GUIDE FOR APPLICANTS

euROBIN 1st Open Call
for Technology Exchange Programme

Submission of applications starts on
28th of February 2023 at 13:00 Brussels Time

Submission deadline:
10th of May 2023 at 17:00 Brussels Time

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Basic Info about euROBIN™

euROBIN is the Network of Excellence that brings together European expertise on Robotics and Artificial Intelligence (AI). It will establish a unified pan-European platform for research and development. For the first time, a large number of distinguished research labs across Europe are jointly researching AI-Based Robotics. Goals include both significant scientific advances on core questions of AI-based robotics as well as strengthening the scientific robotics community in Europe by providing an integrative community platform. The network is open to the entire robotics community and provides mechanisms of cascade funding to double its number of members over the next years.

euROBIN comprises **31 partners across 14 countries**. It is coordinated by the Institute of Robotics of Mechatronics of the German Aerospace Center (Deutsches Zentrum für Luft - und Raumfahrt e.V.) and includes the highest-profile research institutions as well as outstanding industrial partners across sectors.

The total euROBIN budget of cascade funding (Financial Support to Third Parties- FSTP) is **€ 2 280 000** of which **€ 1 560 000** will be distributed under 3 Open Calls for the 'Technology Exchange Programme' and **€ 720 000** will be distributed under 2 Open Calls for the 'Collaborative Projects'.

The total budget of the 1st Open Call for the Technology Exchange Programme is up to **€ 600 000.**
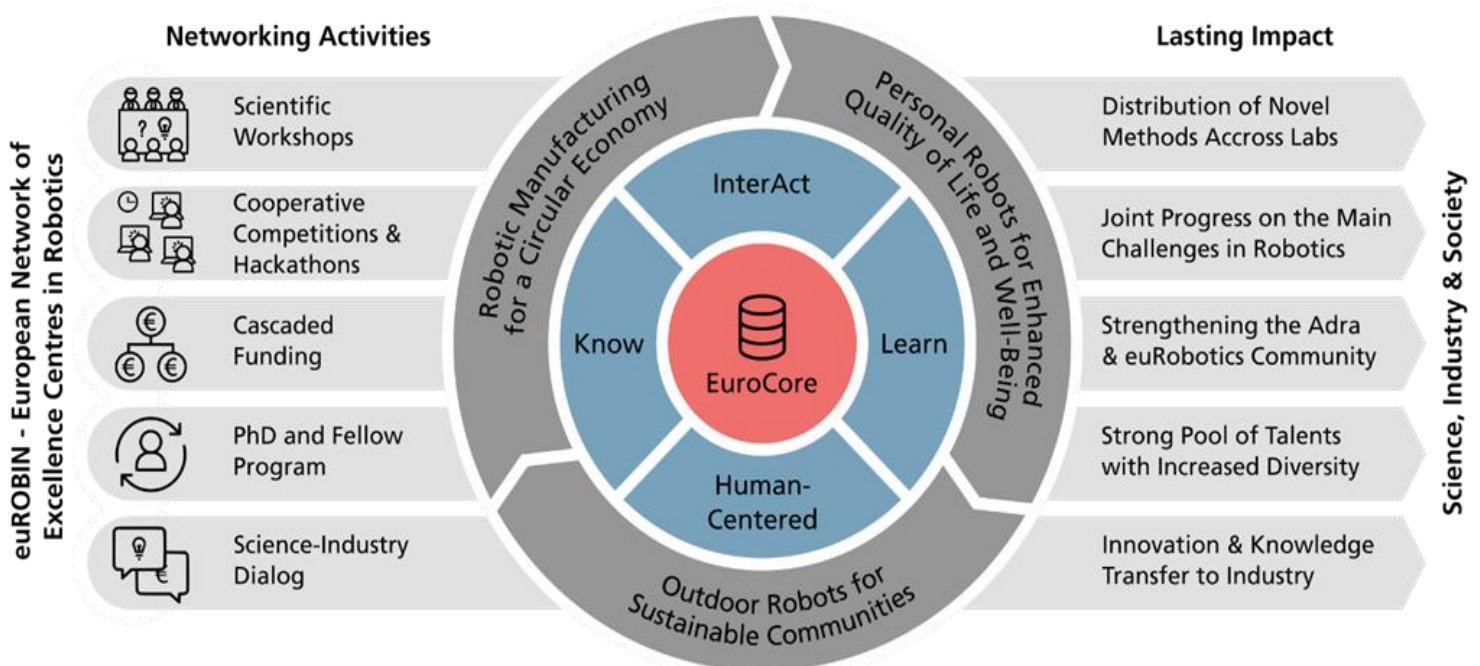

Figure 1 The euROBIN networking concept

BACKGROUND

As a NETWORK, euROBIN aims not only at gathering the most outstanding robotics and embodied AI centers in Europe as core partners but also at involving at different levels of engagement the European robotics community at large. Through involvement in the network instruments of cooperative challenges, hackathons, scientific platforms, and exchange formats, research groups that are not part of the consortium, especially new and young groups, will benefit from the network and become part of it. In addition to Europe's excellent labs and research centers, further PhD students and outstanding fellows will contribute to the consortium.

Through cascade funding, **up to 38 beneficiaries** will contribute to euROBIN during the course of the project (up to 26 beneficiaries under 3 Open Calls for the Technology Exchange Programme and up to 12 beneficiaries under 2 Open Calls for Collaborative Projects).

The mechanism of cooperative challenges, hackathons, and the EuroCore (European Robotics Collaborative Repository)[1] ensure that technologies will be brought up to TRL 4-5 during the project.

By interconnecting and organizing the top scientific research in addressing the formulated challenges and by building up and sharing the EuroCore, euROBIN will provide particular services to the robotics community.

AMBITION

European ROBotics and AI Network (euROBIN) therefore proposes a threefold strategy:
1. Leading experts from the European robotics and AI research community will tackle the questions of transferability in main scientific areas;
2. The relevance of the scientific outcomes will be demonstrated in application domains that promise to have a substantial impact on the industry, innovation, and civil society in Europe;
3. Finally, euROBIN will create a sustainable network of excellence to foster exchange and inclusion. Software, data, and knowledge will be exchanged over the **EuroCore** repository, designed to become a central platform for robotics in Europe.

The vision of euROBIN is a European ecosystem of robots that share their data and knowledge and exploit their diversity to jointly learn to perform an endless variety of tasks in human environments.

SCIENTIFICALLY, euROBIN will take a new and integrated perspective in designing the future ecosystem of heterogeneous intelligent machines interacting with humans. Therefore, euROBIN will substantially advance four core scientific topics:

---

[1] Please find more information about the EuroCore in Annex 2 Background Information/Definitions

Funded by the European Union

InterAct: universal and transferable embodiment design and interconnection principles for intelligent and safe interaction with humans and the environment; representations enabling the transfer of design and advanced control between different embodiments; low-level sensori-motor loops and reflexes.

Learning Transfer: analytic and data-driven methods for learning skills from human demonstrations, transferring learned skills to novel tasks or different robots, transferring skills learned in simulation to real robots (sim2real), resilience, and transferring learned perception routines between robots.

Transferable Knowledge: knowledge representations that enable transfer, empowering humans to specify common sense knowledge, symbolic and hybrid representations.

Human-Centered Transfer: intuitive methods for providing demonstrations, social interaction, natural language communication, explainability, human-aware planning, situation assessment, and human-centered metrics for benchmarks.

TECHNOLOGICALLY, euROBIN will lay down architectures and tools to exploit European robot diversity through the power of their communication and interoperability.

2. 1st Open Call - what do we offer?

The exact amount of financial support to be granted to each selected third-party project under the 1st Open Call of the Technology Exchange Programme is up to **€ 60 000**. During the 1st Open Call up to **10 beneficiaries** will be selected.

The 1st Open Call of the Technology Exchange Programme starts on the 28th of February at 13:00 (CET) and the deadline for application will be the 10th of May at 17:00 (CEST).

Apply here: https://eurobin-project.fundingbox.com/ .

The scope of the Technology Exchange Programme is:

Promoting the participation of researchers and companies for the design, development, and validation of novel scientific methods and technologies that contribute to the extension of the range of intelligent transferable skills and capabilities of robots in different application domains (industrial, personal, and outdoors), complementing the main goals considered in the euROBIN project. Participants will have the possibility to integrate and test their code, method or hardware in some of the most advanced robotic platforms in Europe to address significant research challenges (see attached list in Annex 1) thanks to the cascade funding mechanism that will support their work.

Researchers from organisations such as research groups and institutions, or companies of any size(which will be the formal entities receiving the grant) will join some of the euROBIN core teams, integrating and evaluating the developed solutions of the robots at the hosting labs. Two euROBIN partners will typically act as host institutions for the stays, providing access and support to the euROBIN robot platforms.

