Ref. Ares(2023)327133 - 16/01/2023

This project is funded by the European Union
G.A No 101016906

Project Number: 101016906
Start Date of Project: 2021/01/01
Duration: 48 months

Type of document D10.3 – V1.1

Communication, Dissemination and Exploitation Plan

Dissemination level	PUBLIC
Submission Date	2021-03-31
Resubmission Date	2023-01-16
Work Package	WP10
Task	T10.2-T10.4-T10.5
Type	Report
Version	1.0
Author	UPC, PAL
Approved by	Alberto Sanfeliu, Andrea Gasparri

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History of changes

Changes in original text	New version	Old Version
Page 1	Type of document D10.3 – V1.0 Communication, Dissemination and Exploitation Plan	Type of document 0.0 – V1.0 Project Management Guideline
Pages 34 – 35	Appendix introduced to reply to the "Request for Revision Comment"	N.A.

This project is funded by the European Union G.A No 101016906

Executive Summary

This deliverable describes the Communication, Dissemination and Exploitation activities that the CANOPIES partners will coordinate and develop during the next four years. The Communication activities aim to promote the project and the results, providing targeted information to multiple audiences in a strategic and effective manner. Through the Dissemination activities, the project partners will share the research results with potential users - peers in the research field, industry, other commercial players and policymakers. Finally, the Exploitation plan will describe the use of results for commercial purposes.

Deliverable 10.3 is included in Work Package 10: Dissemination and Promotion of the Exploitation. Five tasks are described in this WP. UPC is leading the Task 10.1: Website Construction and Updates (Deliverable 10.1 (Month 2)) Task 10.2: Dissemination; and the Task 10.4: Communications activities and Events. UNIROMA3 and DTI are leading Task 10.3: Dissemination and Synergies with DIH-agROBOfood; and Pal Robotics is leading Task 10.5: Exploitation and Management of Knowledge. As it is described in the Grant Agreement, all project partners are committed to an effective participation in this WP and the present document has been elaborated with the contributions of all of them. To evaluate the success of the dissemination and communication action, the consortium will go ahead of the proposed KPIs to measure the impact of the communication and dissemination activities.

The plan proposed along this document is a tentative plan to the activities that the CANOPIES consortium will organize and participate during the next four years. This plan will be updated periodically.

This project is funded by the European Union G.A No 101016906

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This project is funded by the European Union
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Abbreviations and Acronyms

WP	Work Package
PA	Precision Agriculture

1 Communication, Dissemination and Exploitation Plan

The objectives of the Communication, Dissemination and Exploitation Plan are: i) to advance scientific knowledge; ii) to create value within the targeted communities (farmers, but also technological operators in the fields of robots, autonomous robots and sensors) of the European Union; iii) to encourage both public and private investments for possible follow-ups to trigger further advancements iv) to raise awareness within the involved actors concerning the potential of human robot interaction and AI based perception and robotics technology for developing novel PA-related technological solutions in line with the "Sustainable Development Goals" of United Nations on sustainable agriculture.

The Plan is conceived with an integrated approach, combining scientific dissemination (targeting the scientific community and innovation actors) and technical dissemination (targeting farmers, robot manufacturers, agricultural equipment producers and sensors' manufacturers). The consortium will develop such high-level strategy from the outset of the project. The dissemination strategy assures that our results outlive the duration of the project by: i) making the results of our proposal known to those who could benefit from the results directly (farmers) or indirectly (producers, operators); ii) generate interest in the research world which may multiply the results targeting PA; and iii) creating the context for possible follow-ups.

The document is structured in two parts: first, the Communication and Dissemination Plan and Second, the Exploitation Plan.

2 The Communication and Dissemination Plan

2.1 Policy and rules

The project Grant Agreement explain the policy and rules that will drive the dissemination and communication activities in its articles 29 and 38.

Article 29 includes the obligation to disseminate the results by disclosing them to the public by appropriate means including in scientific publications. This does not change the obligation to protect results (Article 27), the confidentiality obligations (Article 36), the security obligations (Article 37) and the obligations to protect personal data (Article 39)

A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of — unless agreed otherwise — at least 45 days, together with sufficient information on the results it will disseminate. Any other beneficiary may object within — unless agreed otherwise — 30 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests. If a beneficiary intends not to protect its results, it may — under certain conditions (see Article 26.4.1) — need to formally notify the Commission before dissemination takes place.

Each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results. In particular, it must: a) as soon as possible and at the latest on publication, deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications.

Moreover, the beneficiary must aim to deposit at the same time the research data needed to validate the results presented in the deposited scientific publications. (b) ensure open access to the deposited publication — via the repository — at the latest: (i) on publication, if an electronic version is available for free via the publisher, or (ii) within six months of publication (twelve months for publications in the social sciences and humanities) in any other case. (c) ensure open access — via the repository — to the bibliographic metadata that identify the deposited publication. The bibliographic metadata must be in a standard format and must include all of the following: - the terms "European Union (EU)" and "Horizon 2020"; - the name of the action, acronym and grant number; - the publication date, and length of embargo period if applicable, and - a persistent identifier.

The project Data Management Plan (Deliverable 10.2, Month 6) will describe the open access to research data.

Article 38 explain the policy and rules of the communication activities. The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner. Before engaging in a communication activity expected to have a major media impact, the beneficiaries must inform the Commission (see Article 52).

Any communication and dissemination of results (in any form, including electronic) must: (a) display the EU emblem and (b) include the following text: "This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101016906".

When displayed together with another logo, the EU emblem must have appropriate prominence. For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the Commission. This does not however give them the right to exclusive use. Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

Any dissemination of results must indicate that it reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

The Commission may use, for its communication and publicizing activities, information relating to the action, documents notably summaries for publication and public deliverables as well as any other material, such as pictures or audio-visual material received from any beneficiary (including in electronic form). This does not change the confidentiality obligations in Article 36 and the security obligations in Article 37, all of which still apply. If the Commission's use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the Commission not to use it (see Article 52). The right to use a beneficiary's materials, documents and information includes: (a) use for its own purposes (in particular, making them available to persons working for the Commission or any other EU institution, body, office or agency or body or institutions in EU Member States; and copying or reproducing them in whole or in part, in unlimited numbers); (b) distribution to the public (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes); (c) editing or redrafting for communication and publicizing activities (including shortening, summarizing, inserting other elements (such as meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation); (d) translation; (e) giving access in response to individual requests under Regulation No 1049/200127, without the right to reproduce or exploit; (f) storage in paper, electronic or other form; (g) archiving, in line with applicable document-management rules, and (h) the right to authorise

third parties to act on its behalf or sub-license the modes of use set out in Points (b), (c), (d) and (f) to third parties if needed for the communication and publicizing activities of the Commission.

2.2 Management of activities

The management of activities will be led by UPC and UNIROMA3. All the partners will participate in the full management of the communication and dissemination activities. A good example will be the joint coordination of workshops in top conferences as ERF, ICRA or IROS; the shared participation in fairs and events and the combination of scientific, industry and end users efforts in the development of seminars in the robotics and agricultural communities.

The project activities, news and results will be communicating at the website and in the social media – YouTube, Twitter, LinkedIn, Facebook and Instagram. All the project publications and public deliverables will be accessible on the website. The dissemination mechanisms will include branding, flyers and brochures. The project partners will engage in communication with local, regional and national mass media with the goal of reaching the widest possible public. PAL Robotics has a strong communication team. They will provide regular social media coverage (posts from the PAL Robotics account several times a day) and 1-2 blog posts per year.

