

**H2020—ICT—732410**



**RobMoSys**

**COMPOSABLE MODELS AND SOFTWARE  
FOR ROBOTICS SYSTEMS**

**DELIVERABLE D6.2:  
FOUNDATION SUPPORTS**

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Executive Summary	4
1. Introduction	5
1.1 Scope	5
1.2 Document Structure	5
2. Overall Activities and Achievements	6
2.1 Scope of the foundation and list of potential stakeholders	6
<b>2.1.2 Roadmap for an Eclipse Intelligent Robotics Working Group</b>	8
2.2 Industry oriented dissemination activities	9
2.3 Academy oriented dissemination activities	9
3. Survey Results	10
3.1 Industry Day	10
3.2 Academy Day	15
4. Conclusions	20

## Executive Summary

Research projects often focus solely on communication of project outputs and results that take place during the project. However, RobMoSys has aimed from the beginning to include building a sustainable RobMoSys community to be able to continue to benefit from sharing relevant updates between members connected to using the RobMoSys approach and the creation of an EU Digital Industrial Platform for Robotics.

This document presents the background on aims to create a lasting project community and build a foundation (known as the Eclipse Working Group) as part of the RobMoSys project legacy, with the project now having reached its official end date. This includes how the foundation fits into building a community, the reasons to create the foundation, the initial steps taken to engage project participants and supporters in a foundation, and the results of these activities.

The principal idea, for the foundation (the Eclipse Working Group), is to be at the heart of the RobMoSys community that continues the work and impact of the project, after the official project completion date. The foundation represents a way of bringing together a list of stakeholders with a specific interest in supporting the legacy of the project and continuing the project's work.

The work of the RobMoSys project recently culminated in a concluding two-day event (The Conference on Software and Systems Engineering for Robotics) with the purpose of keeping the project community on board with the work of the project and the RobMoSys approach, growing the community and continuing the RobMoSys movement after the official project end date.

At the recent event, steps were taken to keep the existing community engaged, including using surveys to evaluate the impact of the project and interest of the community in ongoing communications, including joining the proposed foundation. The goal of the surveys was to find out how participants have used the RobMoSys approach already, and how they plan to use it in the future, leading on to most importantly ask how they would like to stay in touch as a community, through email, events, The RobMoSys Academy and with the foundation (the Eclipse Working Group) that is being set up, amongst other options. Results of the surveys and recommendations for utilising these are included in this report.

# 1. Introduction

RobMoSys' main goal is to create and consolidate an EU Digital Industrial Platform for Robotics to establish a common methodology for software development, improve tools and foster interoperability by model interchange and composability. The RobMoSys approach aims at solving critical issues observed in the industry and draws a migration path for a stepwise adoption of existing systems for interested early adopters. It consists of a specialized set of players with both vertical and horizontal interaction levels, providing both widely applicable software products and software-related services. This ecosystem will be able to rapidly address new functions and domains at a fraction of today's development costs.

## 1.1 Scope

This report is focused on presenting a list of supporters for a foundation. This deliverable is linked with task T6.3 oriented to generate acceptance within industries and to create a list of supporters for the foundation project, connected with WP7.

## 1.2 Document Structure

The remaining of this document is organized as follows:

- Overall activities and achievements
- Results
- Conclusions

## 2. Overall Activities and Achievements

### 2.1 Scope of the foundation and list of potential stakeholders

The previously created vision for the RobMoSys community within the EU Digital Industrial Platform for Robotics is provided [here](#) and is defined in three different levels. These are as follows:

- Level 1 is the stewardship hosted by euRobotics (Topic Group). It's related to conceptual aspects only.
- Level 2 is the Eclipse Working Group (Intelligent Robotics) in the process of creation. This level aims to coordinate all implementation projects and harmonize with other initiatives outside RobMoSys: ROSIN, Seronet, etc.
- Level 3 are specific Eclipse Projects for implementation (tools, software components, etc.): Papyrus4Robotics, SmartMDS, etc.

Level 2, the Eclipse Working Group (Intelligent Robotics) proposed by Eclipse, specifically represents the "foundation", which aims to continue the project legacy and to collaborate with other initiatives.

All of the stakeholders that attended the recent RobMoSys closing event (The Conference on Software and Systems Engineering for Robotics) and completed the post-event survey(s), expressed an interest in staying in touch with the community.

The potential stakeholders, that expressed an interest in continuing to be in touch with the RobMoSys community and the foundation, includes the following:

- Alessandro Di Fava, PAL Robotics
- Dennis Wigand, Bielefeld University
- Cristina Vicente-Chicote, Universidad de Extremadura
- Armando Tacchella, University of Genoa
- Michael Rathmair, Kompetenzgruppe Robotics at JOANNEUM RESEARCH
- Karl Buckley, GMV NSL
- Paco Arjonilla, Shizuoka University
- Marta Millet, Robotnik Automation
- Georg von Wichert, Siemens AG, Technology
- Franziska Kirstein, Blue Ocean Robotics
- Wout Borger, Hochschule Osnabrück

Of those listed, the following specifically highlighted an interest in the foundation (the Eclipse Working Group) on Intelligent Robotics:

- Armando Tacchella, University of Genoa
- Alessandro Di Fava, PAL Robotics
- Cristina Vicente-Chicote, Universidad de Extremadura

There is also the potential to introduce European Robotics Associations to the community and foundation, including the following:

- EU Robotics (PAL Robotics' CEO is in the board of directors of this association and is one of the founding members.)
- SPARC
- EUnited Robotics

In terms of the scope of the proposed foundation, Eclipse has defined the concept, which includes industry working groups. Working Groups provide a proven framework based on the Eclipse bylaws and governance structures for companies to collaborate on joint open source strategies.