Research results will be disseminated through the euROBIN media channels, while the developed software and produced documentation such as datasheets and tutorials will be included in the EuroCore repository with open access policy.

3. Admissibility and eligibility criteria

We will check the admissibility and eligibility of all proposals submitted before the deadline via our online application form here: https://eurobin-project.fundingbox.com/apply. All the admissibility and eligibility criteria are listed in this section of this 'Guide for Applicants'.
The projects that do not comply with those criteria will be excluded and marked as ineligible. We will check the admissibility and eligibility criteria based on the information provided in your application during the whole evaluation process.

3.1 Who are we looking for?

We are looking for a single (individual) legal entity (not a consortium) which is:
1. a Company of any size registered before the 28th of February 2023;
2. a Research Organisation[2];
3. an Academia Research Institution[3] registered before the 28th of February 2023.

Proposals should be submitted exclusively by the aforementioned applicants who will delegate a group of researchers/PhD students (that are endorsed by the organisation they belong to/work at) to work in a laboratory.

---

[2] **Research organisation** means an entity, such as university or research institute, irrespective of its legal status (organised under public or private law) or way of financing, whose primary statutory goal is to conduct fundamental research, industrial research or experimental development and to disseminate their results by way of teaching, publication or technology transfer; all profits are reinvested in these activities, the dissemination of their results or teaching; undertakings that can exert influence upon such an entity, in the quality of, for example, shareholders or members, shall enjoy no preferential access to the research capacities of such an entity or to the research results generated by it.
[3] **Academic sector** refers to (1). public or private higher education institutions awarding academic degrees; (2). public or private non-profit research organisations whose primary mission is to pursue research; (3). International European interest organisations.

The entities have to be registered in:
- The Member States of the European Union[4] and its Overseas Countries and Territories (OCT)[5]; or
- Associated Countries (AC)[6] to Horizon Europe.

The applicants who are subject to EU restrictive measures under Article 29 of the Treaty on the European Union (TEU) and Article 215 of the Treaty on the Functioning of the EU (TFEU)[7] are not eligible to participate in this Open Call.

The euROBIN partners are not eligible to act as applicants and CANNOT be involved in the grantees' projects, neither their affiliates nor employees or permanent collaborators.

3.2 Ideal project and the Process of organising

Project proposals from participants should align and complement the general goals of the European Robotics and AI Network, implementing and demonstrating advanced transferable robotics solutions across the different robots and euROBIN application areas. The software and the models generated with their methods should be open-sourced, documented, and accessible in EuroCore.

Cutting-edge methods and technologies, or hardware and software modules which are mature and reliable enough should provide general solutions to one of the identified challenges (see Annex 1) that can be easily adopted and benchmarked in at least two robotic platforms among those used for the three domains challenges of the project. Appropriate measures to ensure validation on different platforms should be considered in the proposals.

The work done by participants should be preferably planned jointly with the host institutions according to the milestones or relevant events of the euROBIN projects, such as cooperative competitions and hackathons, project deliverables and reports. This will contribute to achieve the euROBIN project goals while increasing the visibility of the results produced by the participants.

---

[4] https://european-union.europa.eu/principles-countries-history/country-profiles_en

[5] According to the Horizon Europe Programme Guide, the OCTs (and their linked Member States) are: Aruba (NL), Bonaire (NL), Curação (NL), French Polynesia (FR), French Southern and Antarctic Territories (FR), Greenland (DK), New Caledonia (FR), Saba (NL), Saint Barthélemy (FR), Sint Eustatius (NL), Sint Maarten (NL), St. Pierre and Miquelon (FR), Wallis and Futuna Islands (FR).

[6] AC as of 27.02.2023: Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Iceland, Israel, Kosovo, Moldova, Montenegro, North Macedonia, Norway, Serbia, Türkiye, Tunisia, Ukraine, for the most up-to-date list please first part of this document.

[7] Please note that the EU Official Journal contains the official list and, in case of conflict, its content prevails over that of the EU Sanctions Map.

THE PROCESS OF ORGANISING

Figure 2 Process of organising

At the beginning, there will be a process of organising the Programme involving the applicant and two euROBIN partners. The euROBIN partners will be responsible for hosting researchers delegated by the applicant, who will define jointly the details of the process that will integrate and validate method/hardware on the robot platforms of the two hosting institutions during the stay. Applicants will be supported and will receive advice from euROBIN partners throughout the experimentation to make their application successful.

During the development of the selected projects, participants will be provided with simulation tools, hardware platforms, software and knowledge representation frameworks, as well as detailed instructions and procedures to test and benchmark the proposed solutions. The generated results (datasets, source code, videos, reports, or any other scientifically or technologically relevant outcome) should be adapted and uploaded to the European Robotics Code and Data Repository (EuroCore) so the robotics community can easily access and visualize these results through a web browser. It is expected that, based on the validation of performance and transferability, and thanks to the publicity given through the project, your methods or hardware will be adopted by further groups, including the industry.

Additionally, beneficiaries will be involved in one of our Hackathon or Cooperative Competitions celebrated annually, contributing in this way to the overall goals of the euROBIN project while increasing the impact and visibility of the scientific and technological achievements (more information about Hackathons and Cooperative Competitions can be found in Annex 2 - Background Information/Definitions). Significant advances in relevant topics such as cognition-enabled transferable embodied AI should be demonstrated at the end of the project in representative scenarios (TRL 4-5), considering AI-empowered heterogeneous teams of robots capable of agile task acquisition and execution. TRL 4-5 will be achieved not only by one individual group, but also involving the entire ecosystems of robots from the manufacturing, personal, and outdoor domains.

Common know-how substrate of hardware, sensing, and control capabilities will be shared in this ecosystem in order to build higher level functionalities. New prototypes of actuators, sensors, and mechanisms should comply with the jointly defined formats and interfaces for ensuring better compatibility and interoperability. On this basis, the major potential in transferability will be exploited by

algorithmic advances in cognition and transferable learning, as well as in the human-robot and robot-robot interaction technologies.

3.3 What types of activities can be funded?

The activity that qualifies for financial support under the 1st Open Call for the Technology Exchange Programme is to build transferable tech solutions to be included in the EuroCore repository shared and disseminated by and with the euROBIN Consortia Partners - Hosting Institution (Technology Development). Particularly, it is expected that participants contribute to the design, development, and validation of:

- Perception methods for the realization of complex manipulation tasks, or for the navigation in either domestic environments or in outdoor urban scenarios;
- Software modules that extend the range of functionalities of robots to conduct daily life tasks and facilitate interaction with human users;
- Novel mechanisms that improve the dexterity and reliability of robots, or novel robot platforms whose features and capabilities may be of particular interest in some application domains;
- Simulation tools combined with advanced Artificial Intelligence techniques that have the potential to speed up the development of general robot skills.

We are looking for new partners with outstanding scientific and technical expertise in the topics of the call. You have to reply to one of the Open Challenges (Annex 1) defined by the Consortium. Ideally, you have this expertise proven on benchmarks or previous publications.

OPEN CHALLENGES
Please read Annex 1 - Open Challenges description carefully to properly address the selected challenge and accurately fill out the application form. In the application form, you will need to mark the specific challenge that you will address in your proposal.

The mechanism of cooperative challenges and the EuroCore ensure that technologies will be brought up to **TRL 4-5** during the project. For details about the TRL structure, please refer to the 'Frequently Asked Questions' document.

3.4 How to apply?

Proposals must be submitted through the euROBIN Open Call microsite:

https://eurobin-project.fundingbox.com/

We know applying to an Open Call takes time and dedication, and we are grateful you take up the challenge of applying to euROBIN 1st Open Call for the Technology Exchange Programme. Please take into consideration the guidelines below to prepare the best possible application.

✓ **Be on time and use our system**
Make sure you submit your proposal through the <u>online form</u> before the deadline on the 10th of May 2023 at 17:00 CEST (admissibility criteria). If you submit the form correctly, the system will send you a confirmation of your submission. Get in touch with us if it is not the case. We will not be evaluating any proposal sent after the deadline and submitted outside the dedicated form.

✓ **English Language**
Your proposal must be written in English in all mandatory parts in order to be eligible. Only parts written in English will be evaluated. If the mandatory parts of the proposal are in any other language, the entire proposal will be rejected (admissibility criterion).

✓ **Every question deserves your attention**
All mandatory sections of your proposal - generally marked with an asterisk - must be completed (admissibility criterion). The data provided should be actual, true, and complete and should allow assessment of the proposal. Additional material, not specifically requested in the online application form, will not be considered for the evaluation.

✓ **European dimension:**
Your proposal should have a clear European Dimension (fostering the projects that generate a substantial positive impact for European citizens). The main vision of euROBIN is that of a European ecosystem of robots that share their data and knowledge and are able, based on their diversity, to jointly learn to perform an endless variety of tasks in human environments. euROBIN is looking forward to building new collaboration among different European Institutions.