With respect to the participation to Fairs / Events / Open days, each partner will create a short press note describing the event or specific news. UPC and UNIROMA3, with the participation of all the partners, will create the press releases and the regular news articles for press media. Each partner will contact with their academic, sector, local, regional and national press. UPC and UNIROMA3 will contact with the European and international press. Radio and TV interviews and participation will be managed by each partner. Identification of the target groups as well as the media and means to be used

As it is described in the "CANOPIES project Gran Agreement", the project communication and dissemination should be done structured in targeted groups. We will address our activities to the scientific community – Coordination and participation in international scientific conferences and workshops -, the industry – international fairs and industrial conferences -; end users – table grape and permanent crops farmers' associations -; agricultural schools and last but not least, the general public – open days, open laboratories, science fest.

The academic partners will boost the publications in scientific journals, for example IEEE Transactions on Robotics, IEEE Transactions on Patter Analysis and Machine Intelligence, Journal of Autonomous Robots, Journal of Field Robotics, Robotics and Autonomous Systems, International Journal of Computer Vision, Computer Vision and Image Understanding; and the participation in international conferences, for example ICRA, IROS, Robotics Science and Systems, International Conferences on Pattern Recognition and Computer Vision. The consortium will participate in relevant conferences and workshops.

The industrial partners –PAL and Paleblue - will participate in industrial fairs and will organize presentations and workshops along the project.

Finally, the plan includes the participation in associations of popular science and technology and possible organizations interested in a more sustainable concept of agriculture (e.g. environmentalist groups). The project end user – AGRIMESSINA – jointly with UPC (UMA) will disseminate the project results to the agricultural and food sector, for example - Agricultural magazines: Italiafruitmagazine, Freshpointmagazine, Freshfruitportal, Agrotecnica, Agricultura, Vida rural, Interempresas, La Terra, Agrodigital, La Tierra, Terrali,

Profesional ARGO -, or in fairs - Macfrut, Fruitlogistica, Fruitattraction, London Produce Show, FIMA -;. They will also participate in seminars in for example institutes and schools - A.P.E.O. (Associazione Produttori ed Esportatori Ortofrutticoli), C. U. T. (Commissione Uva da Tavola Italiana), Fruitimprese (National Institute for fruit and vegetables), International table grapes commission. Finally, they will participate in Radio and TV programs as Agroesfera, Tempero, or others, with interviews about the work and the results done.

A special mention will be the dissemination and synergies with the Digital Innovation Hub – agROBOfood – lead by UNIROMA3 and DTI. Companies in our consortium can become business members of agROBOfood and participate in the activities and calls that the Digital Innovation Hub will program. The consortium will connect also with DIH Smart Agri Hubs.

In order to coordinate all the information about communication and dissemination activities to be done during the next years, we have prepared a tentative program that is summarized in the next sections.

2.3 Activities overview. Year 2021

Plan Overview 2021	MONTH 1-3	4-6	7-9	10-12
Dissemination				
Scientific community Scientific publications	Journal of Intelligent & Robotic Systems		CASE Conference	
Scientific community Scientific conferences and workshop (Coordination-Participation)	Invited Lecture "Ground robotic platforms for Precision Agriculture"	*ERF Workshop Coordination & Participation *ICRA Workshop: *29th Med. Con. Control and Autom.	Participation IROS RO-MAN EMCR	Int. Forum of Agricultural Robotics European Researchers' Night 2021
Industry	LogiMat	Hannover Messe	*Solo talk VR/AR Global Summit *Stereopsia, World immersion	
End users Table-Grape Farmer's associations Permanent Crops Farmer's Association		agROBOfood summit April Virtual		
Academic dissemination Agricultural Schools /Seminars held		Agri-food event		
General Public /Popular science / Open days, Science Fest				European Researchers' Night 2021
Communication Activities and Events				
Press releases- Regular news articles Mass media/ Popular media AGRICULTURE	KoM PRESS RELEASE		PRESS REL./ ARTICLE SPAIN(Agric. Magazine /ITALY(A.P.E.O / CUT / Others)	
Press releases-Regular news articles ROBOTICS				

Table 1– Communication and Dissemination Plan 2021

Scientific publications

Academic partners will contribute with scientific publications at International journals and conferences as it is explained in the previous section. A first publication is already presented:

- "Human Multi-Robot Physical Interaction: a Distributed Framework. Martina Lippi & Alessandro Marino. Journal of Intelligent & Robotic Systems volume 101, Article number: 35 (2021)"

- Conference paper in IEEE International Conference on Automation Science and Engineering (CASE), A ROS Package for Human-In-the-Loop Planning and Control under Linear Temporal Logic Tasks (YouTube link: https://youtu.be/9juAhYtq7aw). Partner: KTH

Scientific Community (Coordination and participation in scientific conferences and workshops)

- Invited Lecture "Ground robotic platforms for Precision Agriculture" by Andrea Gasparri and Daniele Nardi. Master course in Precision Agriculture. Università della Tuscia. February 19th. Partner UNIROMA3, UNIROMA1 http://www.unitus.it/it/dipartimento/dafne/master4/articolo/agricoltura-di-precisione (in Italian)
- Agri-food Workshop coordination. ERF 2021. Partner: PAL Robotics.
- Invited talk by Andrea Gasparri at European Robotics Forum (ERF April 2021). Partner: UNIROMA 3
- Workshop participation to the international conference "International Conference on Robotics and Automation (ICRA May-June, 2021) ". Partner: UNICLAM. Participants: Project Partners
- Workshop "Control, Robotics, Sensing and Artificial Intelligence for Precision Agriculture". International conference "29th Mediterranean Conference on Control and Automation". June 22-25. Bari, Italy. http://med2021.poliba.it/wordpress/workshops-and-tutorials/ Partners coordination: UNIROMA3 and UNIROMA1 (Sapienza)
- Participation in RO-MAN - The IEEE International Conference on Robot & Human Interactive Communication. Partner: Pal Robotics
- Participation in EMCR - Biennial conference in the area of mobile robotics and mobile human-robot systems. Partner: Pal Robotics
- European Researchers' Night 2021. Presentation of the Canopies project during the Marie Skłodowska-Curie Actions, European Researchers' Night. November. Partner: UNICLAM

Industry conferences and events

- Solo Talk. (20') VR/AR Global Summit 2021 – Europe, September 29 – October 1. Online conference. https://www.vrarglobalsummit.com/ Partner: Paleblue.
- Participation to Stereopsia, World immersion forum: 13th edition 8-10 December 2021 Brussels, Belgium, https://europe.stereopsia.com/en. Partner: Paleblue
- Advanced Factories - Congress and exposition on industrial automation. Partner: Pal Robotics
- Hannover Messe - Annual industrial technology trade fair held in Hannover, Germany: Partner: Pal Robotics
- LogiMAT - International Trade Show for Intralogistics Solutions and Process Management. Partner: Pal Robotics

End users (Table-Grape Farmer's associations / Permanent Crops / Farmer's Association)

- Dissemination on Agricoltural/food industry website: Freshplaza, Italiafruitmagazine, Freshpointmagazine, Freshfruitportal. Partner: AGRIMESSINA
- Technical communication in sector magazines (see relation). November. Partner. UPC (UMA)

- Agri-food event "Unidos por una agricultura innovadora," 6 - 7 April 2021. Partner: Pal Robotics

Dissemination and Synergies with DIH-agROBOfood

Companies in our consortium can become business members of agROBOfood. The consortium will also try to connect with DIH Smart Agri Hubs.

Although it is very early for a specific plan for the rest of the project development, we have included the proposals received from all the project partners for 2022 to 2024.