#### 2.1.1 Eclipse Foundation Industry Working Groups

Eclipse Working Groups (<https://www.eclipse.org/org/workinggroups/>) provide a vendor-neutral governance structure that allows organizations to freely collaborate on new technology development. The already established Eclipse Foundation, through Eclipse Working Groups, provides five basic services to

enable these types of collaborations:



Figure 2. Pillars of open collaborations

- **Governance:** Good governance that controls how decisions are made, policies established and disputes resolved is important for any successful collaboration.
- **Intellectual Property Management and Licensing:** Collaborations among different organizations requires due diligence on the co-developed intellectual property. Eclipse Working Groups are established under the Intellectual Propriety (IP) policies of the Eclipse Foundation. These policies ensure that any open-source software created in Eclipse projects is available for use by anyone, including developers of commercial software products.
- **Development Processes:** The Eclipse community has created a successful development process for large-scale distributed development that involves many different organizations.
- **IT Infrastructure:** The Eclipse Foundation manages the IT infrastructure for Eclipse Working Groups, including Git code repositories, Bugzilla databases, Hudson CI servers, development-oriented mailing lists and newsgroups, download sites, and websites.
- **Ecosystem Development:** An important way that the Eclipse Foundation supports the community is through active marketing and promotion of Eclipse Working Groups and the wider Eclipse ecosystem.

Any collaboration needs these services. Eclipse Working Groups make it easy to reuse the services provided by the Eclipse Foundation rather than creating them from scratch.

Today, the Eclipse Foundation has established 14 working groups. In the following is an overview of the working groups which are relevant for RobMoSys:

- **Internet of Things:** With over 40 industry-leading member companies, more than 35 IoT projects, and 350+ contributors, the Eclipse IoT Working Group (<https://iot.eclipse.org/>) is the preeminent open source community for commercial-grade IoT innovation. This initiative enables collaboration on the development of open source implementations of IoT standards and protocols, frameworks and services that will be used by IoT solutions, and tools for IoT developers. IoT and Robotics are overlapping in certain technical areas as robots can benefit from interacting with IoT environments.
- **OpenADx:** The OpenADx Working Group (<https://openadx.eclipse.org/>) is centered around the autonomous driving toolchain and aims to bring transparency and better integration capabilities into the autonomous driving tool space. This industry-wide initiative is of special interest for OEMs, Tier 1s, and tool and technology vendors. OpenADx was launched by Bosch and Microsoft and now comprises contributors from the industrial, research, and start-up worlds

Eclipse Cyclone DDS, a tier one ROS 2 middleware has found its way into the openADx WG.

- **EdgeNative:** The Eclipse Edge Native Working Group (<https://edgenative.eclipse.org/>) drives the adoption of Edge Computing technologies. It provides services like vendor-neutral marketing to the Eclipse Edge Native ecosystem and defines licensing and intellectual property flows that encourage the community to open collaboration. Edge processing of information is highly relevant for robotics applications.
- **Cloud Development Tools:** The Eclipse Cloud Development Tools Working Group (<https://ecdtools.eclipse.org/>) The Eclipse Cloud Development (ECD) Tools Working Group will drive the evolution and broad adoption of de facto standards for cloud development tools, including language support, extensions, and developer workspace definition. Cloud Tools are an emerging topic for robotics development, aka Cloud Robotics.

### 2.1.2 Roadmap for an Eclipse Intelligent Robotics Working Group

In the last year of the RobMoSys project, partners started to investigate the creation of a foundation (Eclipse Working Group) to sustain and further promote the RobMoSys open-source results and establish a business ecosystem around them.

The agreed vision of this working group will be to harmonize the development of an industry platform for robotics based on open technologies. The starting point are the two RobMoSys projects Eclipse SmartMDSD and Eclipse Papyrus for Robotics. Another candidate is Eclipse Cyclone DDS, a tier one ROS2 middleware. At the time of writing, the process of creating the working group is in the state of raising interest and identifying interested parties as core founding members. Typically, this process takes time because Eclipse Working Groups are not loose collaborations without binding. Committing to a working group means committing time, effort, and budget to implement, maintain, and marketise open-source technologies in cross-organisational collaborations.

The initiative is mainly driven by CEA (who are already involved in other Eclipse Working Groups) and the Eclipse Foundation who started presenting and discussing the idea at relevant occasions. These include among others EclipseCon, the ERF2020 and bi-lateral meetings with potential interested parties. Table 1 shows the roadmap for establishing the working group.

Table 1 - Roadmap for Eclipse Intelligent Robotics Working Group

Period	Tasks	Expected outcome	Comment
<b>During RobMoSys</b>			
M1 – M36	Creation and community building of RobMoSys open-source products.	Eclipse SmartMDSD and Papyrus for Robotics	Achieved
M37 – M48	Shaping the idea of a working group. Initial discussions and presentations.	Raising awareness and creating interest in the working group	Ongoing
<b>Beyond RobMoSys</b>			



Q1 2021	Identify at least two committed founding companies.	Commitment from at least two companies to found the working group (CEA + 1 other)	Ongoing bilateral discussions with interested parties.
Q1 2021	Define and agree on a charter that describes the goals and modus operandi of the working group.	Working Group charter	Pending
Q2 2022	Found the working group	Working group officially announced	Pending

## 2.2 Industry oriented dissemination activities

At the recent RobMoSys project official closing event (The Conference on Software and Systems Engineering for Robotics) which took place on 12 and 13 January 2021, PAL Robotics conducted surveys to event participants to understand more about how they have used the RobMoSys approach and how they plan to use the RobMoSys approach, as well as how they would like to stay part of the community.

