



Funded by the European Union



**RoCKIn - Robot Competitions Kick Innovation
in Cognitive Systems and Robotics
FP7-ICT-601012**

Grant Agreement Number: 601012
Funding Period: 01.01.2013 - 31.12.2015
Instrument: Coordination and Support Action

D6.1 - RoCKIn Competition 2014

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D3.1 - Report on Progress of the Competition and Benchmark Activities

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Due date of deliverables: 31 December 2014 (D6.1) and 31 January 2014 (D3.1)

Actual submission date: 31 December 2014

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Executive Summary

The goal of RoCKIn (“Robot Competitions Kick Innovation in Cognitive Systems and Robotics”) is to speed up the progress towards smarter robots through scientific competitions. Two challenges have been selected for the competitions due to their high relevance and impact on Europe’s societal and industrial needs:

- domestic service robots (RoCKIn@Home) and
- innovative robot applications in industry (RoCKIn@Work).

Both challenges have been inspired by activities in the RoboCup community, but RoCKIn is improving and extending them by introducing new and prevailing research topics, such as natural interaction with humans and networking mobile robots with sensors and actuators spread over the environment, in addition to specifying concrete benchmark criteria for assessing progress.

Two Competition Events are planned during the project lifetime (one in 2014, the other in 2015), each of them based on the two challenges and their respective test beds.

The **RoCKIn Competition 2014 took place in Toulouse from 24 to 30 November 2014** (see Figure 1) during the European Robotics Week 2014 (ERW2014) with the following schedule outline:

- 24-25 November: assembly of the competitions team areas and arena;
- 26-27 November: team arrival and set up days;
- 28-30 November: competition days, open to the public.



Figure 1 – RoCKIn 2014 at Cité de L’Espace (Toulouse).

Following a 4-step qualification process, **7 teams participated in RoCKIn@Home, and 3 teams participated in RoCKIn@Work 2014, in a total of 79 participants from 6 countries.**

An infrastructure consisting of an outdoor tent, the RoCKIn@Home and RoCKIn@Work arenas and team areas, the test bed components (objects, machines, furniture), the benchmarking components (Motion Capture System and the Referee Boxes, to name but the most relevant ones), was set up by the RoCKIn partners and the IST-ID subcontractor Dr.Bredenfeld UG company. **Special emphasis was put on the data acquisition for benchmarking and on the scoring procedures** as crucial aspects of the RoCKIn approach to competitions.

A significant amount of communication and PR materials was prepared and disseminated, namely brochures, leaflets, banners and t-shirts. Badges, bags and trophies were procured and made for the participants. **The interest raised by the RoCKIn Competition 2014 event made euRobotics aisbl decide to move, for the first time, the Communication Centre of the European Robotics Week 2014 to La Cité de L'Espace (CDE) and Toulouse,** and enabled financial support from the Toulouse region (Midi-Pyrénées Innovation, Toulouse Métropole), as well as the fundamental involvement of Dr. Rachid Alami through the Laboratoire d'Analyse et d'Architecture des Systèmes (LAAS/CNRS) and CDE in the organization of 4 parallel events (for academic and industrial researchers, but also for the public) during the event's week. Dr. Khalil Rouhana, Director of DG CONNECT, participated in RoCKIn Competition 2014 Opening Ceremony.

The following institutions were **partners/sponsors** of the event:

- Toulouse Métropole
- Région Midi-Pyrénées
- Cité de L'Espace
- Laboratoire d'Analyse et d'Architecture des Systèmes (LAAS/CNRS).

The SMARTIF and FVR companies respectively sponsored the home automation network used in RoCKIn@Home and the support to the installation of the OptiTrack Motion Capture System in RoCKIn@Home and RoCKIn@Work arenas.

Overall, **the RoCKIn Competition 2014 can be considered a successful event** from the viewpoint of the technical infrastructure developed by the project team for benchmarking and automatic competition execution, and of the visibility gained, namely in the EU space, through its integration as the core event of the European Robotics Week 2014.

Preparation of the Event

Partnership with the Toulouse region and euRobotics aisbl

The RoCKIn Competition 2014 was initially planned to take place in Munich during the AUTOMATICA 2014 Fair, in June 2014. However, due to the coincidence of this event with IEEE ICRA 2014, one of the major annual robotics conferences, held in Hong-Kong, China, the RoCKIn consortium, in agreement with the Project Officer, decided to move the Competition Event to November 2014, during the European Robotics Week 2014 (ERW2014), taking advantage of an offer for cooperation extended by Rachid Alami (LAAS/CNRS, Toulouse). Dr. Alami suggested to held the competition in Toulouse's Cité de L'Espace (CDE).

A preparatory meeting took place in Toulouse on 22-23 January 2014, with the presence of Pedro Lima (RoCKIn Coordinator and WP6 leader), Rachid Alami and representatives from CDE (including the Director Jean Baptiste Desbois) and Toulouse Métropole (Eric Tardieu, head of the Robotics Cluster, and Caroline Lapellerie from the City Hall). During this meeting, RoCKIn and CDE described the event and its potential to bring attention to the region technological activities, especially in Robotics. A budget for a larger event, with RoCKIn Competition 2014 at its core, targeting academia, industry and lay citizens, was presented, including RoCKIn's contribution. In May 2014, Toulouse Métropole and Région Midi-Pyrénées decided to support financially the events composing the ERW2014 in Toulouse, listed in Table 7, as well as the renting of a tent to host the RoCKIn Competition 2014, since the available space inside the CDE premises would not have been enough.

In June 2014, euRobotics aisbl contacted the RoCKIn Coordinator to explore the possibility of centring the ERW2014 in Toulouse, taking advantage of the appeal created by the RoCKIn Competition. After several exchanges of e-mails, teleconferences and a working visit of Dr. Uwe-Haass (euRobotics aisbl Secretary-General) to Toulouse in July 2014, euRobotics aisbl decided to move the Communication Centre of the ERW2014 from Brussels to CDE for the first time in its history. As a consequence, meetings of euRobotics Technology Topic Groups took place in Toulouse during that week, and RoCKIn benefited both from that extra exposure to leading European roboticists and from an extended live video-streaming coverage of almost the entire event, carried out by CDE cameramen under RoCKIn and euRobotics direction.

Infrastructure set up

The competition infrastructure consists of the following main elements:

- **Management structure and information channels** (between committees and teams; with stakeholders, the media, satellite-event organizers and visitors)
- **Communication materials** for visitors, teams, experts and distinguished guests
- **Hardware and software to support the competition execution**
- **Arenas and team areas.**

In the following subsections we describe in detail the preparation of each of these elements that took place between April and November 2014 (except for the rule writing, which was finished by the end of March 2014).

