



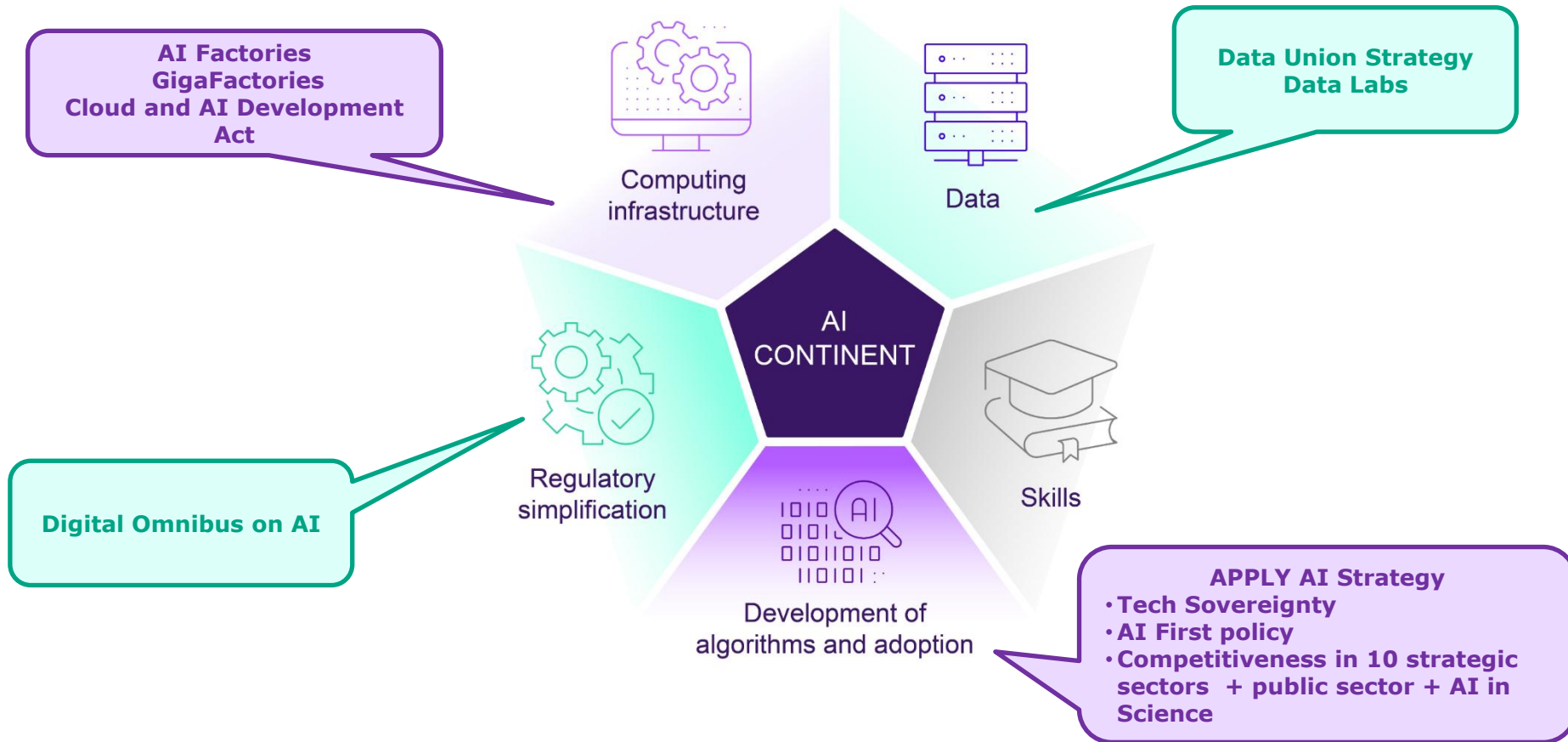
Soft Manipulation in recent EC-Funded Projects

Progress, Achievements, and the Automation Gap

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AI Continent Action Plan – 9 April 2025





Apply AI Strategy

8 October 2025

Apply AI Strategy: Key actions for the strategic sectors



Healthcare and pharma

Deploy AI-powered screening centres to improve detection and diagnosis.



Agrifood

Create an Agri-food AI platform for specialised farming apps to reach the market.