The two-day virtual event organised by project partners, included an industry day and an academy day, with the aim of attracting stakeholders with different needs and facing a host of different challenges that the RobMoSys approach can help them solve. On each day at the event, talks were hosted to foster discussion more relevant to either the RobMoSys approach for industry, or the RobMoSys approach in academia.

On industry day, Dr. Huascar Espinoza and Prof. Dr. Christian Schlegel introduced the sessions, they were then joined by guest speakers from industry including organisations such as Robotnik, PAL Robotics and Siemens.

The event included a keynote speech by Stefan Teuchert of MAN Truck & Bus, followed by the use case demonstrations. The use case demonstration talks were by Marta Millet of Robotnik Automation, Karl Buckley of GMV NSL, and Dr. Dennis Stampfer of Toolify Robotics.

Finally, there was a panel discussion on The Future of Robotics and Challenges of the Industry by Dr. Andreas Bihlmaier of ABB Robotics, Dr. David Bisset of euRobotics, Luca Marchionni of PAL Robotics and Dr. Georg v Wichert of SIEMENS.

## 2.3 Academy oriented dissemination activities

On the second day of the event, academy day, event participants and guests were introduced by Dr. Huascar Espinoza, Dr. Marco Jahn and Prof. Dr. Christian Schlegel. Guest speakers from academia included representatives from organisations such as University of Genova, Universidad de Extremadura and IT University of Copenhagen.

The keynote speech was by Arne Hamann, Chief Expert – Distributed Intelligent Systems at Bosch, followed by a number of use case demonstrations by Prof. Dr. Cristina Vicente-Chicote of the Universidad de Extremadura, Dr. Jabier Martinez of Tecnalia Research & Innovation, Prof. Dr. Armando Tacchell of the University of Genova, and Dr. Michael Rathmair, from Joanneum Research.

The subsequent panel discussion on the Future Challenges and Sustainability of Modularity and composable software development for the Robotics of the Future moderated by Prof. Dr. Christian Schlegel, included Prof. Dr. ir. Herman Bruyninckx of the Katholieke Universiteit Leuven, Dr. Arne Hamann of Bosch, Yevgen Kogan of KUKA, Frank Schnicke of Fraunhofer IESE, Prof. Dr. Cristina Vicente-Chicote of Universidad de Extremadura, and Prof. Dr. Andrzej Wąsowski of IT University Copenhagen.

At the end of both the academia day and the industry day, surveys were shared with participants with the aim of understanding more about their knowledge and experience of the RobMoSys approach, as well as their interest in continuing involvement in the RobMoSys community (including the Eclipse Working Group).

Of those surveyed after the closing event, all expressed an interest in staying in touch with the RobMoSys community. The "staying in touch" options given to survey participants were as follows:

- Through future events or webinars with project updates
- By occasional email updates from the group
- By joining a RobMoSys group on social media
- Through the RobMoSys website/academy
- Through the stewardship hosted by euRobotics (Topic Group)
- Through the Eclipse Working Group on Intelligent Robotics (This is to coordinate implementation projects and harmonise with other initiatives outside RobMoSys: ROSIN, Seronet, etc.)
- Through specific Eclipse Projects for implementation (tools, software components, etc.)
- Other

Those who expressed an interest in staying in touch with RobMoSys as well as an interest in joining the Eclipse Working Group, together with organisations already identified by Eclipse, should be approached on the basis of forming the beginnings of the Eclipse Working Group (foundation).

### **3. Survey Results**

The survey results from the event Industry Day indicate participants from a wide range of sectors attended on the day, including automation, electronics and systems builders. Likewise, job titles were varied and included component suppliers, system integrators and end users. Additionally, the results include details of how respondents used the RobMoSys approach in their organisations, such as in the integration of autonomy packages with existing robot hardware.

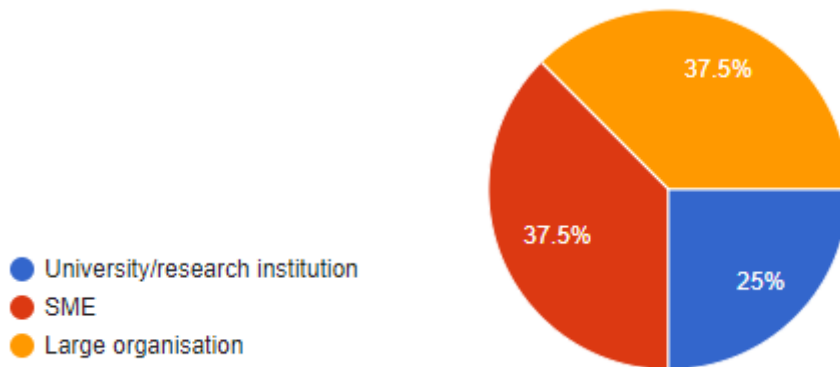
Participants listed benefits brought to their organisations through the RobMoSys approach, including reduction of development time, systems being more certifiable and systems being more reusable. Methodology, tooling and a model-based approach were cited as reasons to recommend the RobMoSys approach to others, at the same time, tooling and toolchain robustness were highlighted as areas for improvement. A number of digital challenges in industry were identified that RobMoSys can help solve including growing complexity of systems and in certification and security in robotics systems. Lastly, participants selected options for receiving communications and staying in touch with the community.