✓ **Be exhaustive & precise**

You have to verify the completeness of the form, as it won't be possible to add any further information after the deadline. After the proposal is submitted, you will be able to modify the form until the deadline.

✓ **Multiple submissions?**

Though applicants can submit multiple applications, one entity can receive the euROBIN grant only once. In the case that more than one proposal from the same organisation will be among the selected projects, only the one with more points will be funded.

✓ **Absence of conflict of interest**

We will take into consideration the existence of the potential conflict of interest between you and one or more euROBIN Consortium partners. Indeed, the consortium partners, their affiliated entities, employees, and permanent collaborators cannot take part in the euROBIN programme. All cases of potential conflict of interest will be assessed case by case.

✓ **Gender Equality Plan**

Public bodies, higher education institutions, and research organisations from EU countries and associated countries must have a 'Gender Equality Plan' (GEP)[8].

✓ **It is your proposal**

Your project should be based on your original work, if the project is not based on your original work, your right to use the IPR must be clearly defined (you must have a licence agreement or the IPR (Intellectual Property Rights) must be transferred to you from somebody who created the work). In particular, any work related to the implementation of the project described in the application may not violate the IPR of third parties, and the IPR to the application project may not be the subject of a dispute or proceedings for infringement of third party IPR.

✓ **Healthy finances and a clean sheet are a must**

We don't accept entities that are under liquidation or enterprises in difficulty according to the Commission Regulation No 651/2014, art. 2.18. Neither will we accept proposals from entities that are excluded from the possibility of obtaining EU funding under the provisions of both national and EU law or by a decision of both national or EU authority; met national regulations regarding bankruptcy.

---

[8] For more details please check here

Funded by the
European Union

✓ **Acceptance of the open-call rules**

To apply for this Open Call you have to accept its rules and regulations detailed in this Guide for Applicants.

euROBIN is planning a certain number of online webinars about this Open Call. They will be announced at the euROBIN Community Space.

4. How will we evaluate your proposal?

Our evaluation process is transparent, fair and equal to all our participants. We will evaluate your project in a few phases. For this call, we are looking for the best fit for our project and we expect a high number of applications. Since we are much more concerned with quality than quantity, we suggest that you put effort into how you present your project in the best possible way, providing as much detail as you can, to support us while evaluating your application and identify the main key points and how it fits with the overall euROBIN scope.
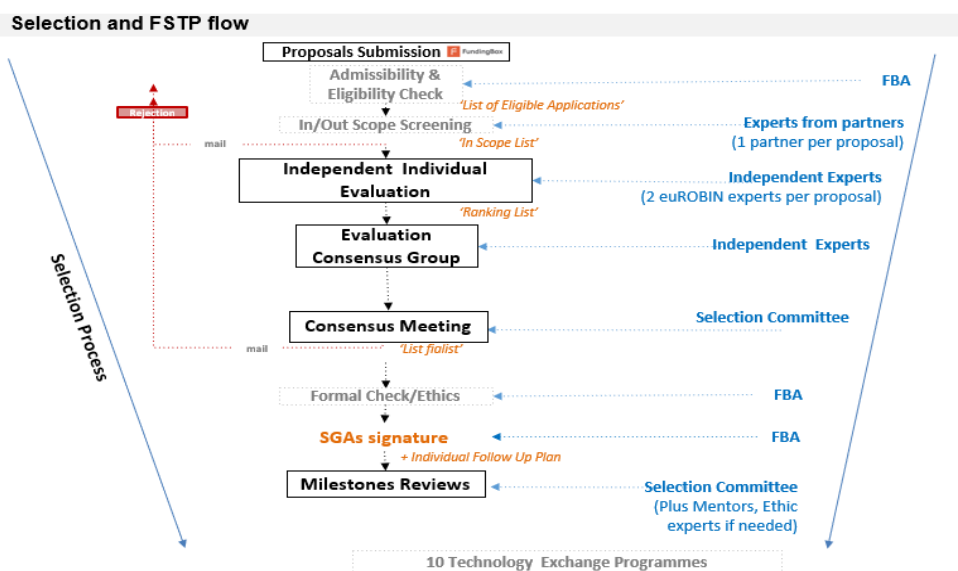

Figure 3 The euROBIN Technology Exchange Programme Selection Process

4.1 Step 1: Admissibility and Eligibility Check

Once an Open Call is closed, we will check whether it meets the admissibility and eligibility conditions set up in section 3. We will do it on the basis of the statements included in your proposal.

At this stage, the eligibility criteria are checked against a Declaration of Honour or self-declarations included in the application form. Later on, during the evaluation process, the above criteria will be verified during the whole evaluation process (including the final formal check).

The projects that do not comply with these criteria will be rejected.

As a result of the checking, an 'List of Eligible Applications' will be produced.

4.2 Step 2: In/Out Scope Screening

The In/Out Scope Screening will be done by the 'Selection Committee' which means that each proposal will be reviewed by the one entity from the following list of partners: Commissariat A L Energie Atomique Et Aux Energies Alternatives (CEA), Technische Universitaet Muenchen (TUM), Institut National De Recherche En Informatique Et Automatique (INRIA), Universidad De Sevilla (USE), Interuniversitair Micro-Electronica Centrum (IMEC), Kungliga Tekniska Hoegskolan (KTH), Universitaet Bremen (BREMEN), Centre National De La Recherche Scientifique Cnrs (LAAS/CNRS), Universita Di Pisa (UNIPI), Karlsruher Institut Fuer Technologie (KIT), Ecole Polytechnique Federale De Lausanne (EPFL), Deutsches Zentrum Fur Luft - Und Raumfahrt Ev (DLR).

The overall summary/general objectives of all proposals included in the 'List of Eligible Applications' will be reviewed to evaluate the following items:
- Scope. The objectives of the proposal must fit within the scope of the euROBIN project as it is described in the Guide for Applicants (GfA). In particular, relation with euROBIN EuroCore repository will be compulsory;
- European Dimension. The project should have a European dimension as it is described in the Guide for Applicants (GfA) in section 3.4.

The Selection Committee will assess if your proposal complies with the aspects above on a YES/NO basis and will provide reasoning in the cases where no compliance evidence is found. The Selection Committee will meet to review the partners assessment and validate the ones proposed, generating an 'In Scope List' and agreeing on the ones to be excluded.

Be aware that proposals that do not comply with any of the aspects described above will be rejected. The ones complying with all of them will move on to the experts' evaluation phase.

We will inform you about the results of the admissibility and eligibility check and the IN/OUT SCOPE SCREENING.

4.3 Step 3: Independent Individual Evaluation

Independent Individual Evaluation will be done for all 'In Scope' proposals.
In this phase, each project will be evaluated by 2 Internal Evaluators that are independent of applicants and cannot be members of the euROBIN Selection Committee. They will be appointed according to the specific characteristics of the applicants.

Your project will be evaluated within the following awarding criteria:

(1). EXCELLENCE will evaluate:
- Ambition. The applicants have to demonstrate to what extent the proposed third-party projects contribute to the project scope, have a European dimension and are beyond the State of the Art. The third-party project has to describe the innovative approach behind it (e.g., ground-breaking objectives, novel concepts and approaches, new products, services or business and organisational models);
- Innovation: applicants should provide information about the level of innovation within their market and about the degree of differentiation that this project will bring;
- Soundness of the approach and credibility of the proposed methodology.

(2). IMPACT will analyse:
- Market opportunity: The applicants have to demonstrate a clear idea of what they want to do and whether the new/improved product has market potential, e.g., because it solves a problem for a specific target customer;
- Competition: The applicants have to provide information about the degree of competition for their particular product/service and if the idea is disruptive and breaks the market. i.e. the products/services to be brought to market can be clearly differentiated from the competition;
- Commercial Strategy and Scalability: The applicants have to demonstrate the level of scalability of the new/improved product meaning by not addressing a specific problem but able to be commercialised to solve a structural problem in a specific sector/process/etc;
- Environmental and social impact: The applicants have to demonstrate the project contribution towards environmental, social and economic impacts to contribute to sustainable development, Green Deal and other European policies.

(3). IMPLEMENTATION will consider:
- Team: The applicants have to demonstrate their management and leadership qualities, their ability to take a concept from ideas to market, their capacity to carry through their ideas and understand the dynamics of the market they are trying to tap into. The team should be a cross-functional team, with a strong background and skills base and taking into account its gender balance (at all levels of personnel assigned to the action);
- Resources. Demonstrate the quality and effectiveness of the resources assigned in order to get the objectives/deliverables proposed.