Robotics

Establish a Catalyst for the Uptake of European Robotics to boost innovation.



Manufacturing, engineering and construction

Develop advanced AI models and agents for manufacturing.



Mobility, transport and automotive

Launch an Autonomous Drive Ambition Cities initiative to accelerate the use of self-driving vehicles.



Electronic communications

Create an AI platform for telecoms operators to build AI elements.



Cultural and creative sectors, and media

Foster EU micro-studios specialising in AI-enhanced virtual production.



Climate and environment

Deploy an AI-Earth model for better weather forecasts, Earth monitoring, and prediction.



Energy

Support a generative AI-enabled backbone to better balance energy generation and demand.



Public sector

Build an AI toolbox with open-source reusable tools and solutions.



Defence, security and space

Deploy secure infrastructure for the development and training of defence AI models.

INPUT STACK

Integration
Frameworks



Flexible
Robotics
Platforms



Foundation
Models for
Robotics



Compute



Data



European Robotics Catalyst

Autonomy
Real Time
Robust
Safe

Robots' Skills
Booster



User driven
Real-World
testing

Robots' Skills
Qualification
Centres



User driven
Sequential funding
Mission oriented/
impact driven

ACCELERATION PIPELINES

TRL 1 TRL 5 TRL 9
Manufacturing Use Case

Agrifood Use Case

Healthcare Use Case



Testing and
Experimentation Facilities



European Digital
Innovation Hubs



Skills



Objective: End-user driven robotics excellence,
from the lab, to large-scale deployment

Automation Gap in Textile Industry

- Textile industry employs ~300 M people worldwide.
- EU Textile Strategy targets 100% reusable or recyclable textiles by 2030.
- Ageing populations drive demand for robotic assistance in dressing, handling of Personal Protection Equipment and management of clinical textile management.
- Automation has conquered rigid manufacturing. But tasks involving soft materials — folding laundry, assembling garments, sorting recycled textiles, disassembly — remain almost entirely manual.

"Cloth manipulation is one of the last great unsolved problems in robotics."

~ Review of Robotic Cloth Manipulation, Annual Reviews 2024

Some recent EU-funded projects

- **ROMANDIC** (Organising this event) - Network of Excellence · Community & knowledge transfer in deformable manipulation.
- **FlexCycle** (Session 4) - Flexible robotics for soft material recycling: textiles, cables & membranes.
- **SoftEnable** (Session 4) - Soft fixture primitives for safe manipulation in healthcare & food.
- **TORNADO** (Session 4) - Foundation models for small, soft and deformable object handling.
- **MOZART** - Textile-like morphing mats as grippers · manipulation of food items.
- **SWAG** - Introducing structural compliance directly into robot limbs, combining soft mechanics with highly precise control.
- **BACCHUS** - Mobile robotics platforms for active inspection and harvesting in agricultural areas.

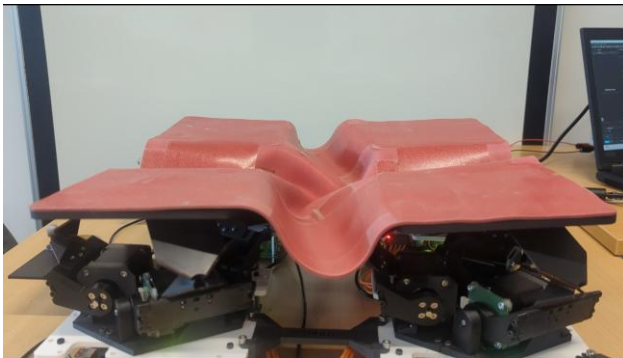
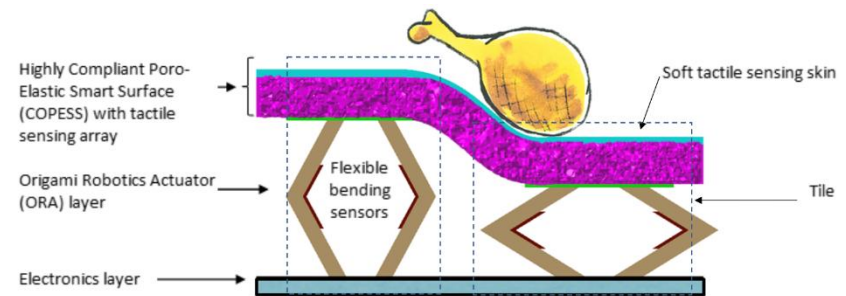
MOZART - Scaling Soft Manipulation for Delicate Industries 1/2