Management structure and Information channels

Preparing a competition requires a management structure and a communication infrastructure that supports exchange of relevant information among all the intervening people. In RoCKIn 2014, the management structure included project partners, competition organizing and technical committees, which regularly communicated with CDE staff, qualified team leaders, participants, visitors, media representatives and satellite-event organizers.

The Executive Committee (EC) is represented by the coordinators of each RoCKIn partner and is mainly responsible for the overall coordination of RoCKIn@Home and RoCKIn@Work competitions and especially for their dissemination in the scientific community. The RoCKIn Coordinator also played the role of overall Chair of the RoCKIn Competition 2014.

The Technical Committees (TCs) for RoCKIn@Home and RoCKIn@Work are responsible for writing, maintaining and improving the competition rules and also for the adherence of the teams to these rules. Other responsibilities include the qualification of teams (together with the Executive Committee), handling general technical issues, deciding about giving awards in case the number of participants is lower than the thresholds specified in the rulebook, as well as resolving any conflicts during an on-going competition (together with the Executive Committee, and with the possible advice of the RoCKIn Experts, if necessary). The members of the committee are further responsible for maintaining the RoCKIn@Home and RoCKIn@Work Infrastructures.

The Organizing Committees (OCs) for RoCKIn@Home and RoCKIn@Work are responsible for the actual implementation of the competition, i.e. providing everything that is required to perform the various tests. Specifically, this means supporting the test arena(s) set up, providing any kind of objects (e.g. manipulation objects), scheduling the tests, assigning and instructing referees, recording and publishing (intermediate) competition results and any other kind of management and advertisement duties before, during and after the competition.

Regarding information channels, part of the information was made available to the relevant stakeholders through web pages periodically updated:

- Web page (<http://rockinrobotchallenge.eu/rockin2014.php>) for participants and visitors (including public, robotics professionals and the media), including live streaming during the competition days through the euRobotics aisbl YouTube channel, and regularly updated details such as the schedule of competitions and satellite events, as well as information on the participating teams
- Password-protected web page (<http://rockincompetition.eu>) for team application and registration of the qualified teams, with the Call for Participation and a page listing all qualified teams' information, including affiliation, web page and logo, and the Team Description Paper (<http://rockincompetition.eu/teams>)
- Wiki page (<http://rm.isr.ist.utl.pt/projects/rockin-competitions-wiki/wiki/>) where detailed technical information for the qualified teams and a list of FAQ concerning the task and functionality benchmarks for the two challenges was regularly updated, including the list of all data to be logged by the teams during the competitions for later benchmarking processing

More interactive channels were based on e-mail lists for easy communication between organizers and participants:

- Organizing and Technical committees:
 - oc.tc-at-home@rockinrobotchallenge.eu
 - oc.tc-at-work@rockinrobotchallenge.eu
- Team Leaders:
 - tl_athome@rockincompetition.eu
 - tl_atwork@rockincompetition.eu
- Information for interested people (subscribing the e-list from the competition web page):
 - rocking-at-home@rockinrobotchallenge.eu

- o rockin-at-work@rockinrobotchallenge.eu

Communication materials

A comprehensive set of communication materials to be distributed to visitors and displayed at the venue was produced by INNO, based on contents prepared by IST-ID. They are listed in Table 1.

Materials to be distributed to the qualified teams are listed in Table 2.

Table 1 – Communication materials.

Item	Distribution	Image
Brochure	All qualified teams, Experts, AdBoard member, invited people, media, visitors	
Leaflet	All qualified teams, Experts, AdBoard member, invited people, media, visitors	
Roller banners	Venue	
Banners	Venue	

T-shirts	All participants, Experts, AdBoard member, organizers	
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Table 2 – Materials for qualified teams.

Item	Image
Bags	
Badges	
Trophies (competition awards)	

Guidelines plus questionnaires for the Experts Board and industry visitors were also produced and are included in Appendix B.

Hardware and software to support the competition execution

The TC and OC members for both leagues were also involved in the more detailed specification of the rules for the Task Benchmarks (TBMs) and Functionality Benchmarks (FBMs) – see listing of Benchmarks in Section “RoCKIn 2014 Week in Toulouse” - including developing some of the software and hardware involved, procuring/transporting arena components and writing scripts for the TBM and FBM execution.



Figure 2 – USB pen for storage of data acquired by the teams during each trial.



Figure 3 – Deli Man and postman uniforms.



Figure 4 – RoCKIn@Home FBM2 switch panel.

A non-exhaustive list of items resulting from this work and related activities for RoCKIn@Home 2014 follows:

- Referee Box that includes referee control, manual Start and Stop, Auto-Stop after timeout, information about whether the robot is connected to save benchmarking data, receive stop signal from robot to count time, goal specification for FBMs, robot message acknowledgments, display communication and robot state, interface to and control of home automation devices,

tablet used by Granny Annie to interact with the robot, display of time, schedule, and current TBM/FBM and team for the public, controlling the competition schedule, featuring multiple simultaneous benchmarks.

- Detailed information on the motion capture system setup and data acquisition procedures
- List of variables to be logged in each TBM and FBM and respective format – data must be saved in a USB pen at the end of a trial (50 RoCKIn USB pens were produced to be distributed to the participating teams to store their data at the end of each trial – see Figure 2).
- Set of objects available for the different TBMs and FBMs, and respective body reference frames, to be used in manipulation and perception.
- Sentence and lexicon examples for TBM3 and format of input audio files and output CFR format for FBM3.
- Tool to create rosbags for teams not using ROS.
- Postman and Deli Man uniforms and parcel package (images distributed prior to the competition – see Figure 3).
- “Dr. Kimble” face pictures distributed prior to the competition.
- Detailed scripts for some of the TBMs and FBMs, as well as for safety check and robot inspection and for running all the tests.
- Switch panel for FBM2 (see Figure 4).

A non-exhaustive list of items resulting from this work and related activities for RoCKIn@Work 2014 follows:

- Referee Box similar to the one described for RoCKIn@Home.
- Tool to create rosbags for teams not using ROS.
- Aid tray, container for bearing boxes and several boxes with QR codes.
- Detailed scripts for some of the TBMs and FBMs.
- Detailed information on the motion capture system setup and data acquisition procedures.
- List of variables to be logged in each TBM and FBM and respective format (50 RoCKIn USB pens were produced to be distributed by the teams to store their data at the end of each trial).
- Set of objects available for the different TBMs and FBMs, and respective body reference frames, to be used in manipulation and perception.

