AI, Data and Robotics for the critical raw materials crisis

Nabil Belbachir

Research Director, DARWIN @NORCE (Data, AI, Robotics, Vision, Norway)
CTO, DIH Oceanopolis AS
Director eu-robotics Aisbl (EU association)
Co-editor SRIDA, ADRA Aisbl (EU Partnership)

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Passion for knowledge – together for sustainability

Globalization and the actual transition

Globalization resulting supply to Europe to be more sensitive to conflicts and disruption.

Increasing wars and conflicts

Impact and effects:

New priorities (e.g., militarization of the world), supply disruption affecting welfare and growth.

China' housing market crash and subsequent crises

Impact and effects:

Middle class lost their savings, consumer spending decline, deflation, Norway/ Europe export crashing and many companies are at recession.

Raising polarization: radicalization and strong nationalism increasing

Impact and effects:

Export control, trade war, protectionism, fragmentation, and polarization. (No winners). Largest loser: Society

Keywords from the actual priorities

Sovereignty

Bureau of Industry and Security
U.S. Department of Commerce

FOR IMMEDIATE RELEASE
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www.bis.doc.gov

BUREAU OF INDUSTRY AND SECURITY
Office of Congressional and Public Affairs
OCPA@bis.doc.gov

Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)

Washington, D.C.—The Department of Commerce's Bureau of Industry and Security (BIS) is implementing a series of targeted updates to its export controls as part of BIS's ongoing efforts to protect U.S. national security and foreign policy interests. These updates will restrict the People's Republic of China's (PRC's) ability to both purchase and manufacture certain high-end chips used in military applications and build on prior policies, company-specific actions, and less public regulatory, legal, and enforcement actions taken by BIS.

Mostly following the National Security Strategy of US government

Technological competitiveness

Depending on technology (e.g., AI) supply chain outside Europe, companies having customers monopoly

Strategic autonomy

Relying on chips from Asia (Four Asian countries supply 90% of world electronic needs)

Resilience

Depending on critical raw materials from China (germanium and gallium restricted in 2023, antimony in 2024…etc.)

Way too big challenges requiring coordinated actions and alliances

Why critical raw materials are important?

Critical raw materials are strategic ingredients (metals and minerals) in key technologies, which are essential for the green shift, digitalisation, industrial and military products. They are critical, because our economy is dependent of them and there is a risk with their supply (one country control most of the supply).

Antimony (Sb)

Use: Flame retardants, in alloys (with tin and lead) for hardening, mechanical strength.

Applications: Solar cells, semiconductors, defence technologies (ammunition), batteries.

Properties: Toxic, high purity for high value of use.

Neodymium (Nd)

Use: Permanent magnet (alloyed with iron and boron).

Applications: motor, laser, ceramic, capacitor.

Properties: less toxic, metal dust is combustible with explosion hazard risk.

There is a long list of critical raw materials (Source European Commission 2023)

How to secure the supply?

Mountain Pass mine in CA (USA) Photo: Tmy350

Conventional Mining

Europe has natural reserves on critical raw materials. However,

1. Mining business is costly & maybe not viable.
2. Mining has severe negative impacts on the environment, society and the climate.
3. The process may take few years ahead to get established.

The solution is not immediate and will not solve the actual crisis

Urban Mining

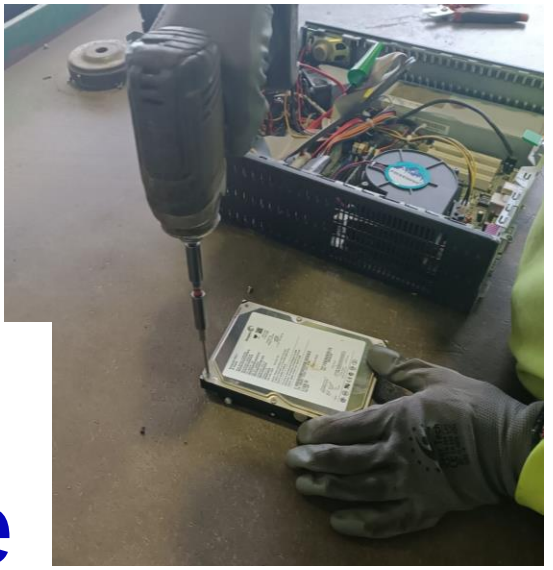
Exploiting anthropogenic stocks (waste products after use by humans) as a source for recovering raw materials.