- **MOZART** focuses on the automated handling of flexible and delicate materials (like food products or soft materials) using textile-like deformable mats as the end-effector.
 - *In the context of this workshop, the perspective is reversed, not considering textiles as objects to be manipulated, but using textile to manipulate fragile objects.*
- **Main technologies:**
 - Origami-inspired deformable modular mat structures replace rigid grippers.
 - Embedded soft sensing skins with distributed AI control.
 - Adaptive surface conforms to heterogeneous, fragile objects.
 - Demonstration: fish de-scaling, chicken sorting & packaging.

MOZART - Scaling Soft Manipulation for Delicate Industries 2/2

Major Achievements:

- **Advanced Sensing:** Integration of smart, compliant grippers with tactile sensing to prevent damage to fragile items.
- **AI-Driven Control:** Using machine learning to help soft grippers dynamically adapt to unpredictable shapes and textures.
- **Industrial Viability:** Demonstrating that soft robotics can meet high-speed, hygienic, and scalable production standards.



SWAG - Soft Wrists and Grippers for Advanced Manipulation

- **SWAG** introduces structural compliance directly into robot limbs, combining soft mechanics with highly precise control.
- Major Achievements:
 - **Compliant Hardware:** Developing innovative "soft wrists" and multi-material grippers that mimic human anatomical flexibility.
 - **Safety by Design:** Creating inherently safe robotic systems capable of close-proximity, physical Human-Robot Collaboration.
 - **Robustness:** Overcoming traditional durability issues by utilizing advanced, resilient elastomeric materials.

BACCHUS - Mobile robotics platforms for active inspection and harvesting in agricultural areas

Autonomous mobile robotics for high-value crops

- Smart mobile platform with **dual manipulators** for active inspection and selective harvesting
- Tested in vineyards to monitor vine condition and harvest different grape varieties
- Designed to replace labor-intensive manual tasks while preserving crop quality

Primary use cases

Harvesting wine & table grapes

Inspection & Yield prediction

Thinning small wine grapes

Funghi detection & removal



Robot harvesting



Vineyard inspection and yield prediction

Soft manipulation: harvesting without damage

BACCHUS uses human-like, bi-manual manipulation: one arm perceives and cuts; the other gently holds and stabilizes the grape cluster.

1 Active perception

RGB-D cameras identify grapes, leaves and stems for safe, collision-free motion.

2 Bi-manual control

A camera/cutter arm works with a soft-gripper arm to stabilize the cluster.



3 Custom soft gripper

3D-printed fingertips are tailored to crop geometry using parametric models and demonstrations.

4 Gentle cut & hold

The stem is cut while the grape cluster is securely supported, reducing bruising and loss.

Key Challenges - What Stands Between Lab Breakthroughs and Large-Scale Adoption in Industry?

- **Perception:** very difficult, even with advanced vision and haptic, to understand how a tissue is folded or crumpled, as key geometric features might be hidden.
- **Control:** Soft materials have infinite degrees of freedom, making precise mathematical modeling and real-time control highly complex, and they deform during interaction, invalidating prior models.
- **Contact physics and gripping:** Complex friction, stiffness, wrinkling — hard to simulate
- **Speed vs. Precision:** Achieving the rapid cycle times required by industry while maintaining gentle, precise handling.
- **Standardization:** Lack standards datasets, shared performance metrics and safety certifications for soft materials.

Conclusion & Future Outlook

- A **rich EU ecosystem** addresses deformable manipulation from complementary angles.
- **Way Forward:** Hybrid systems combining the strength of rigid robotics with the adaptability of soft manipulation (as demonstrated by MOZART and SWAG).
- **Expected Impact:** Unlocking automation for sectors previously deemed "un-automatable," such as complex food processing, fragile logistics, and flexible assembly.
- If this research field is assessed as being a priority for European industry, it should accordingly become a **sustained priority for EC funding under the European Robotics Catalyst.**

Thank you for your attention!
Any further question?