Arenas and team areas

The construction and set up of the competition arenas was one of the crucial aspects of the preparation for RoCKIn Competition 2014, and was executed by IST-ID's subcontractor Dr. Bredenfeld UG, based on the arenas design specified in the rulebooks [1,2], through regular tele-conference and e-mail contacts, which included CDE staff in several occasions.

The rules specify a range of dimensions, relative locations of rooms/areas, a superset of the objects to be manipulated, perceived or just disposed to affect navigation, to name but a few of the specific features for the two arenas. This provides some flexibility to enable adjusting the arena layouts and contents to the available space in a given laboratory or competition venue.

In Toulouse, since the indoor space available at CDE was not enough for RoCKIn needs, an outdoor tent was rented with the local partner sponsorship. The tent plan is rectangular, with dimensions 60 X 20 m. The ceiling has an arch profile, with the height varying between 2.5 and 5 m from the top of the tent walls. The RoCKIn@Home and RoCKIn@Work arenas were disposed to the left and right of the tent centre, and the team areas were located on the extremes of the tent, close to the respective arenas. The centre of the tent provided space for visitors' passage and was the location of an elevated big screen for projection of live video, scores and general information. Bleachers for visitors were installed in front of the two arenas. Drawings of the tent seen from outside and of the final layout inside are presented in Figure 5.

The furniture inside the RoCKIn@Home arena was acquired at IKEA (see listing in Table 3) and is almost the same as the furniture installed in the RoCKIn@Home test bed at IST-ID. The IKEA codes can be used for easy replication of the furniture and some of the objects inside the home in locations where IKEA stores are available. The RoCKIn@Work 2014 arena is also an almost exact replica of the BRSU RoCKIn@Work test bed. Several devices and objects were taken by some of the partners to Toulouse for the competition, e.g., home automation device network, home objects, IP camera for visitors' recognition (IST-ID – from its test bed), RoCKIn@Work motion capture system, drilling machine and conveyor belt, quality control camera (BRSU – from its test bed), youBots (KUKA), RoCKIn@Home motion capture system and several objects for benchmarking purposes (POLIMI), visitor's uniforms and mail packages (INNO).

Objects inside the arenas were chosen both for realistic purposes but also to push forward research challenges regarding perception (e.g., solid colour but also textured pillows), manipulation (e.g., objects located on a transparent table) or navigation (e.g., wardrobe with a mirror).

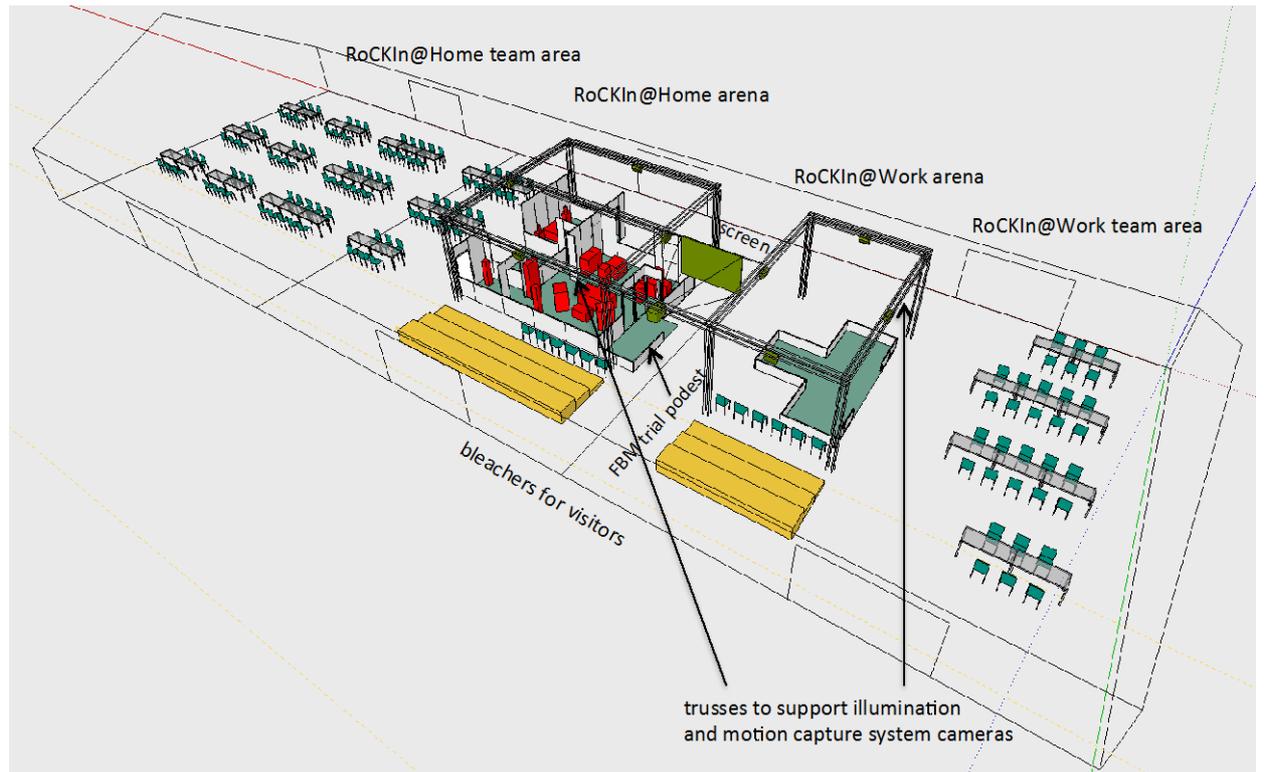


Figure 5 – Views of the tent and competitions area layout designed for RoCKIn Competition 2014.

Table 3 – RoCKIn@Home arena IKEA furniture.

Item	Quantity	Classification
BESTÅ Shelf unit	1	Living Room
BORGSJÖ Bookcase	1	Living Room
BORGSJÖ Glass door	1	Living Room
BRUSALI Bed frame	1	Bedroom
BRUSALI Bedside table	2	Bedroom
BRUSALI Wardrobe	1	Bedroom
GLIVARP Extendable table	1	Dining Room
INGATORP Drop-leaf table	1	Kitchen
JÖMNA Sprung mattress	1	Bedroom
Kitchen	1	Kitchen
KLIPPAN Two-seat sofa	1	Living Room
KROGIK Clothes Stand	1	Hallway
KVART Work lamp	2	Bedroom
LACK Coffe table	1	Living Room
Lamp in kitchen	3	Kitchen
POÄNG Armchair	2	Living Room
SAMTID Floor/reading lamp	1	Living Room
SIGURD Chair	3	Dining Room
STEFAN Chair	1	Kitchen

Team qualification process

The selection of participating teams in RoCKIn 2014 took place in four major steps:

1. **Intention to participate:** call out on 11 March 2014, deadline 15 April 2014 – with the goal of having an initial idea of the number of potential participating teams, number of team members, whether the teams would need a robot loan, and middleware to be used (e.g., ROS or other). 17 teams pre-registered.
2. **Application:** call out 1 May 2014, deadline 23 May 2014 – open to teams who declared their intention to participate and to any other teams. Applications were made by filling an online form (prepared by subcontractor Dr. Bredenfeld UG) with the required submission materials: i) team name and affiliation; ii) number of team members, with status (e.g., professor, post-doc, PhD student, MSc student); iii) competition [RoCKIn@Home / RoCKIn@Work]; iv) Team Description

Paper (TDP) with max 6-pages 2-column, describing the team technical approach and research challenges. 16 of the pre-registered teams applied, and were joined by 3 new teams, in a total of 19 applications (14 @Home / 5 @Work).