2.4 Activities overview. Year 2022

Plan Overview 2022	MONTH 13-15	16-18	19-21	22-24
Dissemination				
Scientific community Scientific publications		Conference papers in ICRA 2022		Conference papers in IROS and CDC 2022
Scientific community Scientific conferences and workshop (Coordination-Participation)		*ICRA workshop	Participation RO-MAN EMCR	*IROS workshop
Industry	Technical talk. 42th International Fair on Agricultural Machinery (FIMA) Hannover Messe	ICATPF 2022 International Conference on Agricultural Technology and Precision Farming		*PaleBlue seminar on VR. *Stand at Maker Faire I-RIM/Maker Faire
End users Table-Grape Farmer's associations Permanent Crops Farmer's Association	Participation in Macfrut - Fruitlogistica - Fruitattraction London Produce Show.			
Academic dissemination Agricultural Schools /Seminars held	Agri-food event	*Seminar in agro schools and farmers associations. EEABB *Seminar in Master courses	*Dissemination on Agricoltural/food industry website: Freshplaza, Italiafruitmagazine, Freshpointmagazine, Freshfruitportal. *Technical presentation at RURALCAT	
General Public /Popular science / Open days, Science Fest			TV and Radio programs: Agroesfera, Tempero	
Communication Activities and Events				
Press releases- Regular news articles Mass media/ Popular media AGRICULTURE			PRESS REL./ ARTICLE SPAIN(Agric. Magazine /ITALY(A.P.E.O / CUT / Others)	

Table 2– Communication and Dissemination Plan 2022

Scientific publications

- Conference papers at ICRA, IROS and CDC 2022.

Scientific Community (Coordination and participation in scientific conferences and workshops)

- Workshop about robotics for precision agriculture will be organized at the international conference "IEEE International Conference on Robotics and Automation (ICRA)" (in May) and/or at the international conference "IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)" (in October). Partners' coordination: UNICLAM and UNIROMA3. Participants: Project partners.
- Participation in RO-MAN - The IEEE International Conference on Robot & Human Interactive Communication. Partner: Pal Robotics
- Participation in EMCR - Biennial conference in the area of mobile robotics and mobile human-robot systems. Partner: Pal Robotics

Industry conferences and events

- Specific technical talk. 42th International Fair on Agricultural Machinery (FIMA). Zaragoza, Spain. Partner: UPC (UMA)
- Presentation. ICATPF 2022: 16. International Conference on Agricultural Technology and Precision Farming: June 24-25, 2022 in Oslo, Norway https://waset.org/agricultural-technology-and-precision-farming-conference-in-june-2022-in-oslo. Partner. Paleblue
- Seminar on VR. 2nd or 3rd quarter 2022. Partner: Paleblue
- Exhibition of the robotic platforms at the I-RIM/Maker Faire events in Rome. December. Partner: UNIROMA3, UNICLAM
- Participation in main Fruit International Fair: Macfrut (Italy, Rimini, May); Fruitlogistica (Germany, Berlin, February); Fruitattraction (Spain, Madrid, October); London Produce Show (London, UK, June). Partner: AGRIMESSINA
- Advanced Factories - Congress and exposition on industrial automation. Partner: Pal Robotics
- Hannover Messe - Annual industrial technology trade fair held in Hannover, Germany: Partner: Pal Robotics
- LogiMAT - International Trade Show for Intralogistics Solutions and Process Management. Partner: Pal Robotics

End users (Table-Grape Farmer's associations / Permanent Crops / Farmer's Association)

- Cooperation with main Produce Institute: A.P.E.O. (Associazione Produttori ed Esportatori Ortofrutticoli); C. U. T. (Commissione Uva da Tavola Italiana); Fruitimprese (National Institute for fruit and vegetables); International table grapes commission. Partner: AGRIMESSINA
- Dissemination on Agricoltural/food industry website: Freshplaza, Italiafruitmagazine, Freshpointmagazine, Freshfruitportal. Partner: AGRIMESSINA
- Technical communication in sector magazines (see relation). June-November. Partner. UPC (UMA)
- Specific technical presentation at RURALCAT, Regional Government platform (aimed at technicians and farmers and with a large influx of visits and attendance at conferences). Partner UPC (UMA)
- Seminar in agro schools and farmers' associations. EEABB. Partner: UPC (UMA)

- Seminars in the Official Associations of Agricultural Engineers in the different areas of Spain. Partner: UPC (UMA)
- Thematic seminar in KET master. Partner: UPC (UMA)
- Agri-food event "Unidos por una agricultura innovadora". Partner: Pal Robotics

General public

- Open days/open laboratories concerning the CANOPIES project and the farming robot platform. April/May. Partner: UNICLAM
- TV and radio programs. Agroesfera, Tempero. Partner: UPC (UMA)

2.5 Activities overview. Year 2023

Plan Overview 2023	MONTH 25-27	28-30	31-33	34-36
Dissemination				
Scientific community Scientific publications		Conference papers in ICRA 2023		Conference papers in IROS and CDC 2023
Scientific community Scientific conferences and workshop (Coordination-Participation)	ERF		Participation RO-MAN EMCR	
Industry	ERF	Hannover Messe		
End users Table-Grape Farmer's associations Permanent Crops Farmer's Association		TABLE GRAPE / PERMANENT CROPS PRESENTATION SPAIN-ITALY	TECHNICAL PRESENTATION REGIONAL GOV SPAIN-ITALY	AGRICULTURAL SCHOOL SEMINAR SPAIN-ITALY
Academic dissemination Agricultural Schools /Seminars held	Seminars in the Official Associations of Agricultural Engineers	Agri-food event	Thematic seminar in KET Master	Seminar in agro schools and farmers associations. EEABB
General Public /Popular science / Open days, Science Fest		Open Days / laboratories		TV Interview with Euronews
Communication Activities and Events				
Press releases- Regular news articles Mass media/ Popular media AGRICULTURE	RADIO/TV INTERVIEW	PRESS REL./ ARTICLE SPAIN(Agric. Magazine /ITALY(A.P.E.O / CUT / Others)		

Table 3– Communication and Dissemination Plan 2023

Scientific publications

- Conference papers at ICRA, IROS and CDC 2023.

Scientific Community (Coordination and participation in scientific conferences and workshops)

- ERF Workshop. Robotic technology in Agricultural scenarios. Partner: UPC with the participation of all the project partners.
- Participation in RO-MAN - The IEEE International Conference on Robot & Human Interactive Communication. Partner: Pal Robotics
- Participation in EMCR - Biennial conference in the area of mobile robotics and mobile human-robot systems. Partner: Pal Robotics

Industry conferences and events

- Advanced Factories - Congress and exposition on industrial automation. Partner: Pal Robotics
- Hannover Messe - Annual industrial technology trade fair held in Hannover, Germany: Partner: Pal Robotics
- LogiMAT - International Trade Show for Intralogistics Solutions and Process Management. Partner: Pal Robotics

End users (Table-Grape Farmer's associations / Permanent Crops / Farmer's Association

- Dissemination on Agricoltural/food industry website: Freshplaza, Italiafruitmagazine, Freshpointmagazine, Freshfruitportal. Partner: AGRIMESSINA
- Technical communication in sector magazines. June-November. Partner. UPC (UMA)
- Seminar in agro schools and farmers' associations. EEABB. Partner: UPC (UMA)
- Specific technical presentation at RURALCAT, Regional Government platform (aimed at technicians and farmers and with a large influx of visits and attendance at conferences).
- Thematic seminar in KET master. Partner: UPC (UMA)
- Seminars in the Official Associations of Agricultural Engineers in the different areas of Spain. Partner: UPC (UMA)
- Agri-food event "Unidos por una agricultura innovadora". Partner: Pal Robotics

General public

- Open days/open laboratories concerning the CANOPIES project and the farming robot platform. (April /May). Partner: UNICLAM
- Participation in TV regional program interview. Partner: UNICLAM
- TV Interview with Euronews (https://www.euronews.com/), a Pan-European pay television news network. Partner: UNIROMA3
- TV and radio programs. Agroesfera, Tempero. Partner: UPC (UMA)

2.6 Activities overview. Year 2024

Plan Overview 2024	MONTH 37-39	40-42	43-45	46-48
Dissemination				
Scientific community Scientific publications		**Conference papers in ICRA 2024**		**Conference papers in IROS and CDC 2024**