The evaluators will score each criterion on a scale from 0 to 5:

0 = Proposal fails to address the criterion or cannot be assessed due to missing or incomplete information

1 = Poor – criterion is inadequately addressed or there are serious inherent weaknesses

2 = Fair – proposal broadly addresses the criterion, but there are significant weaknesses

3 = Good – proposal addresses the criterion well, but a number of shortcomings are present

4 = Very good – proposal addresses the criterion very well, but a small number of shortcomings are present

5 = Excellent – proposal successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

Each evaluator will produce an Individual Evaluation Report. The final score will be calculated as an average of the individual assessments provided by the Evaluators.

For each criterion, the minimum threshold is 3 out of 5 points. The total maximum score will be 15 points, with a minimum total threshold of 10 points.

4.4. Step 4 Evaluation Consensus Group

After carrying out the Independent Individual Evaluation, experts who have evaluated the proposals will join a Consensus Group, to agree on a common position, including comments and scores for all evaluated proposals. The Consensus Group will specially discuss the cases where there is a significant divergence between the evaluators' scoring. In case no consensus is reached between the evaluators, an additional evaluator will be included to provide an extra evaluation. FundingBox Accelerator Sp. z o. o. (FBA) will moderate it in order to make those evaluations as much aligned as possible.

In case of ties, the following criteria will be used to rank the projects, in order:
- The highest score in the Impact Section;
- Gender balance among the personnel responsible for carrying out the activities;
- Other factors related to the objectives of the call are to be determined by the 'Selection Committee'.

As a result of the Independent Evaluation, a 'Ranking List' will be produced.

All proposals obtaining a score above the threshold will pass to the next phase. Please note that we need time to process through all the proposals in this phase, so you probably won't hear back for a while.

4.5 Step 5 Consensus Meeting

The 'Selection Committee' (formed by the partners taking part in In/ Out Screening plus FundingBox Accelerator coordinating the meeting and one external expert acting as Advisory Body) will decide by Consensus (minimum ⅔ of the votes) the 'List of Finalists' to pass to the next phase and 'Reserve List'. The discussion will be based on the ranking obtained as a result of the Independent Evaluation.

Whilst normally the highest ranked proposals will be selected for funding, the 'Selection Committee' might have fair reasons for objecting to a specific third party, like the alignment with euROBIN goals and scope,

the ability to achieve the highest impact possible, commercial competition, as well as the existence of significant ethical concerns or a potential conflict of interest. In this case, the choice may pass to the next-ranked proposal.

The exact number of proposals approved will be decided based on the overall quality of the proposals (up to 10 in the 1st Open Call for the Technology Exchange Programme).

5. What's next? Subgrant Agreement Preparation and Signature

Before you get started with the euROBIN programme, you need to sign the SubGrant Agreement with the euROBIN Consortium.

Prior to signing the Agreement, you should provide documents regarding your formal status. The euROBIN Consortium will verify them, to prove your eligibility. (for the details please check our Frequently Asked Questions Document). Please do it within the deadlines that will be communicated to you.

Be extremely vigilant with respect to:

1. **The nature of the documents we request.**
    If the documents you provide us with do not prove your eligibility, the process will end here for you.
2. **The deadlines that we will give you to hand us these documents.**
    If you do not deliver the requested documents on time, without a clear and reasonable justification, we will have to exclude you from further formal assessment. Another applicant from the Reserve list will then replace you.

6. Our Support Programme and Payment Arrangements

Once your eligibility has been confirmed following the formal check and the SubGrant Agreement signed, you will become an official beneficiary of the euROBIN programme.

It is now that the adventure begins, and it is now high time to understand how the funding is going to be distributed.

Figure 4 The euROBIN Technology Exchange Programme

The Support Programme will last from 3 to 12 months, depending on the number of people assigned to the Project and the overall costs set per month. As a beneficiary, you will receive a fixed lump sum of up to €60 000. The lump sum is a simplified method of settling expenses in projects financed with Horizon Europe funds. It means that you are not required to present strictly defined accounting documents to prove the costs incurred (e.g., invoices).

However, you are obliged to demonstrate the implementation of the project in line with the milestones set for it. Simply speaking, it means that we will carefully assess your progress and the quality of your work during Interim Reviews, not your accountancy.

The milestones (deliverables, KPIs and ethical recommendations) and the budget of your project will be fixed in the 'Individual Follow Up Plan' elaborated at the beginning of the programme.
The lump sum does not release you from the obligation to collect documentation to confirm the costs under fiscal regulation.
For a more detailed payment schedule please check the 'Frequently Asked Questions' section.

6.1 Payment Arrangements

For the sake of simplicity and transparency, the financial support will be paid against specific Deliverables and upon achievement of certain milestones or KPIs defined in your Individual Follow Up Plan and in the SubGrant Agreement. The final beneficiaries will receive the funding as described in Table 1.

Milestone review process

The `Technical partner' will evaluate the beneficiaries' performance at the Milestone Review (established every time a payment is due), according to the following criteria.

- Deliverables' quality and Technical performance indicators. To be scored by the Hosting Technical Partners based on the Deliverables and KPIs established in the 'Individual Follow up Plan';
- Deadline Compliance. To be scored by the FBA.

Each criterion will be scored from 0 to 10 and the weight of each one of these criteria, in the final score, will be as follow:
- Deliverable quality (30%);
- Technical performance indicators set in Individual Follow up Plan (60%);
- Deadline Compliance (10%).

According with this final score:
- Beneficiaries over threshold (which is 7 points) will successfully receive the next payment and become candidates to continue in the Technology Exchange programme;
- Beneficiaries under threshold. The beneficiaries which haven't reached the threshold will be proposed, by the 'Hosting Technical Partners', as candidates to leave the Program/Project. And, if this decision is finally ratified by the 'Selection Committee', they will have to leave the Program and won't receive the payment.

The 'Selection Committee' will review and validate the 'Hosting Partners' report, putting special attention to the 'under threshold' cases, if any, by taking into consideration all possible objective reasons for underperformance (i.e. external factors which might have influenced the beneficiaries' performance). The 'Selection Committee' will take the final decision and approve the payments.

Once the deliverables, milestones and payments to each beneficiary are approved by the 'Selection Committee', according to the Milestone Review Process described above, the relevant tranche will be transferred to the beneficiary.

Each beneficiary that completed a given stage will receive the grant corresponding to that stage (there will be 3 tranches in total):

Payment Milestones	Deliverable	Payment Milestone	% Total Grant
Push (Technology Exchange Programme)			
Stage 1 Plan Phase	'Individual Follow Up Plan' Before	Before M2	7%
Stage 2 Implementation Phase	Interim Report from the Hosting Institution	Mid Stage	40%
	Code reviewed by euROBIN and uploaded on the Repository	End of Stage	53%
		Total	100%

Table 1 Payment milestones

A delayed payment mechanism might be applied to the payments. The final payment (up to 15% of the total grant amount awarded to one beneficiary) might be done after the euROBIN project ends. All selected applicants will be aware of it before they join the Support Programme. Relevant provisions will be included in the Sub-grant Agreements.

7. Contact us

How can we help you?
If you have extra questions regarding our Open Call process, you can post your questions at:

✔ Ask your question in the euROBIN Helpdesk Space;
✔ Send us an email to the following address: info@eurobin-project.eu

In case of any technical issues or problems, please include the following information in your message:

✔ Your username, telephone number and your email address;
✔ The details of the specific problem (error messages that appeared, bug descriptions such as a dropdown list that isn't working, etc.);
✔ Screenshots of the problem.

Complaints

If, after receiving the results of one of the evaluation phases (when foreseen), you consider that a mistake has been made, you can send us your complaint. To do so please send us your complaint in English by email to info@eurobin-project.eu, including the following information:

✔ Your contact details (including email address);
✔ The subject of the complaint;
✔ Information and evidence regarding the alleged mistake.

Important note regarding the timeline:
You have **3 calendar days** to submit your complaint starting from the day after the communication was sent. On our side, we will review them within no more than 7 calendar days from its reception.

If we need more time to assess your complaint, we will inform you by email about the extension.
We will not review anonymous complaints as well as complaints with incomplete information.

Please take into account that the evaluation is run by experts in the AI and European robotics field, and we do not interfere with their assessment, therefore we will not evaluate complaints related to the results of the evaluation other than related to the mistakes in the evaluation of the eligibility criteria.

8. Last but not least - final provisions

Any matters not covered by this Guide will be governed by Polish law and rules related to the Horizon Europe programme and European Union grants regulations.

Please take into account that we make our best effort to keep all provided data confidential; however, for the avoidance of doubt, you are solely responsible to indicate your confidential information as such.

Your IPR will remain your property. Further contracts may be needed in case of IPR generated from work carried out jointly by you and one or more euROBIN partners.

For the selected beneficiaries, the SubGrant Agreement will include a set of obligations towards the European Commission (for example: promoting the project and giving visibility to the EU funding, maintaining confidentiality, IPR, understanding potential controls by the EC/ECA, EPPO and OLAF).