3. **Qualification decision:** on 6 June 2014, after assessing the received applications, the EC, together with the TC, under advice from the Expert and Advisory Board members, took a decision on the qualified teams for the RoCKIn Competition 2014. 13 teams were selected for RoCKIn@Home, 5 teams were selected for RoCKIn@Work (see Table 8).
4. **Final Registration:** the qualified teams registered on the web between 9 June and 1 July 2014, having the opportunity to revise their information and TDP contents. All 18 qualified teams registered.

All the Calls were published in major robotics e-lists worldwide and also sent to the e-mails of the teams who participated in the 2013 and 2014 RoCKIn Camps.

The applications listed a potential number of 144 participants from 8 countries (6 EU: Germany, Italy, The Netherlands, Portugal, Spain, United Kingdom; 2 non-EU: Mexico, Turkey). 18% of the team members were university Professors, 4% Post-Doc Fellows; 18% PhD students; 60% MSc students.

RoCKIn 2014 Week in Toulouse

Competition Organization

TBMs and FBMs

The list of TBMs for RoCKIn@Home 2014 was (details in the rulebook [1]):

- TBM1 - “Getting to Know My Home”
- TBM2 - “Welcoming Visitors”
- TBM3 - “Catering for Granny Annie’s Comfort”

The list of FBMs for RoCKIn@Home 2014 was (details in the rulebook [1]):

- FBM1 - “Object Perception”
- FBM2 - “Object Manipulation”
- FBM3 - “Speech Understanding”

The list of TBMs for RoCKIn@Work 2014 was (details in the rulebook [2]):

- TBM1 - “Assemble Aid Tray for Force Fitting”
- TBM2 - “Plate Drilling”
- TBM3 - “Prepare Box for manual Assembly Step”

The list of FBMs for RoCKIn@Work 2014 was (details in the rulebook [2]):

- FBM1 - “Object perception”
- FBM2 - “Visual servoing”

RoCKIn@Home 2014 FBM3 - “Planning-and-Scheduling”, initially listed in the rulebook, was cancelled due to the low number of participating teams.

TC and OC composition

The RoCKIn@Home and RoCKIn@Work Technical and Organizing Committee members are listed in Table 4 and Table 5, respectively.

Table 4 – RoCKIn @Home 2014 Technical and Organizing Committees composition.

RoCKIn@Home Committee	Name	Role / Responsibility
Technical Committee (TC)	Andrea Bonarini (POLIMI)	TC+OC Chair
	Luca Iocchi (UNIROMA1)	TC+OC Coordinator / TBM1
	Pedro Miraldo (IST-ID)	TBM3
	Martino Migliavacca (POLIMI)	FBM1
	João Reis (IST-ID)	Referee Box and Home Automation

		Network and devices (software)
Organizing Committee (OC)	João Mendes (IST-ID)	FBM2 and Home Automation Network and devices (hardware)
	Emanuele Bastianelli (UNIROMA1)	FBM3
	Frederik Hegger / Gerhard Kraetzschmar (BRSU)	TBM2
	Graham Buchanan (INNO)	“Dr. Kimble” (TBM2) / live video director
	Michael Franklin (INNO)	“Granny Annie” (TBM1-TBM3)

Table 5 – RoCKIn @Work 2014 Technical and Organizing Committees composition.

RoCKIn@Work Committee	Name	Role / Responsibility
Technical Committee (TC)	Jakob Berghofer (KUKA)	TC+OC Chair
	Rhama Dwiputra (BRSU)	TC+OC Coordinator / FBM2
	Aamir Ahmad (IST-ID)	FBM1
	Francesco Amigoni (POLIMI)	TBM3
	Sven Schneider (BRSU)	Referee Box
Organizing Committee (OC)	Roberto Capobianco (UNIROMA1)	TBM2
	Frederik Hegger (BRSU)	TBM1
	Graham Buchanan (INNO)	Live video director

Benchmarking and data acquisition

Giulio Fontana and Martino Migliavacca (POLIMI) supervised all the activities concerning benchmarking, scoring, and acquisition of ground-truth and team performance data.

During the competition two kinds of data were acquired: external and internal (with respect to the robot system under evaluation). The following specific examples will refer mainly to the RoCKIn@Home setting due to the number of teams that contributed to their collection and to the higher significance of the future conclusions, to be drawn in Deliverable D2.1.8 "Description of Ground-Truth System To Be Used in the 2 Competitions – v2", after processing the collected data.

By comparing internal with external data (e.g., robot self localization vs motion capture system ground-truth in TBMs, robot object recognition vs ground-truth in object perception FBM) we will compute objective metrics regarding the robot performance and achievements in specific functionalities (e.g., self-localization, object recognition, speech understanding).

At the time of writing this report, we have not yet investigated all the data collected during the competition and this will be done in the upcoming months while preparing D2.1.8. The plan is to provide figures about the team performance on (to name but a few):

- navigation @Home, especially regarding localization
- navigation @Work, especially regarding localization
- object perception @Home
- speech understanding @Home.

Table 6 – Team progress in RoCKIn@Home 2014.

Acquired data / Day	Day 1	Day 2	Day 3
Unsuccessful run (robot did not move and/or do anything)	4	3	0
No data acquired (though robot activity was observed)	8	1	1
Insufficient and/or wrong data acquired	2	5	1
Full data acquisition	10	22	20

The quality of the collected data has not been fully checked yet. Nevertheless, it is clear that most teams did not prepare carefully for the data acquisition, despite the regular warnings sent to team leaders and in the competitions wiki before the event. As a consequence, data is almost missing for the initial runs, but during the days of the competition an increasing amount of data delivered by the teams is noticeable. In particular, for the RoCKIn@Home TBMs, Table 6 registers the progress made.