Scientific community Scientific conferences and workshop (Coordination-Participation)	**ERF WORKSHOP**	***ICRA Worskop**	**I-RIM Institute for Robotics and Intelligent Machines Participation RO-MAN EMCR**	***IROS Workshop**
Industry	**AGRO FAIR STAND + WORKSHOP**	**Hannover Messe**	**PaleBlue seminar on VR.**	
End users Table-Grape Farmer's associations Permanent Crops Farmer's Association	**FIMA FAIR /SPAIN Fruitlogistica**	**London Produce Show**	**TABLE GRAPE / PERMANENT CROPS PRESENTATION SPAIN-ITALY**	
Academic dissemination Agricultural Schools /Seminars held	**Thematic seminar in KET master**	**Agri-food event**		
General Public /Popular science / Open days, Science Fest			**TV / Radio Programs**	**Press Interview**
Communication Activities and Events	**HQ PROFESSIONAL VIDEO / ALL PARTNERS**			
Press releases- Regular news articles Mass media/ Popular media AGRICULTURE		**PRESS REL./ ARTICLE SPAIN(Agric. Magazine /ITALY(A.P.E.O / CUT / Others) RADIO / TV INTERVIEW**		

Table 4– Communication and Dissemination Plan 2024

Scientific publications

- Conference papers at ICRA, IROS and CDC 2024.

Scientific Community (Coordination and participation in scientific conferences and workshops)

- Workshop about robotics for precision agriculture will be organized at the international conference "IEEE International Conference on Robotics and Automation (ICRA)" (in May) and/or at the international conference "IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)" (in October). Partners' coordination: UNICLAM and UNIROMA3. Participants: Project partners.
- Workshop about "Manipulation in precision farming" at "I-RIM Institute for Robotics and Intelligent Machines". Partners' coordination UNIROMA3 and UNICLAM
- Participation in RO-MAN - The IEEE International Conference on Robot & Human Interactive Communication. Partner: Pal Robotics
- Participation in EMCR - Biennial conference in the area of mobile robotics and mobile human-robot systems. Partner: Pal Robotics

Industry conferences and events

- Specific technical talk. 43th International Fair on Agricultural Machinery (FIMA). Zaragoza, Spain. Partner: UPC (UMA)

- Participation in main Fruit International Fair: Macfrut (Italy, Rimini, May); Fruitlogistica (Germany, Berlin, February); Fruitattraction (Spain, Madrid, October); London Produce Show (London, UK, June). Partner: AGRIMESSINA
- Advanced Factories - Congress and exposition on industrial automation. Partner: Pal Robotics
- Hannover Messe - Annual industrial technology trade fair held in Hannover, Germany: Partner: Pal Robotics

End users (Table-Grape Farmer's associations / Permanent Crops / Farmer's Association)

- Dissemination on Agricoltural/food industry website: Freshplaza, Italiafruitmagazine, Freshpointmagazine, Freshfruitportal. Partner: AGRIMESSINA
- Technical communication in sector magazines. June-November. Partner. UPC (UMA)
- Specific technical presentation at RURALCAT, Regional Government platform (aimed at technicians and farmers and with a large influx of visits and attendance at conferences).
- Seminar in agro schools and farmers' associations. EEABB. Partner: UPC (UMA)
- Seminars in the Official Associations of Agricultural Engineers in the different areas of Spain. Partner: UPC (UMA)
- Agri-food event "Unidos por una agricultura innovadora". Partner: Pal Robotics

General public

- Open days/open laboratories concerning the CANOPIES project and the farming robot platform. (May). Partner: UNICLAM
- Press interview with regional/national press. November. Partner: UNIROMA3
- TV and radio programs. Agroesfera, Tempero. Partner: UPC (UMA)

Although during the project duration, the project partners will prepare specific videos about their scientific and social contributions and results, in 2024 the consortium will prepare a professional video to communicate and disseminate the project.

2.7 Management and Measurements of the Dissemination and Communication activities

To evaluate the success of the dissemination and communication action, some key measurement indicators have been defined. These indicators can be seen in the following table.

Venue	Indicator	Poor	Good	Excellent
Website	#of visits	<1000	1000-5000	>5000
Social media	#of followers	<50	50-100	>100
Scientific publications	#of peer reviewed papers accepted	<15	15-25	>25
Scientific workshops	#of scientific workshops organized	<1	1-2	>3

Agricultural schools	#of seminars held	<3	3-6	>6
Table-Grape Farmer's associations	# of press release + # of article in bulletin/magazines + #entry in associations mailing lists + #of intervention to public meetings	<5	5-10	>10
Permanent Crops Farmer's Association	# of press releases + # of articles in bulletins/magazine + #entries in associations mailing lists + #of interventions in public meetings	<2	2-4	>4
Mass Media	#of appearance on mass media of regional or national relevance	<2	2-5	>5
Popular Science	#of appearance on popular science media	<1	1-3	>3

Table 5– Communication and Dissemination KPIs

The consortium will actively participate to achieve an "excellent" plan for the communication and the dissemination of the project contributions and results.

2.8 Conclusions

This document serves as an initial version for the dissemination and communication plan of the CANOPIES consortium members. This plan is forecasted for four years, from 2021 to 2024, and includes scientific (targeting the scientific community and innovation actors) and technical (targeting farmers, robot manufacturers, agricultural equipment producers and sensors' manufacturers) dissemination and communication.

The high-level strategy from the outset of the project. The dissemination strategy assures that our results outlive the duration of the project by: i) making the results of our proposal known to those who could benefit from the results directly (farmers) or indirectly (producers, operators); ii) generate interest in the research world which may multiply the results targeting PA; and iii) creating the context for possible follow-ups.

3 Exploitation Plan

3.1 Introduction

This section serves as an initial version for the exploitation plan of the CANOPIES consortium members. In the plan, each member describes how the results of the CANOPIES project will be deployed. The expected

benefits from the results are also included as part of the plans. These plans will be updated at the end of the project.

The aim of this project is to develop a novel collaborative human-robot paradigm addressing the challenges of Human Robot Interaction and Human-Robot Collaboration in the unstructured highly dynamic outdoor environment of permanent crop farming (Agri-Food Area). The approach will be demonstrated through an integrated system composed by a farming robot and logistics robots with a real-world validation of two economically relevant agronomic operations within a table-grape vineyard: harvesting and pruning. CANOPIES represents the first attempt to introduce a collaborative paradigm in the field of precision agriculture for permanent crops where farmworkers can efficiently work together with teams of robots to perform agronomic interventions, like harvesting or pruning in table-grape vineyards. The final goal is to demonstrate the CANOPIES approach and robots in a real agricultural environment.

The CANOPIES consortium is constituted by different types of organizations: academic institutions (UNIROMA3, KTH, UNIROMA1, UNICLAM, and UPC), small and medium sized Companies (PAL Robotics and PALEBLUE), leading research and technology institute (DTI), agro-industrial company (AGRIMESSINA) and (RSA) specializing in management consulting services. Accordingly, the exploitation plans for each organization type is different.

The objective of this exploitation is to turn scientific results and prototypes into sustainable, user optimized, ready for use applications and services. According to CANOPIES' activities and deliverables, the results will be exploited at different levels. The Exploitation Plan will be developed within the work packages in collaboration with all the project partners. This Exploitation Plan highlights how Project Partners will exploit project results. All Project Partners describe how the results of the CANOPIES project will be deployed. The expected benefits from the results are also included as part of the plans.

Exploitation can be defined as taking industrial advantage of projects results by the project partners, acting collectively as a consortium or as individual organizations.

This document addresses exploitation issues of the CANOPIES assets. The proposed exploitation plan will be incrementally specified and continuously aligned to other related deliverables. This deliverable represents the first Exploitation Plan (Deliverable D10.3), as part of work package "Dissemination and Promotion of Exploitation" (WP10).

3.1.1 Scope

At this point of the project, this plan identifies an overall exploitation strategy for CANOPIES, and reports the individual strategy of each project partner.