The euROBIN Consortium might cancel the call at any time, change its provisions or extend it. In such a case we will inform all applicants about such change. The signature of the SubGrant Agreement is an initial condition to establish any obligations among applicants and any Consortium partners (with respect to the obligation of confidentiality of the application).
You didn't find what you were looking for? You may want to check our 'Frequently Asked Questions' section.

9. Extra hints before submitting your proposal

A proposal takes time and effort and we know it. Here a few crucial points you should read before hitting the "Submit" button in order to maximise your chances of success:

- ✔ Is your project in line with what euROBIN is looking for? Not 100% sure? You can consult this section 3.3 as well as the website.

- ✔ Did you present your project in a way that will convince evaluators? Not sure if you did? Go back to section 4.3 if you have any doubts.

- ✔ Is your project fulfilling all the eligibility requirements described in the Guide for Applicants? Check again section 3.4.

- ✔ Are you sure you are able to cope with our process of the SubGrant Agreement signature and payment arrangements for selected proposals? You may want to go over this section.

- ✔ Did you check our SubGrant Agreement Template? You didn't? Check it out here.

- ✔ Do you need extra help? Get in touch!

You can read our R.E.C.I.P.E. for an outstanding European Funding Opportunity application for additional advice. Good luck!

ANNEX 1 OPEN CHALLENGES DESCRIPTION

10 Calls for the 1st Open Call in 2023

WP1 - Robotic Manufacturing for a Circular Economy
WP2 - Personal Robots for Enhanced QOL and Well-Being
WP3 - Outdoor Robots for Sustainable Communities
WP4 - InterAct
WP5 - Learn
WP6 - Know
WP7 - Human-Centered Perspective

_____

Title:
1_Perceiving and tracking of deformable objects
→ *multiple candidates*

General scientific and technical description:
Identifying and estimating the state of textile items (cloths, bedclothes, napkins, socks, etc). We may assume that these need to be manipulated prior to washing (to be put in the washer) or taken out from the washer (wet) and need to be stretched before hanging for drying. Scientifically, we need methods that perceive, model, track items under complex deformations and do this in real-time from RGB-D cameras (static, or on a robot arm).

Endorsed by WP5

Objectives:
This task involves resolving how to pick single items out of a crumbled/unordered dry or wet pile. This is followed by stretching or straightening of items in the air or on a surface to facilitate identification (what kind of item it is) as well as potentially estimating the shape (mesh representations). The type of item allows sorting as well as the application of different hanging strategies to dry the cloth. From the shape a reliable state estimation can be performed, for example, the position of landmarks or similar features. The system we consider is a dual-arm robot (moving base optional) as well as an RGB-D camera (can be static or actuated).

Thus, the goals are to :
- pick single items from a pile (basket or washing machine);
- grasp (and re-grasped the item such that it is flattened in the air without placing it on a surface (or alternatively stretch/flatten on a surface);
- identify the item, estimate shape. The system is to be evaluated on at least 10 different items in dry and wet condition.

Deliverables:
- Document Method implementation in C++ or Python;
- Video of task fulfilment using at least eight different types of clothes;
- Validation of method on secondary robotic platform;
- Everything available on EuroCore.

Title:
2_Dialog Management for Natural Human Robot Interaction
→ *several candidates*

General scientific and technical description:
We need software modules for a dialog management system to support intuitive human robot interaction. This involves automatic speech recognition and interpreting users' speech utterances to extract the underlying intent (e.g., to formulate a task or trigger a skill), mapping these intents to action plans or executable robot skills, and generating adequate speech responses by the robot. In addition, dialog management must maintain the current state of dialog in order to understand statements relating to previous utterances (e.g., "No, the green one" relating to "Bring me the cup") or enabling the robot to ask questions if instructions are unclear (e.g., "Should I bring you the green or the blue cup?"). The software module should take as input several configuration files to specify the action capabilities of the robots, the human and the scenario. The computation time should enable an online dialog between the robot and the human with "reasonable" delays (e.g., no awkward pauses). The software should be tested and validated with at least three of the euROBIN robots, in particular those of the WP2 teams (INRIA, KIT, DLR).

Endorsed by WP2, WP5

Objectives:
- Components for automatic speech recognition (audio to text), intent parsing (text to goal / robot skill), speech synthesis (text to audio);
- Dialog management allowing multiple bidirectional pairs of utterance / response, allowing the robot to ask questions for clarification or help;
- Allow novice users to enable the robot to understand new language utterances and integrate new robot skills (preferably without full re-training);
- Validate the modules on at least 3 euROBIN robots.

Deliverables:
- Open software modules usable on different robot platforms such as those in WP2 (Personal Robotics);
- ROS compatible interface;
- Documentation and manual to configure and use the system with a specific robot platform and scenario;
- Everything available on EuroCore.

Title:
3_Visual perception: object recognition and 6D pose estimation for known objects
→ *multiple candidates*

General scientific and technical description:
We need to identify objects of interest in the different scenarios, from the visual perception (robot cameras, RGB-D or RGB). We may assume that the objects are known, i.e., we have the 3D model (mesh) of the object and a label for each object. From the camera input, we need to recognize the object in the image, localize it and estimate the 6D pose of the object. This 6D pose will be used by the robot to navigate towards the object (e.g., a chair, a door) and/or to plan a suitable grasping action (e.g., cup, fork, parcel, milk brick). For example, in Year 1 we will use this method to identify a door handle, navigate toward the handle and then grasp it, while in Year 2 we will use it to recognise cutlery and cups inside a dishwasher. The computation time for steps 3) and 4) must be compatible with an online robotics application (e.g., <100ms would be desirable). The perception models should be transferable between robots, even though they may utilize different types of sensors (e.g., stereo cameras or depth sensors). In this regard, the software should be tested with YCB objects and validated with at least three of the euROBIN robots, in particular those of the WP2 teams (INRIA, KIT, DLR).

Endorsed by WP2

Objectives:
- Provide a pipeline to allow a novice user to add new object models, train object models and use them for online object recognition (providing the label and the image area where the object is in the camera image) and online 6D pose (expressed in robot base coordinates) estimation from camera images;
- Provide a solution that can support the transfer of models between different robots with different sensor modalities (e.g., different cameras, different depth sensors);
- Validate the pipeline on at least 3 euROBIN robots.

Deliverable:
- Manual and documentation of the pipeline and the software modules/libraries;
- Implementation in C++ or Python;
- Demonstration (video) of the pipeline with one of the robots of WP2;
- Everything is available on EuroCore.

Title:
4_Defining robotic tasks sequence through imitation learning from videos / observation
→ *multiple candidates*

General scientific and technical description:
In the framework of Industry 5.0, which promotes human-machine cooperation for integrating human intelligence in the loop and combining human reactivity and adaptability with the precision, speed and reliability of robots, one the main challenge lies in the interaction between human and robots. The traditional code programming of robotic tasks has to be replaced by more intuitive ways for the operator to teach the robot, through user-friendly graphical interface, natural language or learning by demonstration. This last approach takes inspiration from humans' ability to learn new skills by observing other humans and trying to imitate them. In the same way, this approach is considered to allow robots to acquire manipulation skills from human demonstrations. While kinesthetic approaches are often considered for teaching by demonstration, the most intuitive method for a human to provide a demonstration is by performing the task himself and letting the robot observe him through a camera.

In this call, we focus on the automatic recognition of a sequence of manipulation tasks by watching an operator perform the demonstration.

Endorsed by WP1, WP2, WP5, WP6

Objectives: Demonstrate the ability to define a simple scenario of manipulation task (e.g., press blue button, take key, insert key) through video analysis of the operator gesture.

Deliverables:
- Dataset of video used for training;
- Algorithm/code with tutorial available in EuroCore;
- Methodology validated in terms of task sequence recognition;
- Transfer to ideally at least two euROBIN systems.

Title:
5_Method for Collecting and Labeling Interactions between Human and Physical Robot with Internet of Things Devices and IMU Time-Series Data
→ *multiple candidates*

General scientific and technical description:
Improvements in robot motion planning have enabled robot system designers to deploy robots in direct proximity to humans. Some force sensitive, collaborative robots interact with the same objects as humans. However, they lack the same speed and dexterity as their human counterparts. Following the trend of making ordinary objects "smart" by equipping them with a microchip and monitoring sensors directly on the object over the internet allows designers to study the interactions between the object and the environment. An inertial-motion-unit (IMU) sensor detects the object's acceleration and orientation and is one of the most common sensors used in internet of things (IoT) devices, e.g., mobile phones, wrist watches and medical devices, and generates an abundance of data over time.