Particularly in RoCKIn@Home, the Referee Box was used for many of the TBM and FBM runs. In FBMs, the Referee Box was instrumental to ensure the synchronization and automatic execution of the tests. In TBMs, the Referee Box was used to detect (by checking the team connection status) situations when teams were not saving their data for benchmarking in the USB pen connected to the running robot.

Communication and Public Relations

RoCKIn Competition 2014 was very successful from the viewpoint of the visibility and prominence during the ERW2014, essentially due to the decision of euRobotics aisbl to locate its Communication Centre in Toulouse during the “RoCKIn week”. The ERW2014 Communication Centre live streamed images from several Robotics labs across Europe, but most of the time RoCKIn competitions were the focus of the live streaming (see “Videos” in <http://rockinrobotchallenge.eu/rockin2014.php> for a full record of the ERW2014 video stream).



Figure 6 – RoCKIn Competition 2014 Opening Ceremony: event sponsors, partners and organizers (left); Khalil Rouhana speech (right).

Khalil Rouhana, the Director for "Components & Systems" in DG CONNECT (Communications Networks, Content & Technology) **honoured the event with his participation in the Opening Ceremony of the RoCKIn Competition 2014**, which included a tour of the venue with the event sponsors and partners, and several journalists (see Figure 6).

The presence in the media was quite significant:

Printed:

- La Depeche du Midi
- Objectifs News
- Midi Presse
- Metro News
- Le Journal des Entreprises

Online:

- GIZMODO FR - <http://www.gizmodo.fr/2014/11/29/les-robots-du-futur-cest-pour-quand.html>
- France 3 - <http://france3-regions.francetvinfo.fr/midi-pyrenees/2014/11/28/avec-rockin-toulouse-est-la-capitale-des-robots-602610.html>
- La Depeche - <http://www.ladepeche.fr/article/2014/11/27/1999625-grand-ecran.html>
- Le Parisien - <http://www.leparisien.fr/toulouse-31000/la-robotique-en-competition-a-toulouse-avec-rockin-28-11-2014-4330503.php#xtref=https%3A%2F%2Fwww.google.co.uk%2F>
- Toulouse FM - <http://www.toulouse.fm/2014/11/27/1ere-edition-du-rockin-robot-competition/>
- BeGeek - <http://www.begeek.fr/rockin-2014-toulouse-capitale-mondiale-de-la-robotique-ce-weekend-154096>
- Birmingham University - <http://www.birmingham.ac.uk/university/colleges/eps/news/college/2014/Let-Robot-Battle-Commence-.aspx>
- 01net.com - <http://www.01net.com/editorial/634529/lelite-mondiale-des-robots-se-retrouve-ce-week-end-a-toulouse/>
- Generation Robots - <http://www.generationrobots.com/blog/en/2014/11/europe-set-to-become-the-leader-in-robotics/>
- Midi-Pyrénées: <http://www.midipyrenees.fr/-Actualite-Rockin-a-la-Cite-de-l-Espace-Robot-Competition-2014>
- Metro News : <http://www.metronews.fr/toulouse/la-region-midi-pyrenees-terre-de-robots/mnkB!mvj29Fbyd67Q/>

Video/TV:

- France 3 : http://france3-regions.francetvinfo.fr/midi-pyrenees/2014/11/28/avec-rockin-toulouse-est-la-capitale-des-robots-602610.html?utm_source=dlvr.it&utm_medium=twitter
- La Depeche : <http://api.dmcloud.net/player/pubpage/50bf573b94a6f617e702bc81/5478a9fc9473990341eb5cbb/c0282b7ea1914856be69a40f3a6f7291?wmode=direct&chromeless=0&autoplay=1>

Satellite Events

Table 7 – RoCKIn Competition 2014 list of satellite events organized and funded by institutions from the Toulouse region.

Event name	Purpose	Organizer
Friendliness made in Midi-Pyrénées	Industry/Academia networking event	Midi-Pyrénées Innovation
Robotics EU Regions: Tell Me Who You Are	Robotics professionals from several EU regions	Midi-Pyrénées Innovation
<i>Les Journées Nationales de la Robotique Interactive</i>	Academic researchers (mostly French)	LAAS/CNRS
Projection/Debate and Exposition "The Robots" at CDE	General audiences	CDE

Competition Deployment

Schedule and daily progress

The RoCKIn Competition 2014 took place in Toulouse from 24 to 30 November 2014 during the European Robotics Week 2014 (ERW2014) with the following schedule outline:

- 24-25 November: assembly of the competitions team areas and arenas (see Figure 7), as well as of the Referee Boxes, Motion Capture Systems and rest of the competition infrastructure;
- 26-27 November: team arrival and set up days;
- 28-30 November: competition days, open to the public (disassembly in the last day).



Figure 7 – The RoCKIn@Home (left) and RoCKIn@Work (right) 2014 arenas.

The competition schedule from 28 to 30 November was quite intense, with trials running from 08:00 in the morning till 20:00 in the afternoon. The teams only had officially available time slots to test their developments in the arenas between 07:00 and 08:00, or between 20:00 and midnight – though the tent ended up being available for the teams all night from the first setup day. This intensity is the result of the distinctive RoCKIn approach to benchmarking through competitions – teams had to repeat several times their TBM and FBM trials over the competition days, to increase the statistical significance of their performance results. In turn, this helped increasing the improvement rate over the competition days.

The assembly of the @Home arena was delayed by approximately half a day, which caused also some delays in the setting up of the home automation network and @Home Referee Box. This, together with the fact that several teams were not prepared to handle the interfaces with the competition infrastructure prepared by the RoCKIn organizers – though the information was available for some time in the competition wiki site and had been fully advertised to team leaders - had a negative impact in the

performance of the TBMs and FBMs in the first set up day. Nevertheless, the progress of the teams over the days was steady (see Table 6) and the small problems detected in the competition infrastructure components in the initial days were corrected, leading to a last day of competitions (30 November) where the technical achievements of the teams was substantially better in both TBMs and FBMs (cf Figure 8).



Figure 8 – FBM trials during RoCKIn Competition 2014: (left to right) speech understanding, object manipulation, object perception.

To ensure an acceptable performance level, and to enable the teams to show some of their technical achievements, some teams were allowed not to use the Referee Box in the two initial days, and even to progress over failures in a given step of the TBM execution by signalling the success of the previous step(s), when necessary, using a tele-operation device (keyboard, gamepad), so as to allow the teams to show some of their technical achievements. The use of the Referee Box was mandatory in the last day of competitions.

