers Reconstruction, Shape control		[T2.S4] Re-grasping if failure (sliding) or not complete extraction Reconstruction, Grasping		[T3.S3] Re-grasping of one/two doll's component/s that are slipping or cannot inserted

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Elements that can be applied to other cases

- **Common software platform** based on ROS
- **Common gripper** technologies with sensor integration
- **Common integrator** that guarantees coherence

https://softmanbot.eu/

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