3.1.2 Document Structure

The remaining of this document is organized as follows:

- Section 3.2 - General exploitation plan, summarizing the plans of the individual consortium members,
- Section 3.3 - Detailed exploitation plans of each consortium member,
- Section 3.4 - Conclusions.

3.2 General Exploitation Plan

The common exploitation strategy and plan to be followed in CANOPIES will not be determined until later the project; this first plan serves as an initial step toward exploitation and will be updated in the last phases of the project, when stable results will be available.

3.2.1 Exploitable Results Identification

The CANOPIES consortium spots different relevant stakeholders: it is constituted by different types of organizations: academic institutions (UNIROMA3, KTH, UNIROMA1, UNICLAM, and UPC), small and medium sized robot providers (PAL Robotics and PALEBLUE), leading research and technology institute (DTI), agro-industrial company (AGRIMESSINA) and (RSA) specializing in management consulting services.

Exploitation in CANOPIES is organized as follows. This project will be carried out along three lines:

i) Scientific Exploitation;

ii) Economic Exploitation;

iii) Societal Exploitation.

Possible new potential exploitation directions will be demonstrated as well. The collected information will be the basis for the formulation of a Plan for Using and Disseminating Foreground (PUDF) that will generate the guidelines for the future use of the project's results.

The exploitation of the knowledge generated in CANOPIES will be carried out along three lines:

Scientific Exploitation (driven by academic partners): A significant re-use of the methodological outcomes for future research and projects is expected, as well as an advancement in the visibility of the respective research groups.

Economic Exploitation (mainly driven by the industrial partners):The knowledge and technological development gained during the project to propose new products and services in the fast-growing PA market, thus creating new opportunities to expand its own business of the industrial partners.

The knowledge will be generating and transferring to industry and society. This is primarily done commercially through creation of novel robotic solutions for end-users in numerous domains (TRL 7-9), consultancy, innovation & business service, and networking & events, and academically through participation in R&D&I projects with industrial and academic partners. The results from CANOPIES will be exploited the same way with a particular focus on side-stepping the developed components and technologies to other sectors in different scenarios, in particular the multi-robot teams and VR technologies.

Societal Exploitation: Promoting especially in the new generations of agricultural operators, a positive vision of the role of automation in agriculture which is expected to provide livelihood for farmers and farm workers, while protecting the environment and helping feed a growing population. In addition, the Consortium will contribute to change the traditional societal perspective of the agricultural operator as a low-tech profession will possibly encourage new young students and prospective researchers to engage in the study of agronomical and agricultural engineering and robotics subjects making the new way of performing agricultural activities more attractive. Promoting the idea of a human-robot collaborative paradigm which is expected to be more naturally accepted by farmworkers as we are suggesting the idea is of deploying robotic solutions to support them rather than to replace them.

3.2.2 Market Analysis

In this section we present a first market projection and the evolution related to the table grape market and especially more in details robotics and mechatronics market which is analyzed globally, regionally and locally. It encompasses a quantitative and qualitative assessment looking into the size of the market both in volume and in value.

- Grapes Market Projections

Table grapes are among the most popular fruits in European consumption. The market for table grapes is mature, with large volumes and a relatively stable demand all year round. This means there are several supply windows throughout the year during which you can step in and meet the demand. According to the CBI, Ministry of Foreign Affairs; with a value of 1.4 billion euros table grapes have the highest import value after bananas. The import volume has gradually increased from 602,000 tones in 2015 to 694,000 tones in 2019. This reflects an import growth of 3 to 4 percent per year. Europe produced 24.2 million tons of grapes in 2019. Only an estimated 1.7 million tons were table grapes for fresh consumption, while less than a decade ago the production was still more than 2 million tons. According to Mordor Intelligence, Europe is the largest grapes producing region in the world, accounting for more than 45% of the world grapes production. The major grape importing countries are the United States, the United Kingdom, Germany, and China.

The major exporters of grapes in the international market include Chile, the United States, and Italy. In 2018, the top three grape importing countries of Europe like the United Kingdom, Germany, and the Netherlands, have imported around 25% of the grapes traded globally. Most of the countries of the European region import table grapes, while countries like Italy have huge acreage under vineyards, for the purpose of the production of wine. Most of the world's finest quality wines are produced in European countries. The grapes market as a whole was valued at USD 189.19 billion in 2020 and the market is projected to register a CAGR of 7.1% during the forecast period 2021-2026.

Grapes are used for wine production and with the increasing demand for wine, the demand for grapes is also increasing. The wine market was valued at USD 297.35 billion in 2018 and is expected to register 5.8 % CAGR during the forecast period, 2021 - 2026. The largest aggregated wine markets are the United States of America, China, and France, due to their larger populations. The United States of America is one of the biggest importers of grapes with a record of importing grapes of value USD 18,04,321 million in 2019.

- The Robotics and Mechatronics Market Projections

The prevalent trend of automation in the agriculture sector has led to the increasing demand for agricultural robots to improve crop cultivation techniques and enhance overall productivity. This represents one of the key drivers propelling the global market for agricultural robots. Robotics and automation are the most focused technologies in the present day agriculture sector. The integration of robotic solutions in farming practices is posing lucrative growth avenues globally. The rising demand for agricultural produce coupled with increasing population is forcing the governments and farming communities towards high-productivity farming practices such as precision farming and smart agriculture. Collectively, this increased use of technology in agriculture is known as "precision farming", and its global value will reach USD 16.35 billion by 2028. It is projected to expand at a CAGR of 13.1% over the forecast period, according to a new report by Grand View Research, Inc.

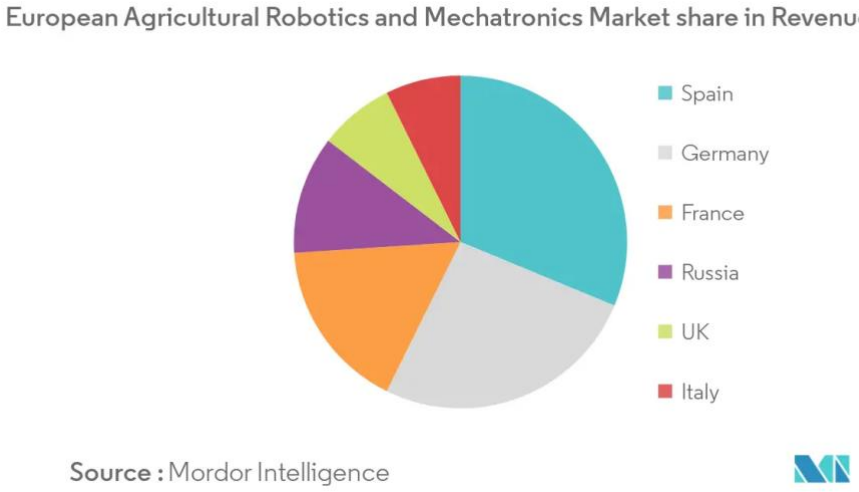
Furthermore, the declining arable land and scarcity in agricultural inputs is also motivating the use of sustainable farming practices that adhere to the 'law of minimum' in food production. Robotics evolved as the promising solution for sustainable farming owing to their timely and accurate performance in a wide array of crop production activities. Robots are integrated in various forms such as drones, robotic arms, autonomous harvesting machines and driverless tractors. These novel farm equipment help improve the

quality and quantity of produce through their high capacity, precise, fast and automated operations in soil management, harvesting and crop protection activities.

Reducing the number of labors, growing population, and increasing requirement for high productivity from the existing farm areas are factors fueling the growth of the agricultural robots' market. The maturity of existing agricultural technologies and the introduction of new agricultural technologies are expected to act as opportunities for the market in the long term. The objective of the report is to define, describe, and forecast the agricultural robots market based on type, offering, farming environment, farm produce, application, and region.