Below are the survey results from the Industry Day:

#### **3.1. Industry Day**

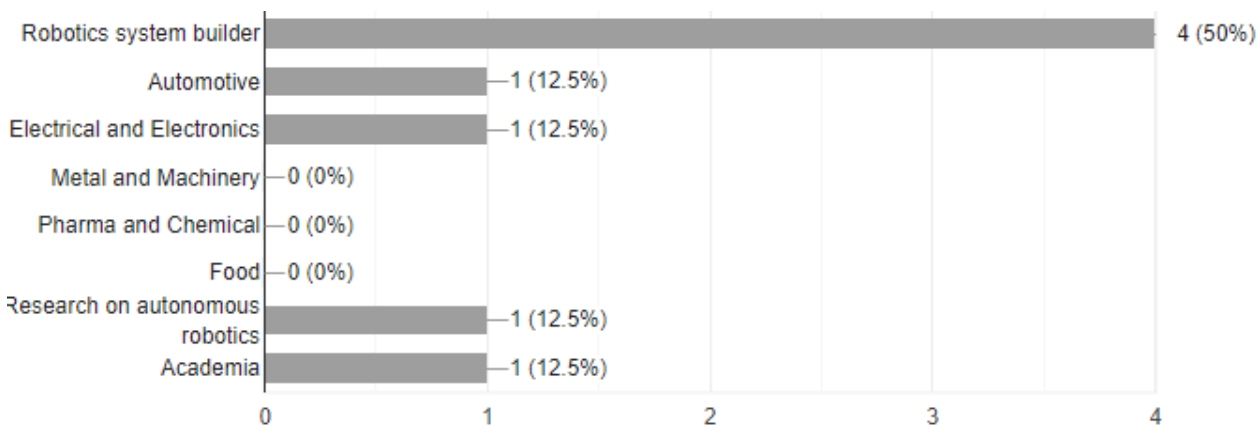
Participants are from a range of organisations, from SMEs, to large corporations and universities, with representation from various European countries as well as Japan.

Name	Organisation name
Paco Arjonilla	Shizuoka University
Marta Millet	Robotnik Automation
Armando Tacchella	University of Genoa
Karl Buckley	GMV NSL
Georg von Wichert	Siemens AG, Technology
Franziska Kirstein	Blue Ocean Robotics
Alessandro	PAL Robotics
	iC-Consult
Role/job title	Location
Doctoral student	Shizuoka, Japan
R&D Engineer	Valencia, Spain
Professor	Genoa
Robotics Engineer	UK
Head of Research Group	Munich, Germany
Project Manager R&D	Odense, Denmark
Robotics software engineer	Spain
Consultant	München
Type of organisation	
<p>Of those surveyed, a higher proportion represented SMEs and large organisations than represented universities/research institutions. SME's and large institutions both represented 37.5% of participants.</p>	



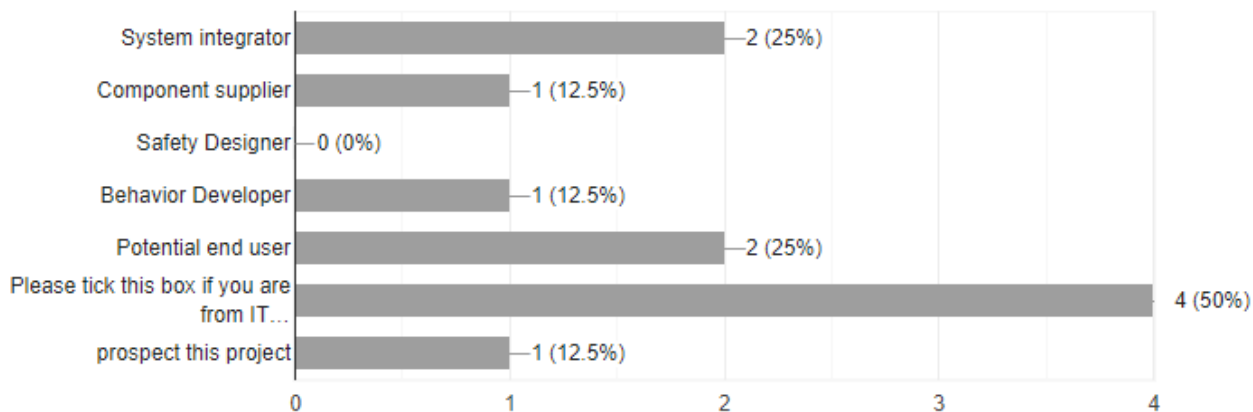
**What sector does your organisation belong to? (please tick all that apply)**

The most popular sector here chosen by participants is 'Robotics system builder.'