Collection of discarded products and the return of recovered raw materials to the economy.

Potentially quicker solution to the crisis?

Actual status of urban mining

Manual sorting f



Manual disassembly

Manual processes are not sustainable and will not solve the actual crisis.

Manual dismantling

Recovery of materials from landfill is not fully explored

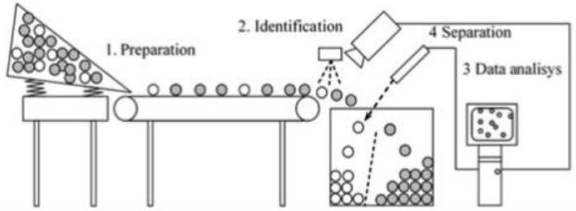
Example:
Horizon Europe
iBot4CRMs

9,5	18	8	4	4
€ mill.	partners	EU countries	Pilots	Years 2024 - 2028

Co-funded by the European Union

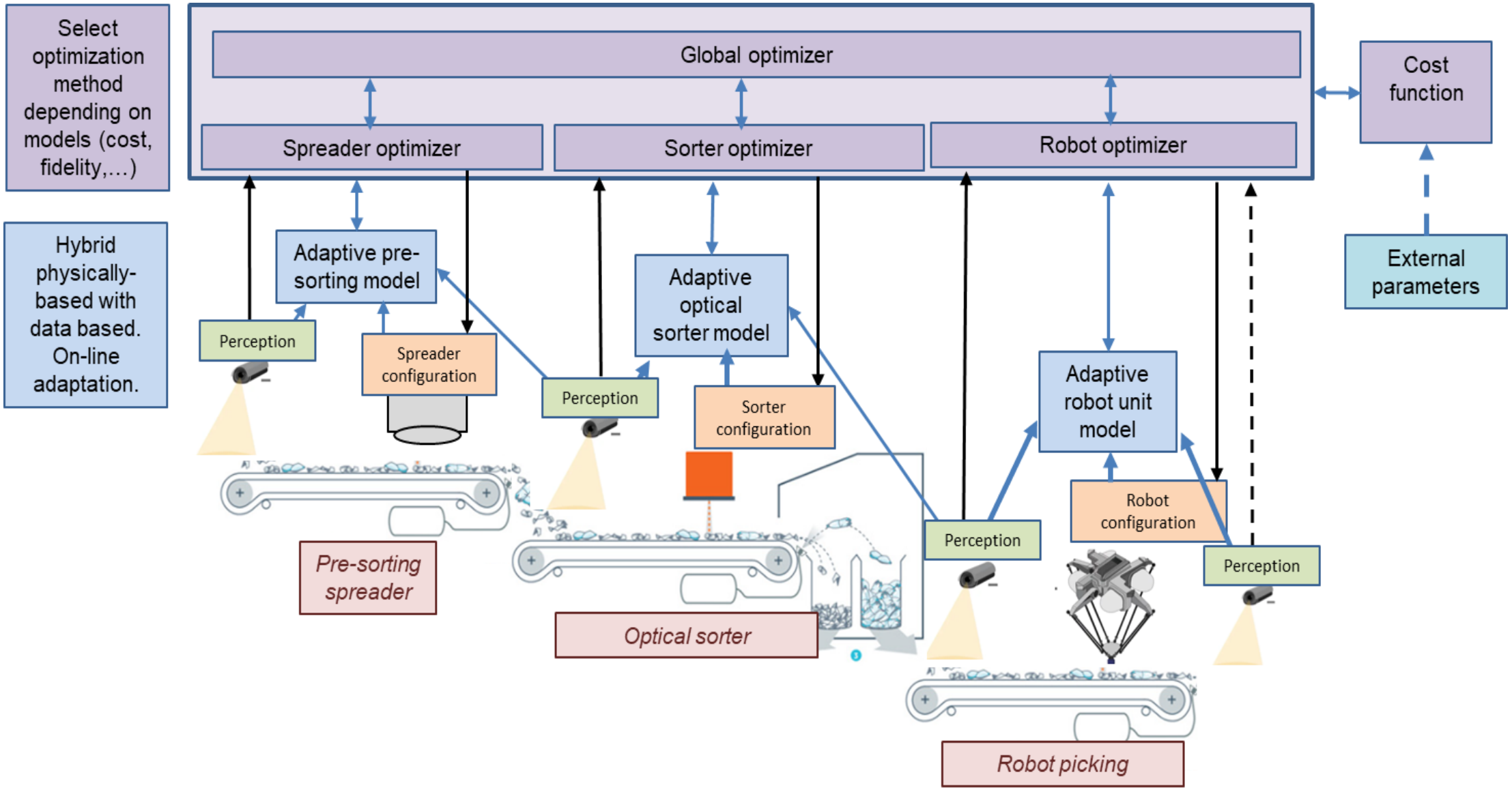
Coordinated by NORCE

iBot4CRMs AI-powered self-learning robots for high-performance waste valorization and Critical Raw Materials recovery



Funded by the European Union

The challenge is big and we do not target many CRMs. Focus on maturing the solutions for few CRMs



The role of Data

- Many critical raw materials are at 0% of recovery nowadays due to many reasons e.g.,
  - Lack of information of the content of end-of life products (e.g., confidentiality, costs).
  - Diversity of end-of-life products: Changing per type, application, producers, technologies.
  - Progress in digital product information is not globally mature.

