

***euRobotics* – Shaping the future of European robotics**

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Summary / Abstract

Over the last few years successful coordination activities have been undertaken within the academic and industrial robotics communities (EURON and EUROP), but both communities still struggle to overcome the community-internal problems regarding terminology and suboptimally coordinated transfer of research visions, technology, and people. The European Robotics Coordination Action *euRobotics*, which started on 1 January 2010 and runs for three years, aims at creating sustainable solutions to all of the above-mentioned problems. It will continue to implement a policy of targeted stimulation of relevant grass-roots initiatives that both communities have already experimented with in recent years, but that have previously seen little success because of a lack of committed, professional and coordinated support. Two main objectives will be targeted: (1) the improvement of cooperation between industry and academia and (2) the enhancement of public perception of (European) robotics. It is hoped by the project partners that the planned activities, described in this paper in detail, will result in significant and prevailing advantages for robotics in Europe.

1 Introduction

1.1 Origins of the project and lessons learnt from former initiatives

Within the last few years successful coordination activities have been undertaken within the academic and industrial robotics communities, most notably EURON (European Robotics Research Network, initiated as a Network of Excellence within the EC Framework Programmes FP5 and FP6 [1]) and EUROP (European Robotics Technology Platform [2]), but both communities still struggle with overcoming some remaining gaps: the community-internal gaps of confusion about terminology, suboptimally coordinated transfer of research visions, technology, and people, and the badly coordinated communication with both the general public and professional audiences. This includes the popular science media, the European Commission, national funding bodies, and representatives from neighbouring technology and market domains, such as cognitive science, mechatronics, automotive, aerospace, security, computer vision, embedded control systems.

Although both communities have already experimented with multiple initiatives in recent years to overcome the

before mentioned gaps these initiatives were of limited success to date because of a lack of committed, professional, and coordinated support. One prominent example for such an initiative was the EURON attempt to develop the yellow pages of robotics much like the “yellow pages” telephone directories that contain lists of companies that sell specific products or services. This was not successful because there was no real incentive for stakeholders to contribute (the Internet search engines did an equally good or even better job). The main reason for this was that the search was purely based on matching text strings and not on semantic web matches.

The EURON Summer Schools on state-of-the-art topical research were a huge success, but they were not filling all the advanced training and education needs of the robotics community in Europe. Most significantly, they failed to provide a quality-controlled education in the complete fundamental scientific background of robotics, training in research attitudes, and customised training opportunities to the R&D engineers in the European robotics industry.

EURON initially had a work package on entrepreneurship, which was later abandoned because of the lack of a dedicated fulltime professional support, and the communication gap with the industrial community.

The Coordination Action for Robotics in Europe (CARE, FP6, [3]) and EUROP were able to bring together industrial robotics experts to successfully develop common product visions and formulate application requirements in a terminology understood by the diverse stakeholders from industrial, professional and domestic service, security and space robotics domains. To some extent these two initiatives also managed to involve academia in their roadmapping efforts with respect to the identification of the relevant technologies, but with insufficient depth and without pointing out the details of the technological gaps that still exist.

1.2 Objectives of the project

Following the experiences of EURON and EUROP the *euRobotics* project was set up to target two main objectives:

- (1) to identify and help closing the gaps between industry and academia and
- (2) to promote European robotics.

The first goal of the project is to identify the gaps that still exist between and within industrial and academic robotics communities in Europe and to create awareness of these gaps. Industry and academia are still not able to fully exploit the synergy between the market pull from industry and the technology push from academic research. Both communities lack structured ways

- to meet and talk to each other in an agreed-upon terminology,
- to streamline their research and development agendas,
- to stimulate robotics entrepreneurship,
- to communicate their achievements to the general public, and
- to optimise the effectiveness of advanced training and education.

The second goal of the project is to give a unique and professional face to European robotics by setting up common external communication channels towards

- the general public,
- professional audiences such as popular science media, European Commission, national funding bodies, and
- representatives from neighbouring technology and market domains such as cognitive science, mechatronics, automotive, aerospace, security, computer vision, embedded control systems.