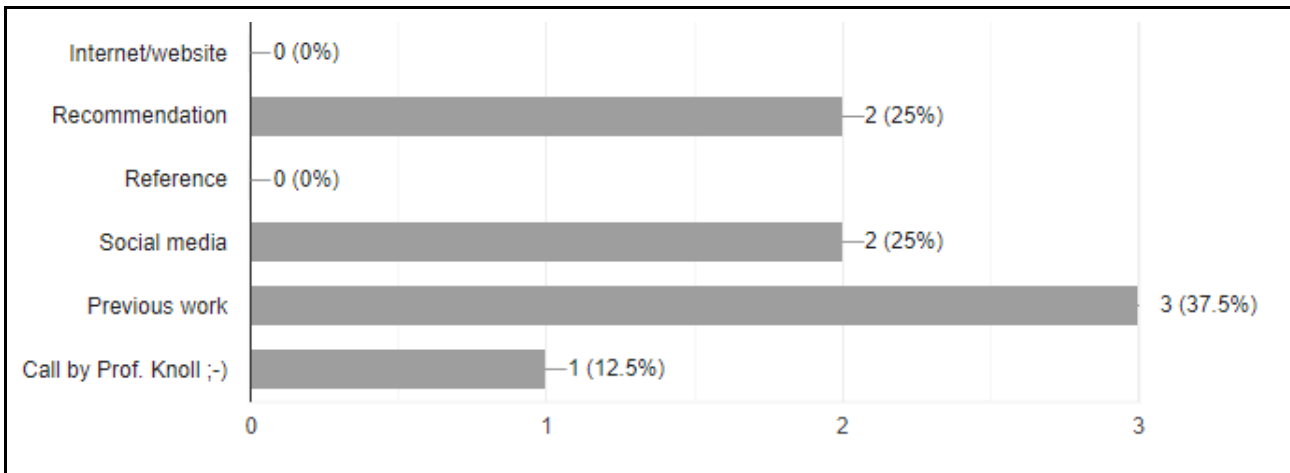
**What's your connection to RobMoSys?**

The responses here show that a number of participants in the survey are from ITPs.



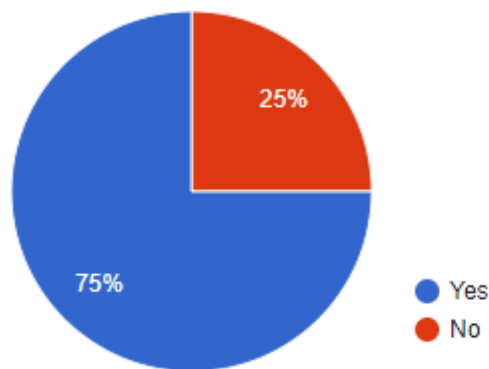
**How did you find out about RobMoSys?**

The responses here demonstrate that 'recommendation' and 'previous work' were key to involvement in the project.



**Have you used the RobMoSys approach in your organisation?**

The majority of the participants here have already used the RobMoSys approach in their organisation.

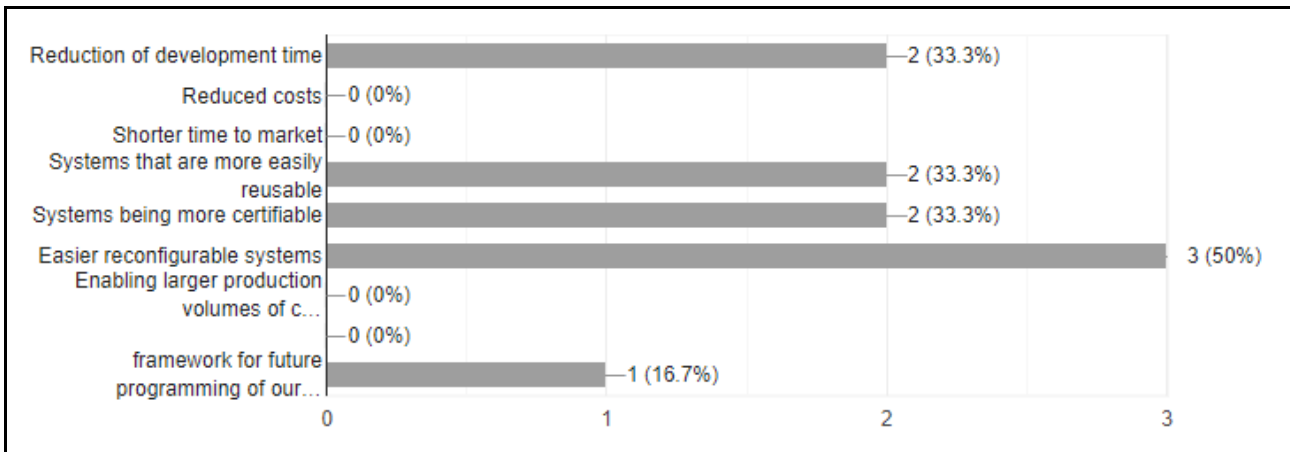


**If you answered yes, how have you used the RobMoSys approach in your organisation?**

- In an ITP
- To build research prototypes
- In the integration of existing autonomy packages with existing robotics software.
- Experiments during our participation
- In our ITP
- We developed on of the pilot of the project.

**If you answered yes, what results has the RobMoSys approach brought to your organisation? (please tick all that apply)**

The most common result/benefit selected here was 'easier reconfigurable systems enabling larger production volumes.'



If you answered no, what results do you think the RobMoSys approach can bring to your organisation?

Standard ontology for robotic middleware

Which aspect of RobMoSys are you likely to recommend to others? Eg tooling, methodology

Methodology

The overall methodology that provides a clear taxonomy of roles and artifacts

Tooling, specifically P4R

model based approach to robotics SW development

What should RobMoSys improve to become more attractive to you?

Stop relying on eclipse so much

Debugging of starting errors and easier installation

Toolchain robustness

P4R increasing scope to include middleware beyond ROS 2.0 (ROS 1.0 would be ideal)

Tooling, show better the benefits for the business, and help in the certification process

What are the digital challenges in industry that the RobMoSys approach can help to solve?