- Data are key:
  - Building secure data spaces that can be populated with products' information for responsible use.
  - Digital operation platform: A data platform that serves for traceability of the product details (production, supply, origin and amount of material).
  - Digital product passport: Product ID that enable connecting production with circularity.

The role of AI

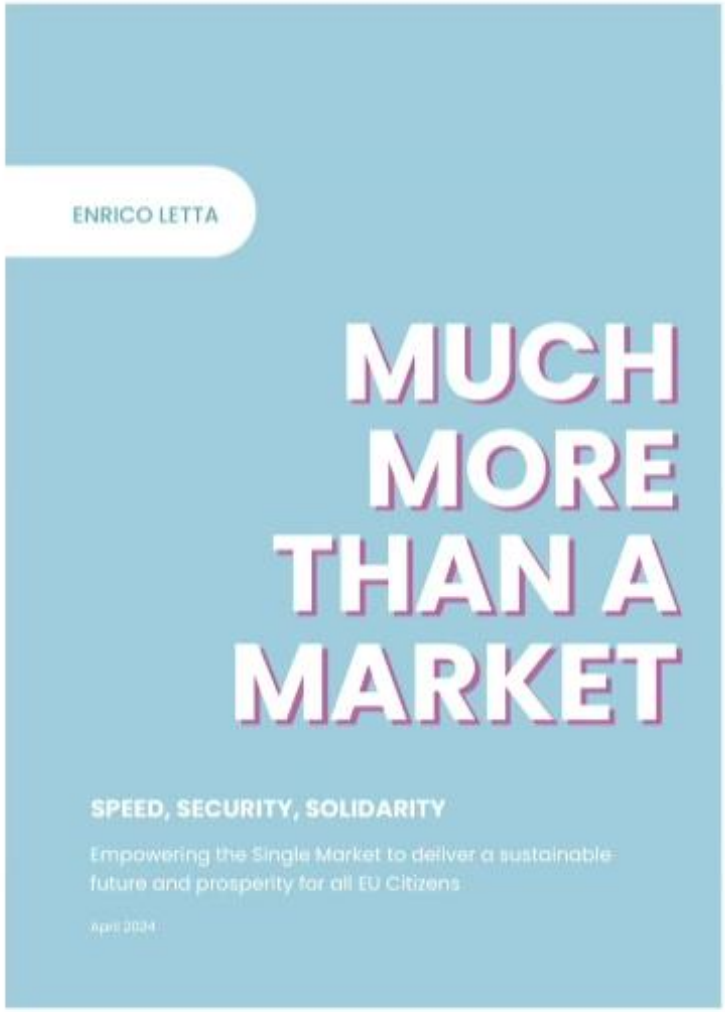
- Recovery of critical raw materials mainly relies on human work for many reasons e.g.,
  - Lack of technologies that can perceive sparse materials in a large waste stream.
  - Diverse end-of-life products require labour to setup sorting systems and adapt to each product specifically.
  - Not possible to know beforehand the types and amount of critical raw materials contained in the waste. Humans have first to find out.
- AI is key:
  - Automating sorting processes to different streams and products types.
  - Enhancing the perception of critical raw materials within waste by mining into multimodal sensor data.
  - Building up new data models and new scenarios that enable to train machine learning algorithms for robust detection and localization of critical raw materials