For full technical details on the infrastructure of the competition, including Referee Boxes, Motion Capture System, Home Automation Network and devices in @Home, network in @Work, please check the RoCKIn Competition 2014 wiki at <http://rm.isr.ist.utl.pt/projects/rockin-competitions-wiki/wiki>.

Presentation to visitors

One of the most important RoCKIn goals is the dissemination to the general public. Robotics is certainly an appealing topic to introduce science and technology research to the citizens, showing them the value of the public investment through research funding and encouraging young people to pursue their studies and careers in related areas.

During RoCKIn Competition 2014, special care was put on the explanation of what was happening during the competitions. One French commentator kept describing (in French and English) the robot features and trial events, while frequently asking clarification to team leaders and keeping the audience engaged

through questions on robotics science and technology. Members of the OCs and TCs also got frequently involved in the explanations themselves.

It should be pointed out that, according to CDE, during the RoCKIn competition days the number of visitors increased from 70% to 100% with respect to the average number of visitors of the CDE. Most of the visitors ended up both attending the robot competitions (free entrance) and visiting the science museum (paid entrance).

Participating teams

In Toulouse, 7 teams participated in RoCKIn@Home, and 3 teams participated in RoCKIn@Work 2014, in a total of 79 participants from 6 countries. The withdrawals with respect to the initially 18 qualified teams, were all (with one exception, due to personal reasons of the team leader) justified by the team leaders as due to lack of travel funding and/or insufficient preparation of the team for the competition. Table 8 shows the details of the qualified vs participating teams.

Table 8 – List of qualified teams for RoCKIn 2014.

Challenge	Team Name	Affiliation	Participated
RoCKIn@Home	PUMAS	Universidad Nacional Autonoma de Mexico (UNAM), Mexico	Y
RoCKIn@Home	b-it-bots	Bonn-Rhein-Sieg University of Applied Sciences, Germany	Y
RoCKIn@Home	PAL Robotics	PAL Robotics, Spain	N
RoCKIn@Home	MAiR @UPC	Polytechnic University of Catalonia, Spain	N
RoCKIn@Home	Delft Personal Robotics	University of Delft, The Netherlands	N
RoCKIn@Home	Homer@UniKoblenz	University of Koblenz-Landau, Germany	Y
RoCKIn@Home	BORG	University of Groningen, The Netherlands	N
RoCKIn@Home	Watermelon	University of León, Spain	Y
RoCKIn@Home	BARC	University of Birmingham, United Kingdom	Y
RoCKIn@Home	Assistobot B.V.	Assistobot B.V., The Netherlands	N
RoCKIn@Home	URSUS	University of Extremadura, Spain	Y
RoCKIn@Home	Donaxi@Home	Universidad Popular Autonoma del Estado de Puebla, Mexico	N
RoCKIn@Home	SocRob@Home	IST / University of Lisboa, Portugal	Y
RoCKIn@Work	b-it-bots	Bonn-Rhein-Sieg University of Applied Sciences, Germany	Y

RoCKIn@Work	ISEP@Work	Instituto Superior de Engenharia do Porto, Portugal	N
RoCKIn@Work	UvA@Work	University of Amsterdam, The Netherlands	N
RoCKIn@Work	IASLab@Work	University of Padova, Italy	Y
RoCKIn@Work	SPQR@Work	Sapienza University of Rome, Italy	Y

Scores and Awards

A decision was taken to separate scoring and benchmarking for the RoCKIn Competition 2014. TBM scoring was based on the sets of achievements, penalizations and disqualifying behaviors explained in [1,2,3], while FBM scoring is specific of each FBM [3]. Benchmarking was introduced in a previous subsection of this document, and the acquired datasets will help in the future to determine the best way of benchmarking TBMs from the FBM benchmarking results, by finding ways to determine the impact of FBM performance in TBM performance. Most teams did not participate in all TBMs and FBMs of their challenge – a decision that will have some impact on the ability to use the acquired datasets for studies on the impact of FBMs in TBMs.

The scores obtained by the participating teams in the different TBMs and FBMs along the competition days are listed in <http://rockinrobotchallenge.eu/rockin2014.php> (“Scores” tab).

The awarded prizes were:

RoCKIn@Home:

- Best Team 2014: Homer@UniKoblenz, University of Koblenz-Landau, Germany
- Task Benchmark Best Team (Getting to know my home): BARC, University of Birmingham, UK
- Task Benchmark Best Team (Welcoming Visitors): BARC, University of Birmingham, UK
- Task Benchmark Best Team (Catering for Granny Annie's Comfort): PUMAS, UNAM, Mexico
- Functionality Benchmark Best Team (Object perception): URSUS, University of Extremadura, Spain
- Functionality Benchmark Runner-up (Object perception): Homer@UniKoblenz, University of Koblenz-Landau, Germany
- Functionality Benchmark Best Team (Speech understanding): URSUS, University of Extremadura, Spain
- Functionality Benchmark Runner-up (Speech understanding): *ex-aequo* b-it-Bots, Bonn-Rhein-Sieg University of Applied Sciences, Germany and PUMAS, UNAM, Mexico

RoCKIn@Work:

- Best Team 2014: b-it-bots@work, Bonn-Rhein-Sieg University of Applied Sciences, Germany
- Functionality Benchmark Best Team (Object perception): b-it-bots@work, Bonn-Rhein-Sieg University of Applied Sciences, Germany

The number of awards was determined by the TC of each of the Challenges according to the rules, i.e., taking into account the number of participating teams and their performance in each of the TBMs and FBMs.

The RoCKIn@Home OC and TC decided to include an extra award, the Best Demo Award, given to the SocRob@Home team, from IST, University of Lisbon, Portugal.

Experts Board Report

The RoCKIn consortium invited one of RoCKIn's Advisory Board members, Professor XiaoPing Chen, from the University of Science and Technology of China, to attend the event and share his views with the consortium. The members of RoCKIn's Expert Board,

- Alessandro Saffiotti, Örebro University, Sweden
- Herman Bruyninckx, University of Leuven, Belgium
- Tijn van der Zant, University of Groningen, The Netherlands

were also invited to write independent reports on the RoCKIn Competition 2014, as planned in RoCKIn's DoW. All four invitees were plenary speakers in the *Journées Nationales de la Robotique Interactive*.