The COVID-19 pandemic will have a varying impact on different agricultural robots. Most agricultural robots will continue to experience high growth as farmers will look to reduce their dependence on manual labor and embrace automation to a greater degree. Hence, the overall market for agricultural robots is expected to pick up from 2021 onwards.

As a region, the Europe Agricultural Robotics and Mechatronics market is estimated to grow at a CAGR of 14.9% through 2025 according to Mordor Intelligence analysis. The largest market by revenue in Europe is set to be Spain, with the other major players in terms of market share being France and the UK. This can be seen in the two graphs below. Moreover, the European Agricultural Robots and Mechatronics Market is moderately consolidated, with the top nine companies accounting for about more than 43% share of the market, while the rest of the companies account for the remaining share.



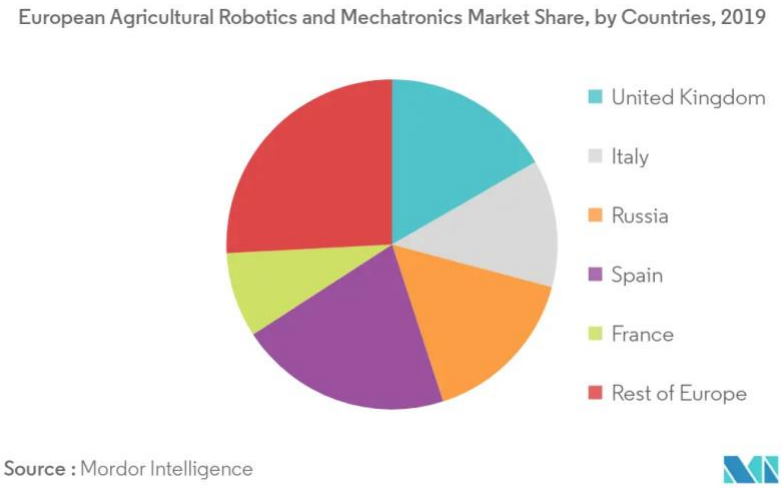


Figure 1 – European Agricultural Robotics and Mechatronic Market

Furthermore, the decrease in the number of young farmers entering the agricultural sector and the rise in minimum wages of farmers is also driving the growth of the agricultural robots' market.

Although the number of emerging agricultural software and services is increasing at a rapid pace, the agricultural hardware is still expected to dominate the agricultural robotics market. Increasing affordability of auto-steering systems and improving GPS accuracy have enabled tractors and other agricultural ground vehicles to operate autonomously.

CANOPIES is well positioned to take full advantage of the growth of the agricultural robotics market in Europe. Inconsequence, advances in the Agricultural Robotics system are more necessary than ever, and this brings new opportunities to use CANOPIES or its components outside of their initial domain of application.

3.2.3 Business Model

This preliminary business model is done taking into account the outcomes of the market analysis and evolution, the identified new value chains and the target groups for each developed technology.

Targeted communities:

- Scientific community and innovation actors,
- Industry and end users (Farmers, robot manufacturers, agricultural equipment producers, sensors manufacturers),
- Educational community.

Main Goals:

- Advancing scientific knowledge;
- Creating value within the targeted communities (farmers, but also technological operators in the fields of robots, autonomous robots and sensors) of the European Union;
- Encouraging both public and private investments for possible follow-ups to trigger further advancements;

- Raising awareness within the involved actors concerning the potential of human robot interaction, AI based perception and robotics technology for developing novel PA-related technological solutions in line with the "Sustainable Development Goals" of the United Nations on sustainable agriculture.

CANOPIES solution to the market needs:

- PROBLEM: The development of fully autonomous robotic solutions for permanent crops is significantly behind compared to other agronomic sectors such as field crops. This disparity can be explained by the higher complexity of these application contexts, which makes it very challenging to fully automate most of the agronomic interventions at reasonable costs.

  → SOLUTION: CANOPIES proposes to reduce this gap by introducing a novel concept of farming robots, where we leverage an effective interaction with the human workers to potentially reduce the complexity of the technological design. As a result, we expect CANOPIES to have a technological impact by contributing to a quicker development of market-ready autonomous agronomic robotics solutions for these "special crops".

- PROBLEM: Technological complexity

  → SOLUTION: CANOPIES promotes the development of autonomous robotics solutions which may have lower technological complexity by resorting to the collaboration with human workers. In this regard, by considering the engineering strength of European manufacturers and high market shares worldwide, there is substantial potential for future development within Europe feeding a global market for autonomous agricultural machines.

- PROBLEM: The composition of the workforce in agriculture is a problem because it is relatively much older than in the rest of the economy. Aging is a problem as these older workers will have to be replaced by younger workers, but these cohorts (ages between 25 and 45 years) are getting smaller and smaller. This trend combined with the fact that there is already pressure on labor participation in agriculture might have dramatic consequences for the European agricultural sector.

  → SOLUTION: The use of robotics on a larger scale would contribute to a solution. Robots also could take over the dangerous, heavy or unhealthy work in agriculture. In this regard, CANOPIES proposes an integrated solution where the hard labor of the human co-workers is expected to be significantly reduced and each human worker is expected to supervise a relatively large fleet of farming robots. We believe these factors may positively impact the demographic issues mentioned above.

- PROBLEM: The positioning of human labor is an important issue in the European agricultural sector. Labor participation in the agricultural sector has decreased considerably, this seems to be a global trend. When Gross Domestic Product (GDP) increases, labor participation in agriculture decreases. Do people turn away from the sector because it is low paid, dirty, physically demanding and involves long-working hours, or because machines have taken over their jobs? However, one thing is clear: the number of farmers is declining. Small margins and high investments have not stimulated succession in family-owned businesses.

  → SOLUTION: The increasing use of technology might influence the daily life quality of farm workers and may also attract a younger generation back into farming. The integrated system proposed within CANOPIES is expected to contribute towards improving the quality of life of EU farmers, by promoting a better education driven by the interaction with cutting-edge technological solutions, ensuring a

better income due to the higher margin of profit expected by the deployment of such an integrated system, and making the agri-food sector appealing also for relatively young people thus acting against the lack of labor force and entrepreneurship in this sector.

- PROBLEM: From an industrial standpoint, farming robotics is a relatively young field. Market-ready robotics solutions available at the state of the art are mostly limited to "intelligent" tractors with autonomous navigation capabilities with applications mainly focused on the sector of field crops. On the contrary, the development of fully autonomous robotic solutions for other agricultural sectors, such as permanent crops, is still at a very early stage due to the inherent complexity of the agronomic interventions in these application settings, which makes it hard to fully automate at reasonable costs, thus limiting the deployment of farming robots in such application contexts. Harvest and pruning in table grape production are the two most important items in the total production cost.

  → SOLUTION: CANOPIES could help mitigating the technological cost of developing farming robots for the agricultural sector of permanent crops by proposing a novel concept of farming robots, where we leverage an effective interaction with the human co-workers to potentially reduce the complexity of the technological design.

3.2.4 IPR Management

From the very first moment, all partners will receive assurance that their contributions to the project based on their pre-existing know-how will be identified and recognized as such by the other participants. Pre-existing know-how means knowledge developed before the beginning of the project, regardless of its being patented or secret, as well as results obtained outside the project after its start. Knowledge exploitation will be administered pursuant to the general provisions and the specific rules to be defined in the project's Consortium Agreement that will follow the highest EC standards. The exploitation of knowledge will involve all activities related to the protection of the intellectual property and the plans for its use. In view of the partners' specific legitimate interests, intellectual property rights (including patent searches, filing of patent or other IPR applications, etc.) will be protected and safeguarded to ensure the smooth and efficient use of results. This approach to knowledge and the IPR management is regulated in detail in the Consortium Agreement will be agreed upon by all partners.

Some of the aspects covered will be considered:

• **Confidentiality**: Each partner will treat information and data from other partners as confidential and will not disclose it to third parties without explicit authorization, unless the information is demonstrably already public.