This project's ambition is to create sustainable solutions to both goals. This will be followed by targeted stimulation of relevant grass-roots initiatives. Having learnt from past failures, these efforts will be backed by the committed, professional and, especially, coordinated support of *euRobotics*. Industry will be the driver behind these targeted stimulations because its needs for innovation and strong positioning in the worldwide robotics market are greatest. The academic research community will be heavily involved via a system of flexible, targeted expert contributions whose short-term benefits are easy to identify and communicate.

2 *euRobotics* activities

To ensure that the goals are reached the policy of the consortium behind this project is based on the best practices and lessons learnt in recent community-driven activities: a small number of committed, self-motivated and respected individuals from both communities can achieve large leveraging effects if:

- they are supported by some professional, fulltime technical staff with clear responsibilities, and
- they are careful to remain extremely transparent to their communities about what the funding is used for and about giving all motivated community members equal and ample opportunities to contribute.

The following concrete activities are planned to reach this project's goals (and to remedy the lessons learned from failures of the past):

- promote EUROP as the first point of call for all interested in European robotics (e.g., robotic stakeholders, press, members of the public),
- organise common activities for industry and academia such as larger annual meetings and smaller dedicated workshops, a web portal on robotics in Europe, advanced training, roadmapping, and entrepreneurship advocacy,
- coordinate communication to the general public, professional audiences and representatives from neighbouring domains through press releases, visibility at major robotics events, competitions related to the shared research and development roadmap, layman's explanation of robotics technologies in combination with semantic search support on the web portal),
- facilitate exploitation of robotics R&D by bringing forward networking between the different stakeholders to overcome the fragmentation between and within sectors and the different communities, by carrying out market studies and prospective marketing, and by pushing international standardisation activities from a European viewpoint,
- provide advanced training and develop a common terminology: the introduction of infrastructural investments in advanced training, and driving forward a common terminology, is a process that will be tedious in the beginning, but will carry itself once a critical mass has been achieved.

euRobotics is coordinated by KUKA Roboter. A small number of partners (see list of authors / organisations) drive forward the many community activities. To support community expert contributions and to be inclusive rather than exclusive, a proportion of the budget will be made available for contributions from members of the community who are not in the consortium. Additionally, links to other projects and external experts ensure broad networking for the widespread involvement of the whole European robotics community. Figure 1 depicts the ways in which *euRobotics* facilitates a closer industry-academia collaboration and the expected impact of such collaboration.