Certification of safety and security in robotic systems

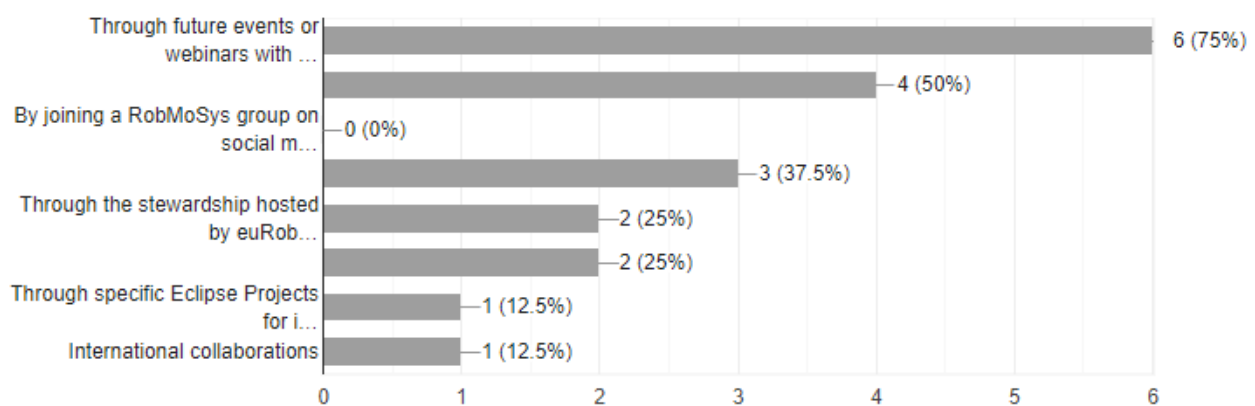
Easing the definitions and modelling of components by integrating these steps into the development process

growing complexity of systems, increased variability, short life cycles

With a model driven approach, together with the ease of exchange of standard component the RobMoSys approach can be very useful in reuse systems, in documentation and certification.

### How would you like to stay in touch with the RobMoSys community? (Please tick as many as apply)

Participants selected here 'through future webinars and events' (6), 'by occasional email updates' (4), 'through the RobMoSys website' (3), 'through stewardship hosted by euRobotics' (2), 'through the Eclipse working group' (2), 'through specific projects with the Eclipse working group' (1), and 'through international collaborations' (1).



### 3.2 Academy Day

Results from the Academy Day survey highlighted researchers again taking part from a variety of fields including robotics, software engineering and safety. Participants have used the RobMoSys approach in their organisation through demonstrator development, and building research prototypes, amongst others. Composable and replaceable components and standardization of models and interfaces were the main results the RobMoSys approach has brought to the organisations surveyed.

Survey participants suggested methodology, tools and meta models were the aspect of RobMoSys they were most likely to recommend to others. In response to the question, "how do you think the RobMoSys approach will impact on the future of robotics?" answers included "robotics will not be scalable enough without modelling" and "modelling will receive increased importance in the robotics domain." The most popular responses for staying in touch with the RobMoSys community were through events and webinars and through stewardship hosted by euRobotics.

Below are the survey results from the Academy Day:

Survey participants from this day were mainly from universities and research institutions, as well as some corporate organisations. Representation came from European countries including Germany, Italy and Spain.

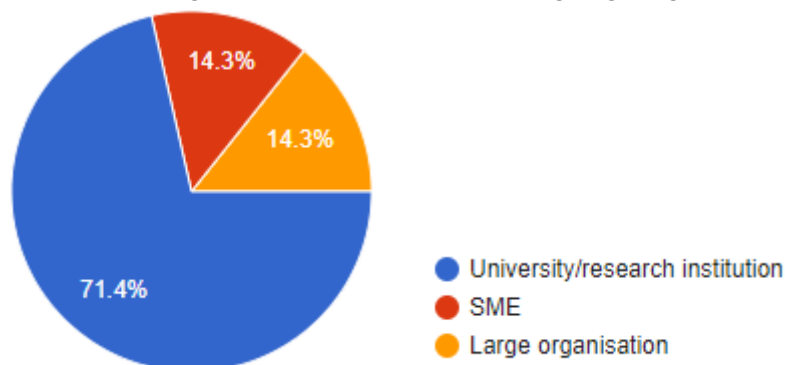
Name	Organisation name
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Cristina Vicente-Chicote	Universidad de Extremadura
Dennis Wigand	CoR-Lab, Bielefeld University
Alessandro Di Fava	PAL Robotics
Wout Borger	HS Osnabrueck
Michael Rathmair	JOANNEUM RESEARCH ROBOTICS
Armando Tacchella	iC-Consult
	University of Genoa

Role/job title	Location
Tenured associate professor	Cáceres (Spain)
Researcher, PhD Student	Bielefeld, Germany
Robotics Engineer	Spain
Dual Student - Master Thesis Industrial Robotics	Lingen (EMS)
Group leader	Klagenfurt Austria
Consultant	München
Professor	Genoa (Italy)

### Type of organisation

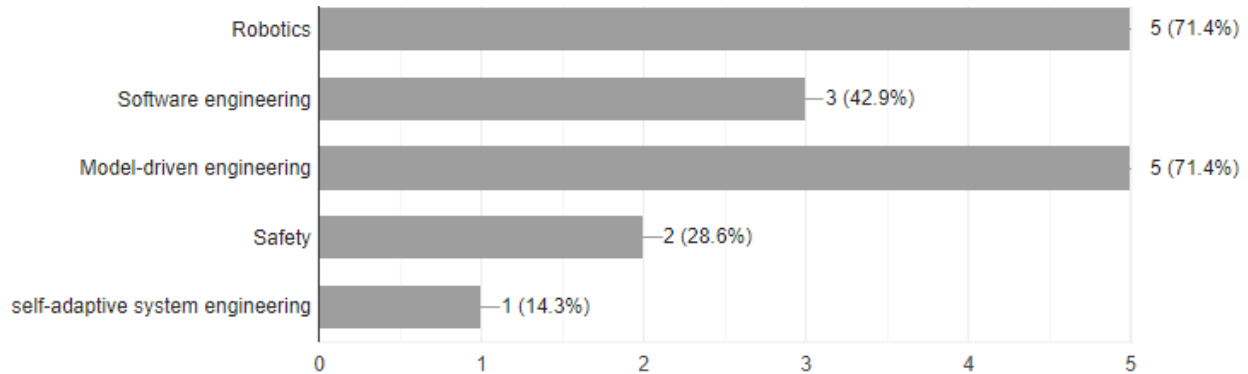
Of those surveyed during Academy Day, 71.4% represented universities/research institutions, with just 14.3% representing SMEs and 14.3% representing large organisations.