• **Ownership of Knowledge**: Knowledge is owned by the partners whose work has originated the knowledge, or on whose behalf such work was conducted. Partners wishing to assign knowledge to a third party, should inform other partners and the European Commission accordingly, and request their consent.

• **Patents**: Partners who own patentable knowledge may (and are encouraged to) at their own expense apply for a patent or a similar form of protection and shall supply the details of such an application to the other partners and to the Project Management Committee.

• **Access Rights**: Partners will grant each other royalty-free access to any knowledge generated within the project, to the extent needed for the project to be successfully carried on. Access rights to pre-existing knowledge needed for use outside of the project shall be granted by owners to other partners at preferential conditions and only to the extent needed to enable the use of the project results.

• **Open Access Publishing**: All scientific outcomes will be provided in open access mode. In particular, the 'green' open access model will be used. Every scientific outcome generated in the project will be self-archived in diverse locations: on the project website, on arXiv, on the institution's website or on Research Gate to ensure maximal visibility. The researchers will be instructed to publish only in journals and conferences ensuring self-archiving (green publishers). Exceptions to this policy must be authorized by the Project Management Committee. The authorization to publish in a journal/conference not ensuring self-archiving will be granted only if motivated by reasons of opportunity.

• **Software**: The consortium commits to make all the algorithms developed in the consortium of public domain and to not hide any information that can contribute to the advancement of science. Whenever relevant, high level implementations (e.g. Matlab, ROS implementation) of the algorithms of scientific relevance will be made public through the project website. The software and libraries developed to make the system work (drivers, interface, etc.) will be released as Open-Source software under GNU 3.0 license.

• **Data Set**: Whenever possible, all relevant no confidential data collected (e.g. measurements collected to calibrate the sensing algorithms) will be stored in a database that will be made accessible to the public to encourage further research on the subject.

3.2.5 Standardization Needs Analysis

CANOPIES could help mitigating the effects of the regulatory issue in two ways. First, the Consortium will work towards generating interest in the industry and in the general public concerning the deployment of collaborative robots in PA settings; this will contribute to generate pressure for a quicker release of ISO standards concerning collaborative farming robots. Second, CANOPIES may effectively contribute in providing guidelines for the definition of such ISO standards by sharing the outcome of the research experienced and the "lesson learned" collected over the years of the project execution.

Two regulatory areas will be considered for the standardization analysis as followed:

- One of the most important areas where standardization is needed in order to drive both regulation and certification is in physical human robot interaction (pHRI). An important distinction in pHRI is between direct and indirect pHRI: in the former, the user and the robot are directly in contact (e.g. human hand touching robot's gripper), while in the latter the contact happens indirectly through an intermediate object (e.g. hand-over of a tool between human and robot).

  In order to execute such actions degrees of context awareness are required that will be application specific. In most cases robots will be required to maintain appropriate margins of safety while performing these types of interactive actions. Also, of importance is that users must be able to understand the actions of the robot and intuit its next action correctly. Relevant standards in this context for pHRI ISO 9241-920:2009 and ISO 9241- 910:2011 for tactile and haptic interaction. In the limit a balance may need to be struck between overriding safety requirements and socially acceptable interaction. Humans may need to learn to interact with robots differently to the way they interact with people.

  In the case of Human Robot Safe Interaction (HRSI), spatial constraints such as human-robot distance, velocity, direction, etc. need to be taken into account, both for mobile platforms and static bases with movable extensions (e.g. robotic arms). In general, the use of spaces shared by the robot and the user should be regulated by a set of expected motion behaviors that guarantee safety and effectiveness of the intended interaction. Other interaction modalities may also need to be standardized, particularly in high risk or hazardous environments, for example voice communication,

lights and warning sounds, or particular gestures or graphical displays by the robot. Relevant standards that consider taxonomies of cultural and linguistic adaptability of user requirements (ISO/IEC TR 24785:2009), gesture-based interfaces (ISO/IEC DIS 30113-1 and ISO/IEC CD 30113-11), as well as voice commands (ISO/IEC DIS 30122-1 and ISO/IEC DIS 30122-4) are important. Ergonomics standards related to dialogue principles (ISO 9241-110:20060) could also apply in design of the HRIs. The presence of robots in human centered environments is challenging with regard to safety and mutually comfortable coexistence, particularly such that the latter does not compromise natural human behaviors.

- Over the years several ISO standards have been developed for collaborative robots in industrial settings, see for example ISO/TR 20218-1:2018 "Robotics — Safety design for industrial robot systems — Part 1: End Effectors", and ISO/TR 20218-2:2017 "Robotics — Safety design for industrial robot systems — Part 2: Manual load/unload stations". On the contrary, for what concerns robotics in the context of PA there is only the ISO 11783 standard, which is focused on communication standards for agricultural machines, especially to distribute information between a tractor and implements (agricultural tools) connected to that, and it does not address collaborative aspects.

3.2.6 Final Exploitation Plan

CANOPIES goals are to change and improve the current labor-intensive paradigm to a modern and more sustainable operational model, in such a way to contribute to the innovation of the international sector of table grape cultivation. To achieve this, towards the end of the project, a complete exploitation plan report will be produced.

CANOPIES will represent a first important step towards a novel concept of table-grape farming that will allow us to:

- Ensure constant quality of product supply;
- Achieve significant economic savings on harvesting and pruning costs;
- Cope with a worldwide labor crisis in the fields.

In particular, regarding the first point, CANOPIES precision harvesting will allow to supply a product that perfectly matches customers' needs by systematically following quality specifications provided to the machine; with this new approach it will be possible to increase customer satisfaction and so sales and prices, so avoid rejections or disappointed customers; regarding the second point, the integrated system proposed in CANOPIES will allow savings costs of harvesting, savings on final processing, reducing waste, savings on pruning costs; and finally, regarding the third point CANOPIES will mitigate the difficulty of finding enough seasonal workers specialized in harvesting and pruning and so save crops, while changing the profile of farmworkers into specialized technological users.

3.3 Individual Exploitation Plans

According to Article 28.1 of the GA, each partner of the consortium has to establish a best-efforts commitment to exploit its own results. Taken this into account, and with the idea of increasing the performance of individual results.

Since the very beginning, the initial plan for the exploitation of results at individual level in the initial stages of the project are briefly gathered in this section. Further information about the initial exploitation plan and

strategy at individual level will be provided in the D10.3: Communication, Dissemination and Exploitation Plan.

Università degli Studi Roma Tre (UNIROMA3)

Exploitation Plan: UNIROMA3 is mostly interested in the scientific exploitation of the results of the project and in particular towards the possibility of re-using the methodological outcomes for future and closely related ongoing research and projects. In addition, UNIROMA3 treasuring the experience collected over the years with the research on Robotics for Precision Agriculture among several projects including CANOPIES is considering the possibility to create a regional (Lazio) center of excellence in Robotics and AI for Precision Agriculture, where the experts and stakeholders could be gathered together in order share their knowledge, data and experience and needs. Finally, to benefit from potential valuable research outcomes that could be directly translated into market opportunities the possibility to open a startup will be taken into account as a natural follow-up.

Expected Benefits: UNIROMA3 expected benefit is twofold: i) the scientific outcomes of the project will help increasing the visibility of the University thus paving the way for new funding and research opportunities; ii) the networking generated by the interaction with involved stakeholders and other players within the context of Precision Agriculture will help in finding new job opportunity for the students involved in the project, which for a public university is one of the foundational missions of our organization.

KTH Royal Institute of Technology (KTH)

Exploitation Plan: From a scientific perspective, KTH aims at advancing the theory and applications of Linear Temporal Logic and Signal Temporal Logic in MRC, human-in-the-loop control, and safety in the human-robot shared workspace. Due to the critical application area, it is focused on -Agri-Food-, and the need of bridging these theoretical tools and real-life advances in the field, the contributions of KTH should have a strong impact on the academic community. In the long term, this framework would also facilitate future research lines due to the versatility of these solutions and the interest of the EU and its members on sustainable/efficient food production.