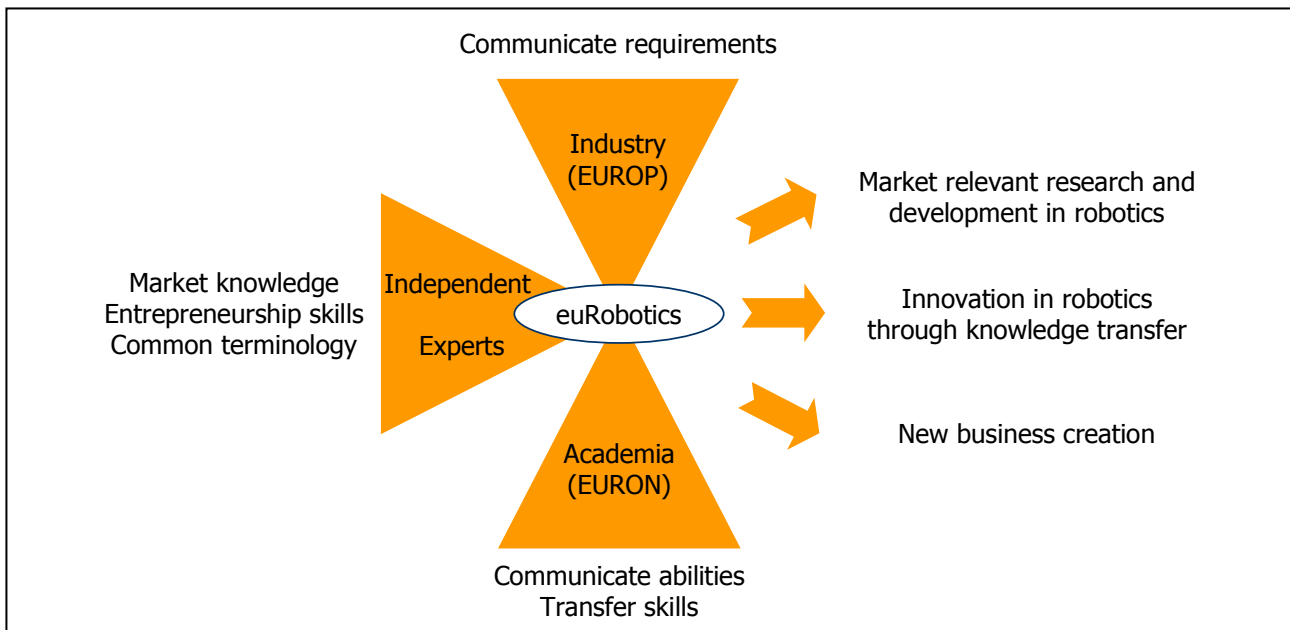


Figure 1: Industry-academia collaboration and the impact of euRobotics

euRobotics brings together the robotics industry (some of which are organised in EUROP) and robotics science/academia (some of which are organised in EURON). While the robotics industry communicates its requirements, the robotics scientists communicate their abilities and transfer skills and knowledge to the industry. The input of a wider circle of people is required, e.g., to draft a terminology/glossary that is accepted by the whole robotics community. In addition to robotics expertise this group of independent experts also contains expert knowledge from other domains such as economics and social science, which is essential, e.g., to provide market knowledge and entrepreneurship skills. *euRobotics* will eventually lead to more market-relevant research and development in robotics, more innovation in robotics and technology transfers, and new business creation.

To fulfil the two main objectives of this project work will be carried out on the following topics:

- Bridging the gap between academia and industry
- Promotion of European robotics
- Facilitating exploitation of robotics R&D
- Strategic coordination and networking

These topics are introduced in detail in the following.

2.1 Bridging the gap between academia and industry

Bridging the gap between industry and academia is the most important task of *euRobotics*. It is crucial that gaps between industrial needs and academic offerings are highlighted and actions to close these gaps are taken. This includes monitoring and updating the European robotics Strategic Research Agenda (SRA) [4] and enabling its implementation. Also important are advanced training of academia and industry, setting up a common terminology and ontology, and formulating challenges for academia to prove the market-readiness of developed technologies.

2.1.1 Identifying hindering gaps

One fundamental problem in the robotics domain is the lack of awareness by researchers about the needs of industry and the similar lack of awareness of industry of what is actually available in research organisations and therefore potentially transferable for industrial development. This gap became apparent during the development of the Strategic Research Agenda formulated by EUROP and CARE with the support of EURON.

A related fundamental problem is that researchers often believe that a particular robotics problem has been solved for some time. While these academic solutions are generally feasible, they may not be sufficient from an industrial point of view. The solutions do often not fulfil all industrial requirements (e.g., ease of setup and usability, robustness, environmental constraints...) or business constraints (e.g., profitability, sensing requirements...). Such shortcomings hinder the creation of new products and services, but because academia is not aware of the problem, they can not contribute to or point towards a solution.

The fundamental discrepancies in understanding of the two communities was made visible from a helicopter perspective through the SRA without providing details on the technical nature of the gaps. It is the objective of this task to identify the gaps, evaluate their "size", and determine which are deemed most relevant for the future of robotics.

A second objective of this task is to make both communities aware of the gaps to prevent these from hindering developments. However, a line has to be drawn between academic research and developing industrial products. This will help to maintain a long term research focus in academia and to prevent the use of public money for product developments for certain companies.

A call for "the most simple and fundamental unsolved problems" was issued and discussed at the first EU-

ROP/EURON annual meeting in March 2010. The output of this activity was a first list of tangible prototype problems. In addition the consortium will try to identify unsolved problems by comparing the list of requirements of industry with the performance in robotic laboratories with the EUROP SRA as a starting point.