This time-series data needs to be filtered and manually labeled to understand discrete manipulation events which is a time-consuming activity. Therefore, we propose to develop an automatic labeling method using IMU data from IoT devices to label when objects were picked up, turned over, and other manipulation movements. This method would greatly speed up the analysis of IoT IMU sensor data and would be used to study the behavior and efficiency differences between humans and robots when interacting with objects of interest. The initial study would investigate two IMU mounting locations. One IMU sensor would be placed on the actor either as a glove for a human or a bracket mounted at the end of a robot arm and the other mounted to the surface of the task board.

Endorsed by WP1, WP4, WP5

Objectives: Develop and validate a task board with an IoT IMU sensor that can label motion events as generated by a human or a robotic system. Example classifications for labels include the state of the actor when the sensor is worn by the actor, or from the progress of an ongoing manipulation task when the sensor is on the object (InterAct). Labels include orientation, in motion/idle, maximum acceleration, task progress and success indicators, etc. The data generated IMU devices can be used to supply training data for learning new interaction methods (Learn). Finally, the labeled data can be used by robot developers in the consortium to develop appropriate behaviors for their physical robot system to reflect the current labeled situation in the surrounding environment.

Deliverables:
- IMU Sensor andA mounting kit for (1) standard robot wrist flange, (2) operator glove, (3) task board;
- Algorihm/code with tutorial available in EuroCore as a code repository that provides labels to time-series data rendered onto a web dashboard visible to all consortium partners;
- Methodology validated using at least two euROBIN systems.

Title:
6_Multifunctional gripper design and tool changing mechanism for assembly
→ *single candidate*

General scientific and technical description:
Flexible robotic assembly requires a manipulation unit to accomplish versatile manipulation tasks instead of establishing an automation pipeline in which each sub-task is achieved by a dedicated system with fixed configuration. To achieve this, it requires the robot to have versatile tool use ability and be equipped with various tools for different tasks, for example, grasping a large variety of objects, manipulating different screws, nuts and bolts, etc. However, a flexible multifunction gripper and tool changing mechanism is usually not equipped with the robot system and how to design such a system to balance the trade off between versatility, complexity and costs is still an open problem. We propose to develop a multifunctional gripper with additional tool changing system to enable complex assembly using common lightweight and collaborative robots. The developed system should be based on recent advances in robot skill taxonomy and task analysis conducted within the framework of euROBIN, and to be validated on at least two real and challenging industrial use cases.

Endorsed by WP1

Objectives: Develop a multifunctional gripper with lightweight tool changing mechanism

Deliverables:

- A multifunctional gripper and tool changing mechanism design;
- Validate on two industrial use cases with two different robots from euROBIN, for example gearbox assembly, electronics disassembly.

Title:
7_Ensuring high precision tasks with collaborative robots for flexible manufacturing
→ *multiple candidates*

General scientific and technical description:
Industrial robots are very efficient when performing repetitive tasks with high accuracy, and are ideally suited for high volume and rigid production lines. However, most of the industrial robots are physically separated from human workers by fences and require specific knowledge to program them. These constraints in terms of integration cost and low interaction with the operator are generally highlighted as the major causes of low adoption of robotics by SMEs or for manipulation tasks in general. Recently, collaborative robots have been more and more integrated in the industry, because they allow safe robot applications within the operator's proximity as well as intuitive programming by kinesthetic demonstration, making them easier to deploy to different tasks. However, these robots do not exhibit the same level of performance in terms of precision, payload or velocity as industrial ones, which slows down their acceptability for some industrial tasks.

In this call, we focus on demonstrating how collaborative robots can be deployed for realizing fine manipulation tasks with sub-millimeter accuracy in industrial or laboratory environments in the case where pure repeatability of the robot cannot be exploited due to a variation of the position of the object of interest.

Endorsed by WP1

Objectives:
Demonstrate the ability to reach a position with sub-millimeter accuracy with a collaborative robot. The target position is typically a given point (or a set of given points) of an object randomly placed in the workspace of the robot (e.g., screws on the lid of an electrical vehicle battery pack). The robotic system can be equipped with embedded or deported 2D/3D visual sensors.

Deliverables:
- Algorithm/code with tutorial available in EuroCore;
- Methodology validated using at least two euROBIN systems.

Title:

8_Novel Control Methods for Cable Suspended Dual Arm Aerial Manipulators in Outdoor Scenarios: Towards Safer Human-Aerial Robot Interactions

→ *single candidate*

General scientific and technical description:

Aerial robotic manipulators (intelligent drones equipped with robotic arms) are capable of quickly conducting object grasping, transportation and delivery of small parcels in areas of difficult access for ground robots, avoiding traffic jams and other inconveniences of urban environments with high density of obstacles. However, the proximity of the aerial platform with the people, the vehicles, buildings and other obstacles should be avoided to reduce the risk of collision. In order to improve safety in the integration of the robot within urban environments, and particularly during the interaction with the human users (handover), a human-like dual arm system will be incorporated to the aerial platform in cable suspended configuration, similarly to a pendulum or swing, extending in this way the reach of the arms.

The scope of the proposed work is therefore the development and experimental validation of novel control methods for aerial robotic manipulators in suspended configuration. Besides drones, these methods can be transferred to other mobile platforms such as cranes, overhead cranes, or suspended structures that could be deployed by users in urban or rural scenarios for grasping and transportation in logistic applications. A dynamic model of the suspended dual arm robot should be firstly derived and validated in a simulator. The control methods should be able to achieve accurate end effector positioning and trajectory tracking, taking into account the dynamics of the cable suspended manipulator while exploiting the kinematic configuration of the arms. The main research and technological challenges are associated with the accurate position estimation and control outdoors, implementing these methods in a lightweight platform provided by the University of Seville.

Endorsed by WP3, linked to WP4 and WP7

Objectives:
- Problem formulation, system identification, and design of system architecture;
- Derivation of dynamic model and development of simulator;
- Controller design and simulation of cable suspended robotic manipulator;
- Implementation of control methods;
- Realization of experiments in outdoor scenarios for validating the developed system;
- Publication of research results at international conferences or journals.

Deliverables
- Simulation of the aerial robotic manipulator in ROS/gazebo, MATLAB/Simulink;
- Source code of the developed methods to be shared in the EuroCore repository;
- Data logs and reports from the experiments;
- Videos with demonstrations of the system;
- Research paper(s) to be submitted to international conferences or journals.

Title:
9_Urban navigation with wheeled-legged robots
→ *multiple candidates*

General scientific and technical description:
The scope of the work is to develop navigation methodologies for wheeled-legged robots for urban navigation. As a platform, we are using a quadrupedal system with actuated wheels capable of going high speed, stepping across obstacles and stairs, or overcoming rough terrain. Local control and motion planning algorithms offer versatile waypoints following in different settings.

In euROBIN, these machines are used as carriers for logistics applications, i.e., to move payloads from a start to a goal location. In order to deploy the system in an urban environment, we have to develop a navigation pipeline that accounts for the system's mobility, is able to handle dynamic obstacles such as pedestrians or cars, and can include a semantic understanding to navigate on sidewalks, to cross streets appropriately, or to use doors to enter buildings.

In this project, the researchers have access to a diversity of sensory information collected by the robot (lidar point cloud, RGB cameras in driving direction, multiple stereo cameras around the vehicle), they can leverage existing SLAM infrastructure, and build upon an established simulation pipeline (NVIDIA issac / omniverse). The algorithms will be implemented on the ANYmal with wheels platform, a robust, field-hardened systems with powerful onboard computers and ROS API.

Figure 1

Endorsed by WP3, **linked to WP5**, **WP6**

Objectives:
- Problem formulation;
- Dataset and software infrastructure analyst to identify the right set of tools, e.g., data labelling for supervised learning algorithms;
- Implementation of semantic-based urban navigation;
- Implementation of dynamic obstacle detection and avoidance;
- Test in simulation (if desired);
- Test and validation in real-world experiments;
- Publication of research results at international conferences or journals.

Deliverables:
- Software for semantic-based navigation and dynamic obstacle avoidance;
- Videos with demonstrations of the system;
- Research paper(s) to be submitted to international conferences or journals.

Title:
10_Massively parallel simulation and learning algorithms
→ *multiple candidates*

General scientific and technical description:
Discovering relevant behaviours through a learning process may require sample-greedy exploration processes. This raises issues when applied to robots due to their operating costs and to the damages it may result in. Combining experiments on a real robot with an exploration in simulation can alleviate this issue. Massively parallel simulations based on tools like JAX or Isaac Gym allow to drastically accelerate exploration processes and open new avenues for learning in robotics, where interactions may be sparse. The goal of this call would be to propose robot simulations and learning algorithms modules that can fully exploit the potential of these massively parallel libraries.