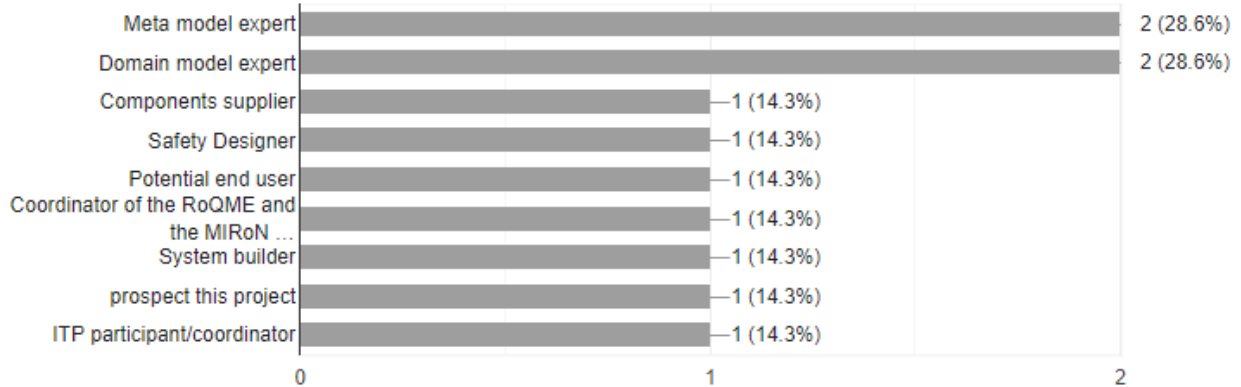
### What is your main domain of research? (please tick all that apply)

The most popular domain of research chosen was robotics, followed by model-driven engineering.



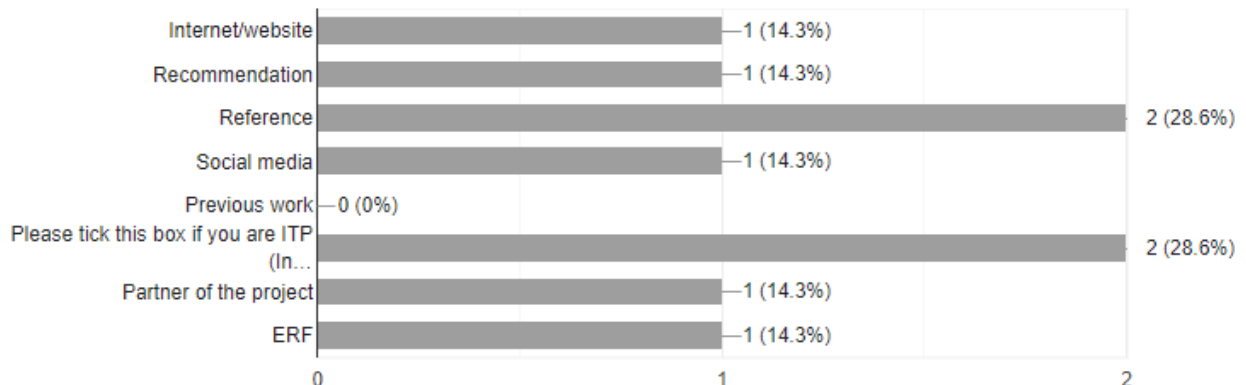
### What's your connection to RobMoSys?

Responses to this question were very varied, with more than one 'meta model expert' and 'domain model expert.'



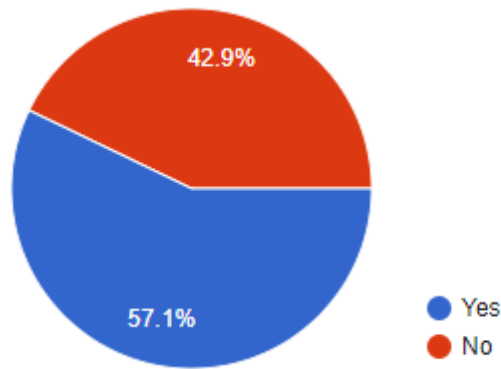
### How did you find out about RobMoSys?

These responses indicate the importance of 'word of mouth' and 'recommendation,' a number of respondents are from ITPs.



### Have you used the RobMoSys approach in your organisation?

Just over 50% of participants had used the RobMoSys approach in their organisation.