2.1.2 Implementation of the SRA

Robotics roadmaps have a long tradition in the European research community. The European Robotics Research Network EURON devised two roadmap documents largely based on *academic* input in 2004 [5] and 2008 [6]. In 2006, EUROP, the European Robotics Technology platform, published a first *industrially* driven roadmap, which has recently been superseded by “Robotic Visions to 2020 and beyond – The Strategic Research Agenda (SRA) for robotics in Europe” [4]. This SRA had been developed from 11/2006-07/2009 with over 130 institutions participating. The roadmapping exercise was driven by the European robotics industry and was backed by the commitment and endorsement of many European robotics stakeholders. It is in the interest of European robotics to disseminate the SRA results with the aim of aligning all robotics stakeholders to the agenda and to work jointly on its implementation. This will help to ensure the SRA has a significant impact on the field. Furthermore, this task has the objective to monitor during the lifetime of this project whether the SRA maintains validity and to provide input for its adaptation should the need arise. Any feedback and further information gathered which could be used to improve the SRA, will be collected and, where appropriate, publicised. Finally, lessons learnt here can be used to maximise the impact of the described overall efforts.

2.1.3 Education and training

Robotics brings together several domains (mechanics, electronics, computing, and control, to name just a few). Two of the problems, which this leads to, will be tackled by actions targeted to education and training:

- PhD students in robotics often struggle with gaining the knowledge they require, which was not covered by their undergraduate degrees, or which is not part of the domain the students’ direct environment is working in.
- Industrial researchers and developers often lack the extensive knowledge required to understand and exploit academic solutions to the problems they face.

To overcome the problems stated above the following three core activities will be supported: (1) a European robotics PhD Programme, (2) European robotics Summer Schools, and (3) Advanced Training Courses for the European robotics industry. An Education and Training Board (ETB) will coordinate, synchronise and control these education and training activities. It has been recently set up consisting of both academic and industrial members. Building on the previous efforts (e.g., EURON Summer Schools), the ETB will help the sector to overcome the first of the above named problems by providing courses and materials to prepare PhD students better for their studies in the field of robotics. These resources (teachers and

materials) will then be adopted to teach personnel from industry the skills they require to make use of academic solutions effectively thereby tackling the second problem.

The main activity of this task is the creation of a European robotics PhD Programme consisting of several PhD Schools which provides a more structural and recurrent training to PhD students. It focuses on the robotics systems level and on stimulating an academic research attitude amongst our PhD students. The subjects and the concrete contents of the PhD Programme will be thoroughly discussed and finalised by the European robotics community, under the leadership of the ETB.

The recurrent PhD Schools will be accompanied by more ad hoc Summer Schools focusing on teaching the technical state-of-the-art in specific robotics research topics to PhD students. Summer Schools will be organised by ad hoc committees. They will take responsibility for their contents while working together with the ETB to receive a quality stamp and to coordinate their organisation and topics.

The Advanced Training Courses will provide customised, advanced training to robotics engineers in the European robotics industry. They will do so by adopting the resources generated or made available for the Summer Schools and the PhD Programme for an industrial audience. Further, the infrastructure to facilitate cross-fertilisation internships (academics visiting industrial partners and vice versa) will be provided.

2.1.4 Terminology and the robotics semantic web

Robotics is a prime example of a science of integration that relies on knowledge from a large variety of fundamental domains (control theory, physics, computer science, artificial intelligence, cognitive science, etc.), and that provides applications in a large variety of scales and scopes (medical, industrial, field, underwater, domestic services, etc.). The result is that students, researchers and engineers have to master an extremely complex set of terminology, meaning, relationships, and concepts, where the same name is often used with different meanings and in different contexts, and where the same concept carries different names depending on the adopted fundamental domain.

This activity wants to help the robotics communities to bring structure in this semantic web and to provide computer support to make effective use of it. To do so, glossaries, taxonomies and ontologies that structure the knowledge in the robotics domain need to be created. Ways to present this information in a useful way need to be found.