Endorsed by WP5

Objectives: -

Deliverables:
- Open source libraries in C++ or Python;
- Example of use in the context of at least one of the euROBIN use cases and two systems;
- Everything available on EuroCore;
- Define the description format for the task environment and the conversion for different platforms (USD, URDF and MJCF);
- Implement a method to generate a digital twin for a specific scenario (e.g., replenishment or set the table);
- Implement modules to apply learning algorithms on parallel instances of the digital twin;
- Implement methods to rate and visualize the effectiveness of the algorithms;
- Test and validation in real-world experiments;
- Publication of research results at international conferences or journals.

ANNEX 2- BACKGROUND INFORMATION/DEFINITIONS

1. EUROCORE (European Robotics Collaborative Repository)

Defining and implementing the type of data and information to be stored and exchanged as well as the respective interfaces and software algorithms will require substantial effort. They reflect the major scientific and technological topics which are addressed in the scientific WPs. The scientific activity will be supported by regular workshops at major international conferences and at the ERF, involving not only the consortium, but also the community at large. While addressing the three application areas identified in the project, the cooperative competitions and their tasks will be formulated in such a way as to allow monitoring and evaluating the progress on the grand scientific challenges.

The EuroCore (European Robotics Collaborative Repository) will not be a physical data storage, but rather a structured set of information and links to resources stored elsewhere. The idea is to provide a central access point for knowledge, data, algorithms, competence and benchmarks for European Robotics3. Descriptions and links stored in EuroCore may be as diverse as a set of 3D object models, a dockerized planning algorithm, a training dataset, a vision benchmark, a knowledge representation tutorial, or an organization's profile.
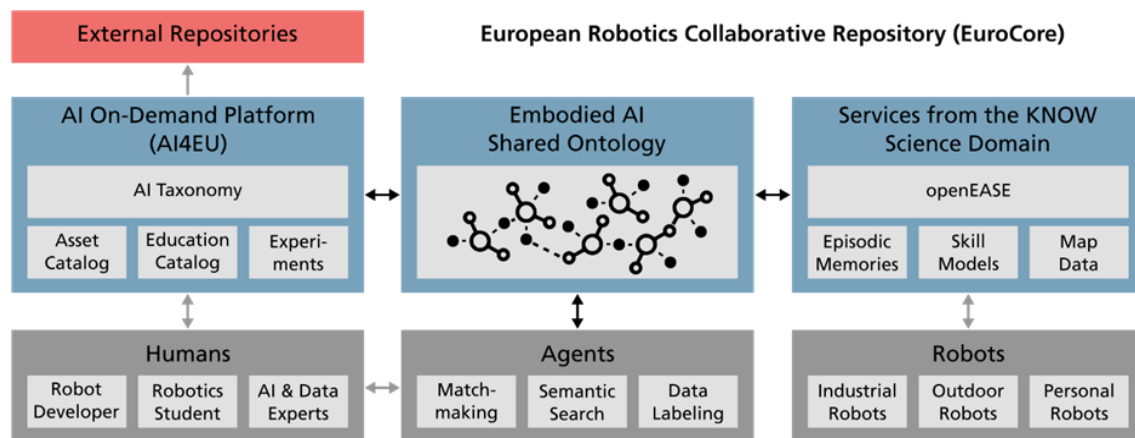

Figure 1 EuroCore

The Repository will federate and leverage existing and future services. Black arrows indicate API and ontology alignment. Dark grey boxes indicate types of users of the distributed repository. Light grey boxes are examples (list is not exhaustive).

2. COOPERATIVE COMPETITIONS

The euROBIN network proposes the novel concept of robot cooperative competition focused on the three main application domains defined in the robotics roadmap of Horizon Europe:

- Robotic manufacturing for a circular economy;
- Personal robots for enhanced quality of life and well-being;
- Outdoor robots for sustainable communities.

The cooperative competitions will leverage community building to advance, validate, and benchmark the progress towards solutions for transferable embodied AI supported by the four core scientific topics. Each application domain cooperative competition will build on the following principles:

1) **Scenario Definition:** Several use cases will be defined and monitored by industrial consortia/representatives together with research consortium members in the Cooperative Competition Definition and Monitoring Board (CCDMB). Each year, there will be a hackathon on updated versions of the competition rules and use cases, with new tasks, based on a roadmap defined by the CCDMB. It will take into account the performance achieved by the teams, including feedback from the larger industrial community through dedicated regular workshops. The scientific and technological focus will be decided and communicated several months in advance, the precise tasks for the yearly hackathon, however, might be communicated to the teams only two weeks before the event. The short time available for preparation should foster flexible, transferable and reusable solutions and avoid over-tuning to specific tasks.

2) **Participating Teams:** At least three consortium members for each of the three application domains will provide their robotic systems and software frameworks as in-kind contributions, for demonstrating solutions to the application scenarios at the yearly events. This makes sure that at least nine systems with a high level of maturity are available for benchmarking and validation in the project. The challenges will be open, however, for any number of systems from the consortium and from partners which might join later, through cascade funding.

3) **Standards and Interfaces:** Each partner providing a robot system to the cooperative competitions must also provide the software infrastructure and documentation to integrate solutions from consortium members acting mainly in the scientific challenges to a level that they can be demonstrated and evaluated. The partners commit to adopting jointly-defined standards and interfaces to facilitate the transferability of solutions.

4) **Transfer Between Teams:** Robot cooperative competitions will mix a competitive element (to motivate a team to develop the best integrated solution) and a cooperative element (to ensure that the teams are also motivated to share their solutions). Shared elements in the form of contributions to EuroCore can be used by other teams to solve the same or other problems. The contributions, including data and source or object code, will be made available in the joint cloud platform, see the section on European Robotics Collaborative Repository (EuroCore). Examples of exchanged data and modules are: geometric and semantic maps of the environments, 3D models of objects, geometric or semantic plans, ontologies about the world and task representation, and functional modules for interacting between different robots and with humans in the shared environment. Starting from the second year, the procedures and the joint frameworks will be made available to further teams, which will be included in the challenges via the 20% cascade funding.

5) **Integration of Scientific Modules:** Each partner receiving funding from the scientific WPs 4-7 commits to integrate the provided methods on at least three systems in the course of the project, possibly including its own system. The consortium as a whole and each competing team should benefit from this approach.

6) **Scoring Criteria:** The scoring system will build upon the H2020 project RoCKIn approach to benchmarking experiments, successfully adopted and currently in use in the European Robotics League (ERL). This is based on the definition of two separate but interconnected types of benchmarks:

   a. Functionality Benchmarks, which evaluate the performance of hardware/software modules dedicated to single, specific functionalities;
   b. Task benchmarks, which assess the performance of integrated robot systems facing tasks that require the composition of different functionalities.
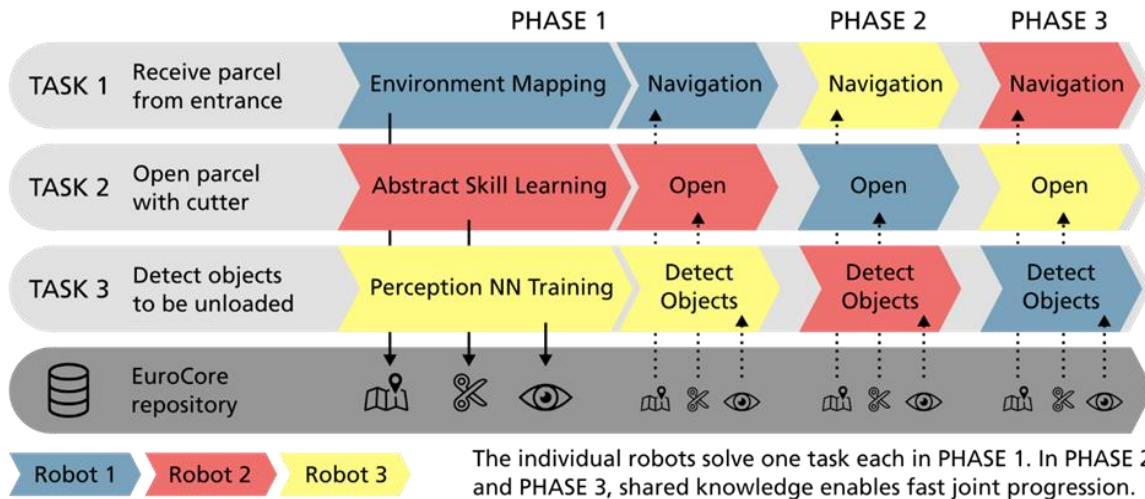
In euROBIN, we will use functionalities to define the functional modules that shall be shared among teams. The RoCKIn/ERL scoring framework will be used only for the evaluation of the task benchmarks. The framework is based on the concept of performance classes used for the ranking of robot performance in a specific task.

The performance class that a robot is assigned to is determined by the number of achievements (or goals) that the robot reaches during its execution of the task (e.g., in the Personal Robots competition, examples of achievements in the Year 1 scenario are the robot receiving a parcel from a human, the robot being able to open it, and then being able to empty it). Within each class (i.e., a performance equivalence class), a ranking is defined according to the number of penalties the robot accrues.