Guidelines on the desired report focus and a questionnaire (see Appendix B) were delivered to and discussed with the RoCKIn Experts on 27 November (during the team setup days). The reports written by RoCKIn Experts are attached in Appendix A. The following is a list of their main remarks and suggestions:

Overall:

- the benchmarking infrastructure is an impressive and distinctive feature of RoCKIn with respect to other existing robot competitions and challenges. It needs improvements but it could lead to a significant step forward in robotics research, if well applied. Better benchmarking of existing robotic technology, rather than disruptive research in robotics should be the goal of RoCKIn. Leading the way to standardized, and preferably low cost, setups with automated software for the measuring and dissemination is the way forward for RoCKIn;
- in general, the technical level of the participating teams could be better, and an extra effort should be made (besides providing means to increase the performance of the current teams) to attract higher quality teams and make RoCKIn setup appealing to industry, e.g., by increasing the presence of RoCKIn in major industrial fairs and conferences such as AUTOMATICA, ICRA and IROS and by making the web page more dynamic and informative about the RoCKIn activities and

opportunities, as well as including there a preview of the current setup with pictures, movies generated from data, other movie material and papers;

- the event has clearly pointed out RoCKIn's distinctive goals (with respect to other existing competitions or projects in Robotics): i) to systematically evaluate full robotic systems; ii) to benchmark key robotic functionalities; and iii) to foster scientific communication and cooperation. The research challenges posed by the rules are ambitious and well-balanced, as they should, though not necessarily more ambitious than in other existing robot competitions;
- the RoCKIn approach should be rebranded as a serious playground for open innovation, where several teams contribute with components that need to be integrated in a "standardized" manner to build up a successful "mixed team" – the consortium should target domotics companies, Internet of Things research groups, care technology providers, to provide infrastructure and/or components;
- RoCKIn rulebooks are too long and still do not avoid some ambiguities – RoCKIn might be the seed to start a community effort to develop a formal language to describe robotic scenarios, robotic tasks, and robotic benchmarks, e.g., the equivalent of PDDL, which allows people in the AI planning competition to describe domains and tasks in a compact but non-ambiguous way;
- make RoCKIn legacy sustainable after the project lifetime, by setting up an "European Foundation" composed of companies and institutions involved in affine areas and competitions.

Benchmarking and Data Acquisition:

- benchmarking procedures should cover not only geometric motion data but also dynamic features of navigation and manipulation;
- RoCKIn should provide a low cost hardware infrastructure with open source software, besides the current setup, to be used as a reference for other competitions and research laboratories;
- the datasets acquired during the competitions (including ground-truth) should be made available to the Robotics community at large, and even more data should be stored in future events for benchmarking purposes, e.g., sound, robot camera point of view, SLAM information, images from non-IR cameras (the Motion Capture System is based on IR-cameras) in fixed positions;
- increase the value of *robustness* in FBM and TBM performance scoring – among other examples, the ability to deal with WLAN failures (or reduced bandwidth, or big latency) should be one of the aspects that is tested in RoCKIn, since this is essential to real autonomy and deployability (namely in home scenarios), possibly giving a negative score to the bandwidth used;
- study further how testing single functionalities relate to the performance of the functionalities in complete tasks - make FBMs better aligned with TBMs, and compulsory for all teams;
- include tests for FBMs and TBMs in more realistic world settings – on a related issue, establishing unexpected tests (e.g., restaurant test is turned into a supermarket test) will force the teams to reduce over-engineered approaches and focus on more general methodologies easy to customize to new tests - but this will come with the cost of being more difficult to benchmark results;
- there should be an extra emphasis on (graphical) user interfaces and on the teams providing real-time data to fill the slots of a dashboard displaying information to the attending public, e.g.,

information about the state of the robot actions such as grasping an object and whether the robots thinks it actually has successfully grasped it – this would force the teams to monitor and diagnose the performance of their robot systems and not only producing and storing data

Challenges:

- in RoCKIn@Home there is too much emphasis on speech interaction and, in general, in “non-touching” interaction, limiting the usage of today’s most pervasive technologies, e.g., smartphones and tablets
- RoCKIn@Home should look at a standard platform with a simulator, to provide access to more teams and to enforce the benchmarking approach to competitions
- the level of realism of the RoCKIn@Work test bed is impressive, displaying components that are use cases of the future smart manufacturing robot systems

Conclusions and Future Actions

The RoCKIn Competition 2014 was a successful event from the viewpoint of the technical infrastructure developed by the project team for benchmarking (test beds, motion capture system, data acquisition procedure) and automatic competition execution using referee boxes, and of the visibility gained, namely in the EU space, through its integration as the core event of the European Robotics Week 2014.

RoCKIn should improve further the competition technical infrastructure and the way its technical details and importance are communicated to the teams, as well as to attract even better teams and research laboratories across Europe.

A number of actions are planned for the final year of the project, following the experience with this year competition and the RoCKIn Experts recommendations:

- the Referee Boxes will be improved (e.g., to improve the public interface and the communications logging so as to show monitoring data regularly requested to the teams, as much online and real-time as possible; to include automatic scoring and easy manual input of scoring points by the referees, saving online data and logging; to include auto-detection of whether a robot is connected and saving its benchmarking data) and their code made public to encourage current and future teams to start using them right away, much before the 2015 competition. An application that helps the team figuring out the code needed to interface with the Referee Box and checking whether the code is interacting with the Referee Box correctly (including the automated FBM tests) will be produced and made public. In the RoCKIn Competition 2015, using the Referee Boxes will be mandatory for all teams during all the competition days, and not using it will imply disqualification;
- the RoCKIn@Home and RoCKIn@Work Referee Boxes will be installed in the IST-ID and BRSU test beds, respectively, so as to enforce the test bed availability as Robotics Innovation Facilities (ECHORD++-style) that any team can access by travelling to the site or replicating the test bed infrastructure at its premises, so as to benchmark its approaches to the RoCKIn@Home and/or RoCKIn@Work challenges;
- the RoCKIn Field Exercise 2015 (March 2015) will be used to organize a hands-on workshop where teams learn to interact with the Referee Boxes and the ground-truth system – and, in general, with the RoCKIn infrastructure;