Major inputs will be the glossaries developed in CARE and RoSta (Robot Standards and Reference Architectures, [7]) and the glossaries, taxonomies, and ontologies which will be generated for each of the PhD School topics. In return, this material will support the PhD Schools and Advanced Training sessions in explaining to students the (ever growing and more complex) relationships between a large set of concepts and terms in robotics.

The relationships between robotics terms will further be made explicit, and available in computer-processable form, such that the search engines can make use of it. This will lead to search results of higher quality. The searcher will,

for example, find all academic labs doing research on “force control”, even if the original search used was “impedance control”. The availability of the semantic web infrastructure provides those with access to it with a significant competitive advantage.

2.1.5 Grand challenges

Situated between the identification of the hindering gaps detailed in Section 2.1.1 and the outreach activities of *euRobotics* described in Section 2.2, this task aims at formulating core RTD issues as competitions that are challenging and attractive to both robotics communities. Creating such competitions and making them visible as *Grand Challenges* will increase the awareness of the core RTD issues within the robotics community and lead to competitive solutions in the long run. The challenge will be defined in such a way that they should tease researchers and developers from both sides to jointly search for solutions.

2.2 Promotion of European robotics

euRobotics also aims at raising the profile of European robotics in general, and in the media in particular. In this section we describe how we intend to establish a unique branding for European robotics. In support of raising the profile, numerous reports, articles and press releases will be published, not only based on the activities of this project, but foremost on activities from the whole community. Further, the access to robotics news and material to be published will be significantly simplified. The ambition is here to establish a press centre for European robotics under the EUROP brand. Besides targeting the media and public in general, it is also the aim to actively promote European robotics at the main professional events of the robotics community such as high-level academic conference and industrial trade fairs and exhibitions.

2.2.1 Public relations

Although European robotics has much to offer, it is not adequately represented in the media to the general public and even within the robotics community itself. Ensuring that EUROP and EURON have the means and tools to sufficiently promote European robotics will have a positive impact both within Europe and abroad.

The public relation activities include the provision of all the tools needed for successful public relations: templates, flyers, standard presentations about European robotics, press releases, list of press contacts as well as establishing the secretariat as central point for European robotics. To this end establishing and maintaining contact to the specialised and general press is of foremost importance. EUROP and EURON members will be asked to give access to their press material to enable the European robotics press centre to compile up-to-date information. Press contacts will be collected as well to create and maintain an up-to-date press distribution lists. Profiles of key professionals within the European robotics community will be compiled. These profiles will help press contacts to find relevant contact persons in their respective field of interest. Press re-

leases about EUROP/EURON events, *euRobotics* achievements, and milestones will be prepared, publicised and sent out as needed.

2.2.2 Press centre

Plenty of information regarding all aspects of robotics in Europe is available, e.g., projects, products, events, workshops, key robotics professionals, etc. The problem is that all this information is scattered without easy access for the public and the press. Interested parties have to conduct a search through a variation of time consuming and complicated channels to get to what they want. A coherent and simplified access to a complete source of information regarding European robotics is not available. However, it is of special importance for the press and the robotics community to have all the information regarding robotics in Europe easily available in a coherent and user friendly fashion (“one stop shopping”). Hence, a press centre will be established which shall become the media face of robotics in Europe featuring relevant European robotics PR material. The press centre shall be recognised as a valued and comprehensive source of robotics information for all interested parties. It should serve as a library for those interested in European robotics and as an encouraging vessel for those keen on wanting to display their relevant information online. This press centre will target the mass media, the specialised press, professionals and enthusiasts alike. The press centre will be actively promoted and representatives of the press will be consulted on how to ensure its success.