Penalties are assigned when robots in the process of executing the assigned task make any of the errors defined in the list associated with that Task Benchmark. Examples of penalty conditions include the outdoor robot bumping into some scene element or letting the transported parcel fall.

The cooperative side of the competitions will be part of the scoring system in the form of achievement multipliers or additional achievements for each task. Both the ability of the team to provide usable functional modules that implement functionalities for other teams to use and the success of this sharing (e.g., number of teams using the functional module) will be assessed. Each of the three application domains will have to define its own functionalities, tasks, task achievements, penalties, multipliers, and disqualifying behaviours, and the cooperation scoring associated with the sharing of functional modules.

Figure 2 Example for the second of the yearly challenges for the application domain personal robotics. It involves three challenger teams solving in a sequential manner three tasks and exchanging task-relevant information. This, of course, implies that the teams agreed in the year before the challenge on exchangeable data formats, possible interfaces, pools of algorithms, etc. These shared elements are stored in the EuroCore Repository. Core partners from the science and technology domains provide the main

The individual robots solve one task each in PHASE 1. In PHASE 2 and PHASE 3, shared knowledge enables fast joint progression.

contributions in defining these interfaces and setting up and running the repository.

Example for the second of the yearly challenges for the application domain personal robotics. It involves three challenger teams solving in a sequential manner three tasks and exchanging task-relevant information. This, of course, implies that the teams agreed in the year before the challenge on exchangeable data formats, possible interfaces, pools of algorithms, etc. These shared elements are stored in the EuroCore Repository. Core partners from the science and technology domains provide the main contributions in defining these interfaces and setting up and running the repository.

euROBIN will benchmark the scientific results and validate their transferability through COOPERATIVE COMPETITIONS and hackathons focused on the three main application domains: robotics manufacturing for a circular economy, Personal robots for enhanced quality of life and well-being and Outdoor robots for sustainable communities as presented below.

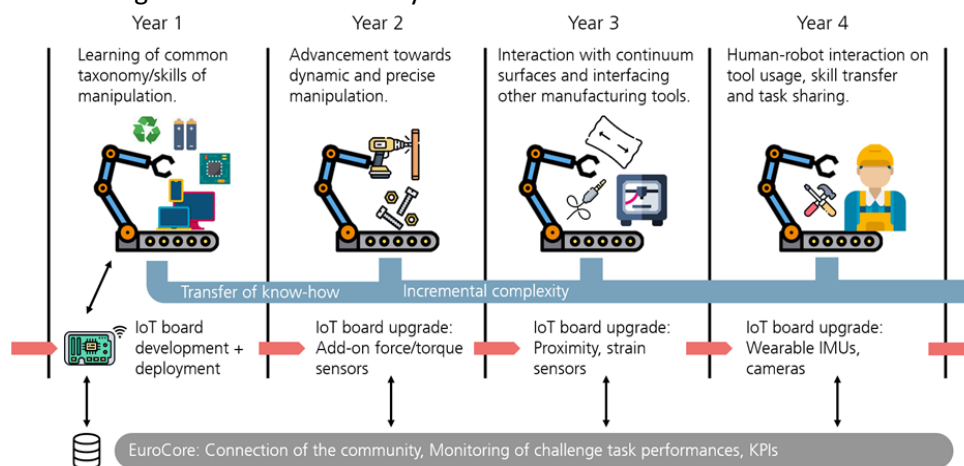Robotic manufacturing for a circular economy

Figure 3 Robotic manufacturing for a circular economy

Advanced manufacturing challenges with increasing complexity over the years with the co-development and deployment of IoT task boards, which will monitor the challenge performances and connect the community over EuroCore with performance metrics.

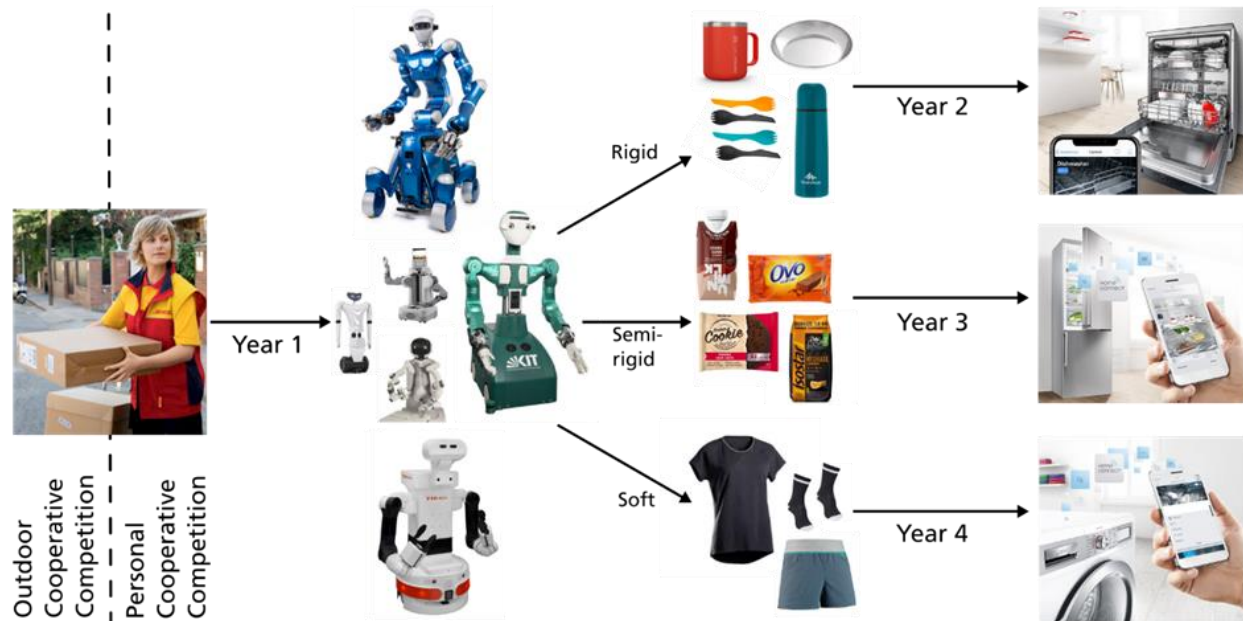Personal robots for enhanced quality of life and well-being

Figure 4 Overview of the progression of the collaborative competition on personal robotics.

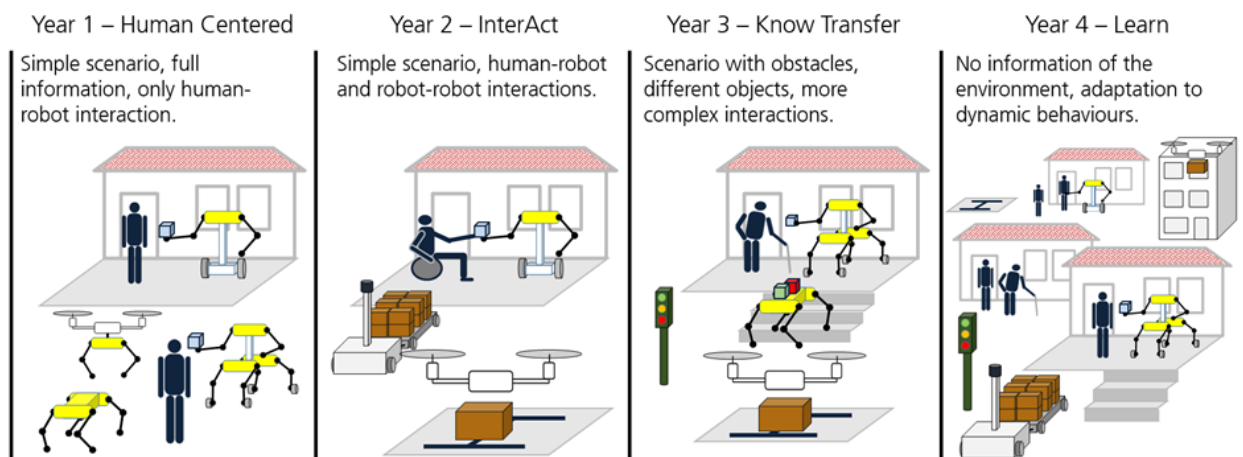Outdoor robots for sustainable communities:

Figure 5 Scenarios of increasing level of complexity considered in the outdoor robotics challenge, involving the transportation and delivery of goods using aerial, legged, and wheeled robots.

38

It involves three challenger teams solving in a sequential manner three tasks and exchanging task-relevant information. This, of course, implies that the teams agreed in the year before the challenge on exchangeable data formats, possible interfaces, pools of algorithms, etc. These shared elements are stored in the EuroCore Repository. Core partners from the science and technology domains provide the main contributions in defining these interfaces and setting up and running the repository.