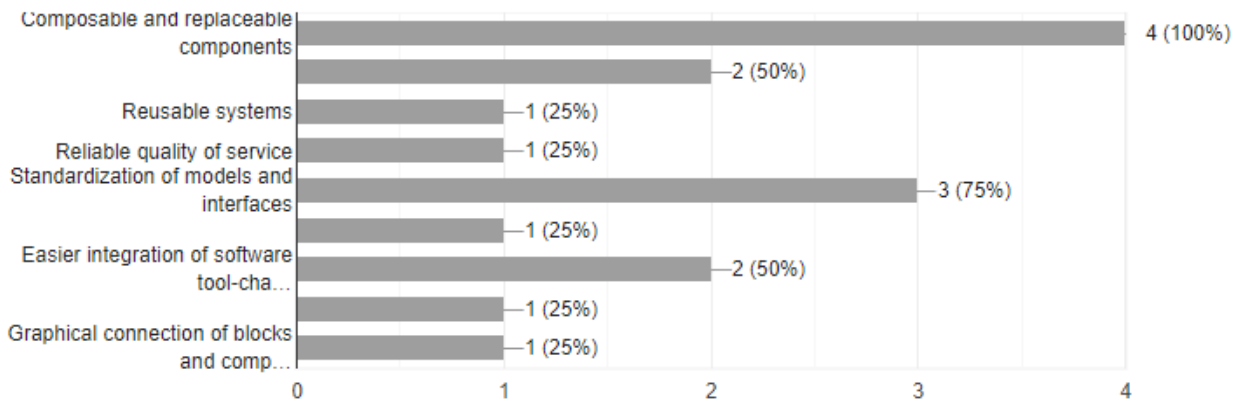


**If you answered yes, how have you used the RobMoSys approach in your organisation?**

- Demonstrator development
- Through the CMCI and VeriComp ITP
- We were part of the project in the realization of the pilots
- To build research prototypes

**If you answered yes, what results has the RobMoSys approach brought to your organisation? (please tick all that apply)**

The most popular results selected here were 'Composable and replaceable components' and 'standardization of models and interfaces.'



**If you answered no, what results do you think the RobMoSys approach can bring to your organisation?**

- implementing the RobMoSys methodology as a standard for development stages of industrial roboticsystems
- A further approach for model-based robot system design and verification

**Which aspect of RobMoSys are you likely to recommend to others? E.g. tooling, methodology**

Methodology

Tooling, methodology and overall, the RobMoSys vision

The general mindset and consolidated meta-models.

methodology

Free tools

### How do you think the RobMoSys approach will impact on the future of robotics?

Sure, I think it has changed some minds. The panel yesterday was quite interesting and showed that industry is now a different mood regarding the adoption of models for robotics software development.

Robotics will not be scalable enough without modeling.

Trying to give a standard and hopeful helping in the certification and applications creation

to little experience. Generate a more streamlined approach to developing industrial roboticsystems in SMEs

In general model-based design will receive increased importance in the robotics domain.

Providing a baseline for model-driven robotics engineering

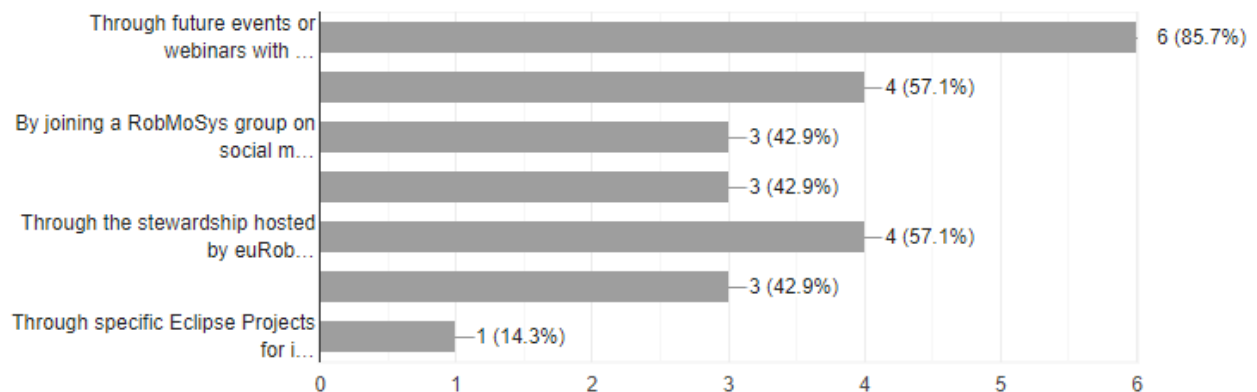
### With the RobMoSys approach and project, what is missing from your point of view?

Other domains and closing the gap between the models and the actual realization.

The deployment part into the robots it's quite weak and the benefits for the certification are not well exploited

### How would you like to stay in touch with the RobMoSys community? (Please tick as many as apply)

Selected here as the most popular were 'Through future events and webinars' (6), and 'by occasional updates from the group' (4).



## 4. Conclusions

Over 114 participants attended the RobMoSys closing event from both industry and academy and survey data collected at the closing event indicated their interest in staying in touch with the RobMoSys community after the official end of the project. Additionally, some of those surveyed expressed a direct interest in joining the foundation (Eclipse Working Group) being developed. It has been suggested that two organisations are needed to form the beginnings of the group and the event survey results demonstrate that there is sufficient interest for this to take place.

Following the collection of these survey results, the recommendation is to contact the individuals/organisations that expressed an interest in staying in touch with RobMoSys, to discuss the proposed Eclipse Working Group with them.

Aside from the Eclipse Working Group, all survey participants expressed interest in staying in touch with and remaining involved with the RobMoSys community. Moreover, survey answer options offered participants choices for remaining connected to the community (including through the RobMoSys Academy, through webinars and events, through social media, through stewardship hosted by euRobotics and via the Eclipse Working Group). All of this demonstrates that the RobMoSys community is highly sustainable. It is recommended to build a communications plan using these channels mentioned above, to enable regular updates to this group, in turn giving others the opportunity to join it too.

The survey results from both the industry day and the academy day events will help determine the how industrial and academic partners plan to use the RobMoSys approach and what they have found most useful, this information, amongst other survey results can be used to help shape the topics and agenda of the future Eclipse Working Group, as well as the content for regular communications to RobMoSys stakeholders.