2.2.3 Promoting European robotics at professional events

European robotics, in general, is underrepresented at professional events. Recognition of EUROP and EURON, which facilitate the cooperation of all European robotics stakeholders, is needed. This task will ensure increased visibility of European robotics and its main source of funding at all levels. The *euRobotics* partners will represent EUROP and EURON at important events at national, European and international level (e.g., ICT and CogSys conferences, IEEE ICRA and IROS conferences, IFR-related conferences and trade fairs such as AUTOMATICA). It is also the intention to encourage active participation of all European robotics stakeholders at professional events, highlighting, however, not just their personal interests, but European robotics as a whole. The first major promotion activity is the organisation of a European robotics research booth at AUTOMATICA 2010, Munich.

2.3 Facilitating exploitation of European robotics R&D

To facilitate the exploitation of European robotics R&D the work described in this section aims to foster and promote entrepreneurship. Additionally, opportunities and threats / barriers due to legal, ethical and social concerns as well as relevant aspects of the markets and standardisation activities will be identified.

2.3.1 Fostering and promoting entrepreneurship

Much of the development of new markets and technical breakthroughs rely on entrepreneurs taking breakthrough technologies out of higher education and applying them to new applications and markets. A less usual, but still important route for such new markets, is the spin-off of small companies from larger established companies. While Europe has a reasonable track record in this area, it is not as strong as the established private enterprise culture of some other countries.

The aim of this task is to foster a vivid entrepreneurial culture as well as giving would-be-entrepreneurs access to support information and contacts related to starting high technology companies. To this end, firstly, we want to foster awareness in potential new entrepreneurs, mainly students and PhD's, attracting new people to become entrepreneurs. Secondly, material covering the methodological aspects of the entrepreneurship processes including financial aspects will be prepared. Thirdly, a series of entrepreneurship workshops will be organised aimed at introducing young researchers to the possibilities and practical steps of setting up a company, bringing together entrepreneurs (and their spin-off ideas) with venture capital organisations and business angel networks.

The further continuation of the EUROP/EURON Tech-Transfer Award and the publicity actions associated with this award is the starting point for a sustainable promotion mission for European robotics beyond the duration of the project. The award highlights excellence in technology transfer to the community and helps establish a culture of targeted and application-oriented R&D.

2.3.2 Analysing ELS issues

Ethical, legal and societal (ELS) implications and constraints are frequently under-estimated or not even considered by robotic projects. These issues are often not considered until developers realise the impact and resulting application limitations or constraints. Many of the companies facing these problems are SMEs which, acting alone, are unable to exert much pressure for the resolution of these non-technical barriers.

This task will highlight the considerable non-technical challenges faced by European companies in delivering advanced service robots to the market. Many of the shorter term challenges are legal and compliance issues, but ethical and societal key issues must also be addressed and the risks have to be managed appropriately if a large European service robot industry is to be grown. This work will feed into the market access analyses described in the following section. Actions required to resolve the identified critical issues and highlight the time scale required for such action will be derived.

As a grass-root initiative the goal of this task is not to solve the previously described problems entirely, but to at least provide pointers for future work. To do so in an efficient and effective way, it will be necessary for the identification of, and a consultation with, existing players in the European robotic industries. It will be useful to assess

what current ELS issues are preventing or hindering the development of markets and which are seen as the major future barriers. Further, the key barriers and stakeholders need to be identified in order to work on the resolution of the identified barriers. Here the resolution timescale vs. the required market timescale is of importance. A series of workshops will be run to promote discussion between industry representatives and representatives of regulatory and / or influential agencies regarding the need, practicality and timeliness of changes needed to remove the identified barriers.

2.3.3 Market studies

Coordination of research and development, technology transfer and entrepreneurial activities in robotics should be based on current market developments, forecasts and justified long-term trends. Factors contributing to and hindering market success of robotics products should be known among the community.

The first objective of this task is to provide a solid basis of market data, specifically in the very diverse area of service robotics including sound forecasts for European manufacturers. These activities build on existing work of market surveys, statistics and forecasts (World Robotics Report [8]) and will be continued with a specific distinction of European activities.