The role of Robotics

- Recovery of critical raw materials is purely manual works e.g.,
  - Dismantling and disassembly of end-of-life products is a complex task.
  - Lack of detailed information of end-of-life products and their wide diversity make pre-programmed and planned robotics manipulation impossible.
  - Lack of high-precision and flexible grippers for managing diverse products' type, size and weights.

- Robotic is key:
  - Design a completely new generation of end-effectors (e.g., new materials, new design) to handle diverse types of waste products.
  - Design a completely new type of control systems to enable effective and self-adaptive manipulation for disassembly of dismantling of waste products.
  - Improve the capabilities in functionalities and performance of robots for precisely picking (sorting out) materials of waste streams.

Three important reports:



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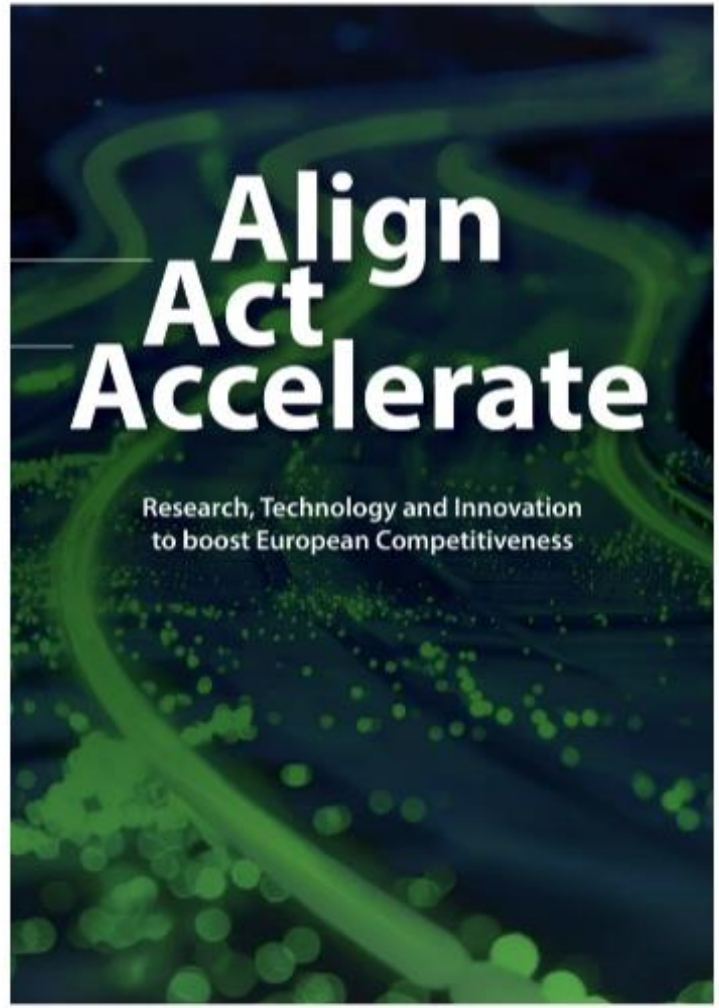

High-level-group (Heitor)

Three transformations ahead for Europe

1. **Closing the innovation gap** → *accelerate innovation and find new growth engines.*
2. **A joint decarbonisation and competitiveness plan** →*bring down high energy prices while continuing to decarbonise*.
3. **Increasing security and reducing dependencies** → *react to a world of less stable geopolitics, where dependencies are becoming vulnerabilities and it can no longer rely on others for its security*.

The AI Data Robotics Association

Highlight: AI, Data and Robotics to strengthen the resilience of Europe along the **critical value chains.**

https://adr-association.eu/srida

Editors
- Fredrik Heintz (LiU),
- Nabil Belbachir (NORCE),
- Edward Curry (Insight Centre/Galway).