- the objects to be manipulated in the RoCKIn@Home “object manipulation” FBM2 will become the same as the ones used in RoCKIn@Home TBMs, so as to enable correlating manipulation functionality benchmark results with the results of the TBMs using that functionality. This will be in general the case for all FBMs of the two challenges, not disregarding that the level of abstraction in the FBMs should be slightly higher than in TBMs, so as to encourage teams to develop more general methods and not over-engineered solutions for the specific problems posed by the TBMs. Additionally, all qualified teams will be strongly encouraged to perform all FBMs and at least more than one TBM, so that acquired data has statistical and functional significance for benchmarking;
- the datasets acquired during the RoCKIn Competition 2014 (including ground-truth) will be made available to the Robotics community at large, and will be used to study impact of FBMs on TBMs performance, paving the way for the usage of benchmarking metrics as the competition scoring mechanism;
- WLAN problems will have to be considered from at least two viewpoints: all well-known measures to reduce communication failures and latencies will be implemented as part of the competition infrastructure; but simultaneously teams will be strongly encouraged (e.g., through the scoring mechanism) to be more robust to WLAN problems, as part of their design features;
- while the rules for the RoCKIn Competition 2015 will, most probably (considering the 2014 team performance), not be substantially changed, measures i) to improve the assessment of dynamic, rather than purely geometric/kinematic, aspects of motion; ii) to enable other kinds of interaction with humans not exclusively based on speech; and iii) to enforce the importance of robustness and dependability, will be discussed and reflected in the scoring and benchmarking methods and metrics
- several measures will be (or have already been) taken to increase the attractiveness of RoCKIn to top research groups Europe-wide. These include:
 - provide travel support for some teams to participate in the 2015 Competition (**budget change already proposed to and accepted by RoCKIn’s Project Officer** – KUKA will convert 12 KEUR of its labor budget into travel support for RoCKIn@Work 2015 qualified teams, while UNIROMA1 will transfer 5 KEUR of its travel support budget for the Camps into travel support for RoCKIn@Home 2015 qualified teams)
 - increase RoCKIn presence in major conferences and industrial fairs, displaying images, videos and diagrams of its benchmarking infrastructure and procedures, targeting major companies in domotics and care technologies, and Internet of Things research groups,

besides more traditional reference groups and companies in service and industrial robotics

- improve the visibility of RoCKIn achievements and the advertisement of upcoming events in the RoCKIn Web page, Facebook and Twitter accounts.

Other measures with long-term impact cannot be implemented during the project lifetime, but initial steps towards their future introduction to the Robotics community will be discussed and taken. These include, not necessarily being limited to:

- writing a “Manual of Best Practices for Robot Competitions”;
- proposing a standard platform for domestic robot competitions, e.g., RoCKIn@Home or RoboCup@Home;
- specifying a low cost hardware infrastructure with open source software, based on the current RoCKIn setup, to be used as a reference for other competitions and research laboratories;
- specifying desired features for interfaces providing remote access to RoCKIn test beds at IST-ID and BRSU for teams willing to test their methods without travelling to the test bed sites;
- start a community effort to develop a formal language to describe robotic scenarios, robotic tasks, and robotic benchmarks;
- include future robot competition tests for FBMs and TBMs in more realistic world settings;
- develop contacts with relevant stakeholders (e.g., the European Commission, euRobotics aisbl, academic institutions, companies, EuRathlon) towards promoting the future sustainability of RoCKIn’s approach to benchmarking through the establishment of partnerships leading to a “Robot Competitions Foundation” or similar;
- keep the dialogue with the RoboCup Federation and the RoboCup@Home and RoboCup@Works TCs to discuss the transfer of some of the RoCKIn features (e.g., networked robot systems, benchmarking infrastructure, methods and metrics) to future RoboCup editions, under the RoCKIn/EC branding.

References

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[2] A. Ahmad, F. Amigoni, I. Awaad, J. Berghofer, R. Bischoff, A. Bonarini, R. Dwiputra, G. Fontana, F. Hegger, N. Hochgeschwender, L. Iocchi, G. Kraetzschmar, P. Lima, M. Matteucci, D. Nardi, V. Schiaffonati, S. Schneider, “RoCKIn@Work 2014 Rulebook (final)”, available at http://rockinrobotchallenge.eu/rockin_work_rulebook.pdf (18/09/2014)

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Appendix A - Expert Board Reports on the 2014 Competition Event

Herman Bruyninckx

Alessandro Saffiotti

Tijn van der Zant



Appendix B - Questionnaires for Expert Board and Industry Visitors

▪ - Expert Board Questionnaire

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7. What impressed you most during this year's RoCKIn competition? And if you feel something did not work well, how would you change it in the future?



- Industry Questionnaire

One of RoCKIn's major goals is to promote technology transfer through robot competitions. By inviting industry representatives, we hope to showcase the capabilities of robotics and its wealth of possible applications, as well as the strong ethos of creativity, innovation and team-work within robotics R&D today.

We would greatly appreciate it if you, as an industry representative visiting RoCKIn Competition 2014, could spare a moment to answer the questionnaire below after visiting the team stands, talking to team members and becoming familiar with some of their technological approaches to solving the challenges posed. Your answers will be treated anonymously and provided to our Experts Board to help them assess the technology transfer impact, a key component of their report on the competitions. The RoCKIn Expert Board is made up of 3 recognised experts in robotics and robot competitions -Herman Bruyninckx, Alessandro Saffiotti and Tijn van der Zant.

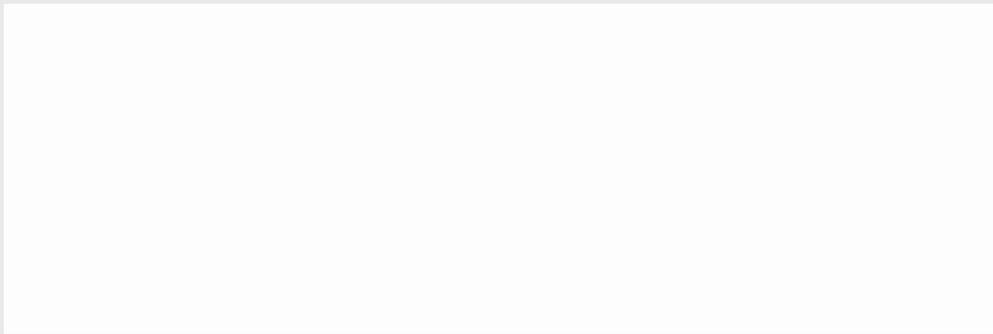
Please take some time to make a tour around the team areas of RoCKIn Competition 2014, talk to the teams and understand their technological approaches to the RoCKIn challenges. Then answer the following questions and issues that refer to both RoCKIn@Home and RoCKIn@Work – but you may explicitly refer one of the challenges when and if adequate.

1. What is your overall impression about the technical level of the competition and its potential to provide successful solutions for today's robotics industry problems?

2. Have you seen clear examples of solutions with significant potential for technology transfer? If so, please list them.



3. Have you identified issues where the competition rules did not encourage the teams to come up with solutions technically relevant for real world problems? If so, please list them, and suggest ways to improve the rules so as to overcome such issues.



4. Do you think RoCKIn Challenges (@Home, @Work) adequately cover market domains that industry is currently interested in? Were there specific parts (functions, tasks etc.) that stood out to you as being particularly relevant to real-world problems? Which other problems or problem areas within industry do you think should be targeted by future robot competitions?