In addition, opportunities and major constraints on further diffusion of service robotics in respective product categories with an emphasis on European manufacturers are identified. The reasons for generally complicated market access of new, disruptive products (e.g., health care, medical, and rehabilitation) have to be understood. Unexpected barriers often prevent the successful penetration of new technology products into these markets. Three critical markets (rehabilitation/care-giving, medical, and robot assistants in manufacturing) will be analysed on a case-by-case basis. Particular attention is paid to the simulation of the market introduction of a lead product (product that opens the market) with regards to economical decisions by the end-user to invest into such an innovation.

2.3.4 Standardisation activities

Standardisation, particularly in safety, is of paramount importance for focused research and product development in robotics to meet legal, economical demands and acceptance. Numerous efforts have started towards standardisation activities in service robotics mainly aiming at safety, and component interoperability on different levels (ISO, OMG, IEEE) with foci ranging from glossaries, safety, and architecture to interoperability and benchmarks.

Participation in the respective standardisation activities is crucial for the further development of European robotics, but the process is lengthy, resource intensive and tedious. The European activity level apart from industrial safety standardisation has been too weak in the past. This is particularly true considering the high level of activity and progress of Japanese and Korean researchers.

The objective of the task is to coordinate European activity in international committees and to secure appropriate lev-

els of activity and competence in all relevant standardisation work. Towards this end, *euRobotics* will focus European presence on the ISO level helping to define vocabulary and to draft robotics standards towards safety.

2.4 Strategic coordination and networking

Experiences from the CARE project and EURON have shown that a coordination of activities within the robotics community, both among industrial members and between academia and industry, is very beneficial. It brings the communities together and greatly improves communication between robotics stakeholders and between European robotics and society as a whole. To coordinate such activities is time-consuming and needs a strategic plan.

Especially in the field of service robotics with its many young companies, a lack of networking between the stakeholders can be observed. Many of these companies have no affiliation with, or knowledge of, other companies already operating in similar markets or with similar technologies. This results in these companies having to develop most of their technology from scratch, leading to higher costs and smaller market possibilities.

For the overall success of *euRobotics*, as enabler of improved industry-academia collaboration, it is essential to establish, monitor and maintain links between EUROP, EURON, euCognition [9] and other organisations and networks in the fields connected to (European) robotics (e.g., the International Federation of Robotics – IFR [10]). By bringing together diverse stakeholders, this task will overcome the fragmentation between and within the different robotics sectors.

The importance of the annual meetings of the European robotics community will be significantly enhanced. It is the aim to make these meetings a focal point of academia, industry and policy makers and to foster their mutual understanding. In the SME-driven service robotics field a European service robotics community will be developed to overcome the lack of networking. This will in the long run lead to relationships between companies to allow greater specialisation, open up markets more quickly and bring cost benefits to end customers.

It is of great importance to develop a strategy highlighting both long- and short-term benefits for all involved stakeholders to ensure these activities are sustainable beyond the project lifetime. Besides a strategic plan laying out the details of the activities, a community secretariat, a web site and other infrastructural means for supporting community building are needed. To facilitate communication a database of companies and academic institutions active in robotics and closely associated technologies / products in Europe will be developed and maintained.

Regular meetings of EURON and EUROP members and other invited robotics experts and stakeholders will be organised. During such meetings the stakeholders in the different sectors will work on topics, challenges and difficulties of common interest (such as technological challenges, market barriers, lessons learnt, etc). The existing EUROP working groups are the facilitators of a structured discus-

sion among their stakeholders and will further expand their activities.

3 First joint EURON-EUROP annual meeting 2010 in San Sebastián

More than 230 European roboticists from both, industry and academia, met for the first joint EURON-EUROP annual meeting for three days in Donostia – San Sebastián – Spain (10-12 March 2010) [11]. The overall vision for the event was to start bridging the gap between industry and academia. Challenges faced by industry concerning the advancement of European robotics and academic solutions to tackle them were discussed. The *euRobotics* project facilitated the overall organisation of the meeting and most of the sessions while Fatronik-Tecnalia made perfect local arrangements.