Coordination team
- Ana Garcia (BDVA),
- Katerina Linden (LiU),
- Philip Piatkiewicz (Adra Secretary General),
- Joost Geurts (interim Adra Secretary General).

Reference Group
- Jon Agirre Ibarbia (Tecnalia),
- David Bisset (euRobotics),
- Freek Bomhof (BDVA),
- Rita Cucchiara (UNIMORE),
- Hans De Canck (FARI),
- Anne Hermsen (TNO),
- Morten Irgens (CBS),
- Christophe Leroux (CEA),
- Petri Myllymäki (HIIT),
- José Saenz (Fraunhofer).

Contributors
- Daniel Alonso (BDVA),
- Freek Bomhof (TNO),
- Rafiqul Haque (Insight Centre/Galway),
- Agirre Ibarbia (Tecnalia),
- Samuel Kaski (Aalto),
- Yiannis Kompatsiaris (CERTH-ITI),
- Marko Grobelnik (IJS),
- Stefan Leijnen (AiNed),
- Christophe Leroux (CEA),
- Paul Lukowicz (DFKI),
- Jessica Montgomery (AI@Cam),
- Chokri Mraidha (CEA),
- Alin Olimpiu (DLR),
- Marc Schoenauer (Inria),
- Morayo Sdedjouma (CEA),
- Rebecca Schedl-Warpup (DLR),
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Glossary of Terms

AAAI - Association for the Advancement of Artificial Intelligence
ADR - AI, Data, and Robotics
AI - Artificial Intelligence
AutoML - Automated Machine Learning
CVPR - Computer Vision and Pattern Recognition
EU - European Union
HPC - High Performance Computing
HRC - Human-Robot Collaboration
HRI - Human-Robot Interaction
ICCV - International Conference on Computer Vision
ICML - International Conference on Machine Learning
ICRA - International Conference on Robotics and Automation
IFR - International Federation of Robotics
IJCAI - International Joint Conferences on Artificial Intelligence
IoT - Internet of Things
ML - Machine Learning
NeurIPS - Neural Information Processing Systems
PAMI - IEEE Transactions on Pattern Analysis and Machine Intelligence
R&D - Research and Development
SDG - Strategic Development Goals
SME - Small and Medium Organisations
WP - Work Programme

A Unified Vision for European Robotics

A Strategy for Innovation, Growth and Societal Impact

eu-robotics.net

About euRobotics

euRobotics (eu-robotics.net) is an international non-profit association for all stakeholders in European robotics. Established in September 2012 and serving its founding purpose: to strengthen Europe's competitiveness and to ensure industrial leadership of manufacturers, providers and end-users of robotics technology-based systems and services, it forms the largest network of roboticists and business in Europe with about 250 institutional members, covering small and large companies, associations and institutions, universities, laboratories and RTOs.

The objectives of euRobotics are to boost European robotics research, development and innovation, to foster a positive perception of robotics, to support the widest and most effective uptake of robotics technologies and services for professional and private use, and to ensure the excellence of the robotics science base in Europe is maintained. euRobotics is a founding member of the AI, Data and Robotics Association (ADRA) and was the private partner in the SPARC partnership with the EC during Horizon 2020.

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https://eu-robotics.net/strategy/

Key recommendations from eu-robotics vision

- Make **robotics a policy priority for Europe** harnessing on its transformative power for resilience and sovereignty and for driving progress and prosperity.
- Recognize and **actively support the full robotics innovation pathway** and maintain **sovereignty over robotics capabilities**.
- **Investment**:
  - Increase the scale and agility of investment in research and innovation.
  - Focus long-term support on the unique challenges of robotics uptake.
  - Provide tailored support for robotics scale-up.
- **Collaboration & Skills:**
  - Stimulate collaboration between end-users, technology innovators, and research.
  - Create a European skills framework.
  - Improve societal awareness and acceptance of robotics.
- **Strategic Focus**:
  - A unified and long-term European approach to robotics, recognizing its importance and ensuring its responsible development.
  - Europe has an opportunity, given its current advantage in robotics and its expertise in AI, to take a global lead in developing the AI that robotics needs. It urgently requires a strategic focus to be placed on robotics to fully exploit Europe's current strength and leadership in Robotics.

Thank you. Takk. Kiitos.

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norceresearch.no nabe@NORCEresearch.no

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