The first day started with the General Assembly of EUROP, in which a report on EUROP activities and recent developments was given to the members. In the five EUROP working groups (industrial, professional service, domestic service, space and security robotics) the participants were first asked to identify real technical problems the industry is currently facing. In a second workshop the participants discussed what robotics can contribute to tackle societal challenges (ageing society, sustainable production, climate change, ...). The workshops on this day were a good starting point – the results and ideas collected will now help the EUROP working group leaders in preparing EUROP position papers.

During the second day, the workshops were more focused on challenges both (academia and industry) are facing. “Autonomous systems in security and aerospace”, “Encouraging Entrepreneurship: Sources of Finance and Early Stage Experience”, “Service Robotics: reasons that are delaying the expected ‘take-off’ of the sector” were more targeted for the roboticists interested in the burgeoning robotics sectors (service, space and security). A workshop on “Robocup and Grand Challenges” elaborated ideas on how to focus (existing or new) Grand Challenges on topics of more (concrete) relevance for the robotics industry.

In parallel, discussion workshops on more general topics took place: brainstorming sessions on “How to strengthen industry-academia collaboration (with focus on technology transfers) in robotics?”, “Feedback on the EUROP Strategic Research Agenda” and “How to raise public awareness of European robotics?” with a lively participation of the community were conducted.

In the afternoon, the community met for plenary sessions. The finalists of the EURON PhD award presented results of their research and the EURON community was asked to determine the winner. Libor Král (EC, Head of Unit “Cognitive Systems, Interaction, Robotics”) gave an overview of the ICT work programme and upcoming funding opportunities. The EC is a major funding source for European robotics research spending about 400 million € alone in the period from 2007 until 2010. Libor Král made clear that the overall aim of the funding is to empower the European

robotics industry with new technologies and solutions and increase its competitiveness. Libor Král's presentation was followed by Rikardo Bueno's (Fatronik-Tecnalia) on the roadmap for the Factories of the Future programme, to which EUROP had contributed [12].

A further highlight of the second day was the Technology Transfer Session, in which the six finalists of the EUROP/ EURON Tech Transfer Award presented their work. It was encouraging for the community to see examples of research conducted by academia resulting in real products with commercial impact. This year's winner was ALSTOM and ETHZ / EPFL for "Highly Compact Mobile Robots for Process and Power Facility Inspections".

During the third day, the workshops were targeted more towards academia, but attendance showed they were of interest for the robotics industry as well. This included sessions on Ethical, Legal and Societal issues / non-technical constraints and robotics education and training. Industry presented state-of-the-art robotics products and discussed academic needs and other R&D challenges with the community. A few workshops dedicated to specific technical issues were also held.

The number of participants and the active participation in the many workshops confirmed that both communities, industry and academia, have an interest to learn from each other and know that a closer cooperation will benefit both.

4 Summary and conclusions

The motivation behind the *euRobotics* project is the awareness in both the industrial and academic robotics communities in Europe that the time has come to work more closely together in a structured way, but without the risk of losing one's own identity. The focus is on a clearly identified set of topics for which the short-term gains for both communities are apparent, relatively easy to achieve effectively, and sustainable beyond *euRobotics* funding.

Industry-academia cooperation is improved by giving more structure to commonly organised efforts and events, e.g., through a common administration, annual meetings, a web portal on European robotics, advanced training, road-mapping, and entrepreneurship advocacy. Furthermore, European robotics is for the first time actively promoted by a central player, the EUROP secretariat. Press releases, visibility at major robotics events worldwide, and robotics competitions are just a few of the means to communicate to the public.

The driver behind these stimulation actions is the robotics industry since its needs for innovation and strong branding are greatest. But the academic research community is heavily involved via EURON. Contributions are requested from the wider community and such efforts can, within reason, be reimbursed when the benefits are easy to identify and communicate. In carrying out these actions it is intended to also address another major issue, the fragmentation of the industry, particularly within the newly emerging market and technology areas.

Academia and industry depend on each other: only a strong cooperation will allow the European robot manufacturers to uphold their leading role in the industrial robotics sector and will put the burgeoning service, security and space robotics markets in a strong position. On the other hand, only a strong industrial foundation will ensure that robotics research will remain on such a high level in Europe.

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