From a societal perspective, our collaborations with industrial partners will accelerate the technology transfer between academia and industry, leading to a faster societal return of investment in both communities. Moreover, we expect that the laboratory will attract and motivate engineering students to become involved in control, planning, and experimentation for agriculture robotics. As an indirect effect of this interest, some positive impact is expected on changing the traditional perspective of agriculture as a low-tech field in which robots will substitute human workers.

Expected Benefits: KTH expects to widen its research scope, and hence, improve its visibility on the application-focused and agriculture academic communities. Thanks to the knowledge acquired in the Agri-Food field, we would also open new possibilities for future research.

Sapienza Università di Roma (UNIROMA1)

Exploitation Plan: The University of Rome “la Sapienza” (UNIROMA1) is a nonprofit organization with three main objectives: achieving excellence in education, consistently producing high impact research results, and using its intellectual and material resources for the contribution to the progress of society at large (a.k.a. third sector). The general expectation for the project CANOPIES is to have a consistent impact on all three

objectives, in different ways. To assure this general goal the initial exploitation plan is refined in the following main components:

- Broadening the impact of research on Precision Agriculture (PA) conducted by this institution: In the last years the DIAG department contributed to the EU funded Flourish project, whose aim was the design and field test of a robotic platform for weed detection and removal. In addition, many researchers acquired experiences in applying computer vision techniques to PA. Building on these experiences, UNIROMA1 plans to expand the reach of the research on PA, expanding both from the side of Agronomy and Computer Science points of view. From the Robotics and Computer Science side, each year starting from the second half of 2021, will have the results of CANOPIES contributed to major Robotics conferences, such as the *IEEE IROS* and *IEEE ICRA* conferences, and to the connected journals (such as *IEEE Robotics and Automation Letters*). At the same time, major results will be extensively discussed in specific A-rank journals, such as *Computers and Electronics in Agriculture*.
  In due time, this project will help to create, together with other academic and industrial partners in the Lazio region, a center of excellence in PA for the whole country.
- Fostering other partnerships with Agricultural sector stakeholders: The visibility that the CANOPIES project will have thanks to the dissemination plans, will help to get in touch with other agricultural stakeholders. In this respect, we consider the industrial partners, but also the regional and national agricultural organizations (e.g. Confagricoltura and Coldiretti), and the general public. This increased network of relationships will help UNIROMA1 to develop new projects and to speed up the technological transfer to the industry.
- Opening other funding opportunities: Since Agriculture is of paramount importance both for the national and European development strategies, there are many funding opportunities for research projects in this area. The first one is the “Programma di Sviluppo Rurale” (PSR) a regional program of agricultural and farm industry development based on European funding. The other funding opportunity is the “Progetti di Rilevante Interesse Nazionale” (PRIN), a prestigious Italian funding mechanism for research institutions. We plan to participate in both these calls for the ensuing years.
- Advancing the experience of the research staff involved in the project and of the students at large: CANOPIES employs two full-time PhD students, one Research Fellows and a Full Professor, and will involve, starting from next year, other PhD students and at least another Postdoctoral Researcher during the four year project timespan. We plan to use the direct involvement of these resources to steer and refine their research skills and to help the research group to have an international impact on the topics of PA and Robotics in Agriculture.
  This new and growing experience will also have an impact on BS and MS students as well. In this respect, it will also be possible to include the topics of computer vision applied to PA in the Computer Vision course and AI for robotics lab thought in both the Bachelor and Master programs at the DIAG.

Expected Benefits: The expected benefits according to the aforementioned plan are:

- **Impact on research:** we expect that the results of the project will allow us to publish at least two works for each ICRA and IROS since 2022. In addition, we plan to extend some of these works to journals, being able to publish one major journal article per year.

- **Partnerships & Funding opportunities:** We expect to be able to participate in the next PSR proposals for the period 2021-27. The participation to the PSR will leverage the newly formed networks and

partnerships created by the CANOPIES project, in particular with agricultural agencies and institutions such as Confagricoltura and Coldiretti.
In addition, we plan to participate in PRIN, where we plan to leverage both the knowledge acquired through the project and the robotic platforms and sensors. In particular, the hardware developed for CANOPIES provides a general-purpose platform for exploring the use of Robotics manipulation and Robotics Vision to different crops and this gives a consistent advantage for the acceptance of the PRIN proposals that UNIROMA1 will present.

- **Advancing the experience of the research staff involved in the project and of the students at large:** The outcomes from CANOPIES will directly contribute to the doctoral training of the PhD students involved, and ultimately to the successful completion of their Doctoral thesis on the topics of efficient fruit segmentation for yield management in one case and Human-Robot Interaction in the agricultural field in the other. Concerning the experienced researcher's staff, the CANOPIES project will grow the experience to publish in high-end cross-topic journals and will increase the skills needed to operate with complex robotic systems using ROS, enhancing the capacities to publish on field robotics journals, and also to attract new collaborations with industrial partners. Finally, with respect to the teaching activities, it will also be possible to include the topics of computer vision applied to PA in the Computer Vision course and AI for robotics lab thought in both the Bachelor and Master programs at the DIAG.

Universitat Politècnica de Catalunya (UPC)

Exploitation Plan: UPC will promote technology transfer from academic research to innovation in industry, looking to support small start-ups, SMEs and big companies by offering access to state-of-the-art experimental facilities, and creating links to established relevant robotics industries to benefit from their expertise and their robotics technologies. UPC will act as a consultant offering these services.

To reach these objectives, UPC gives assistance for entrepreneur, startup creation, services for preparation, advice, and submission of patents and local events, workshops, or talks that can be leveraged to promote CANOPIES project and to foster innovation and engage with industry

Expected Benefits: UPC expects to participate in new innovative proposals not only from EC calls but also from industry, public entities and end users' procurement. CANOPIES project will allow the UPC team to use the methodologies, procedures and outcomes for research purposes and academic courses.

Università degli studi di Cassino e del Lazio Meridionale (UNICLAM)

Exploitation Plan: The exploitation activity will aim at guaranteeing that significant project results survive after the end of the project by: i) using project results in further research activities, which are not covered by the project itself; ii) developing and providing products, processes or services. The main CANOPIES results that immediately UNICLAM will benefit from concerns the manipulation of flexible objects, the human-line dual-arm execution of complex manipulation tasks, human-robot interaction strategies and distributed coordination algorithms. The exploitation plan consists in defining an outcome table containing features of methods/material/product that are the potential outcome of the above activities. Throughout the project, the comparison to the state of the art or to commercial solutions will be continuously refined. Based on the outcome table, application fields shall be selected, most promising areas targeted, and the main corresponding stakeholders individuated. Concerning the research outcome, UNICLAM plans to re-use the

methodological outcomes for future related projects both regional, national and international. Moreover, the robotic group of UNICLAM participating in the CANOPIES project has recently established a spin-off company, Everybotics Srl, with the aim of exploiting research results related to autonomous and collaborative robotics by developing custom solutions and integrated systems to be employed in the industrial sector.

Expected Benefits: The methodologies concerning manipulation of flexible objects, cooperative manipulation in unstructured environments, human-robot-interaction strategies and the related scientific outcome will allow an advancement in the visibility of the research group and of the whole UNICLAM University. The networking fostered by CANOPIES will allow them to apply for new funding and gather new knowledge in Artificial Intelligence related topics that will further allow the advancement of the above topics. Finally, the involvement of students in CANOPIES' related activities will provide new job opportunities for students in the Precision Agriculture field that will be likely hired by the Everybotics Srl spin-off or other interested companies.

Danish Technological Institute (DTI)

Exploitation Plan: Focus on side-stepping the developed components and technologies to other sectors in different scenarios, in particular the multi-robot teams and VR technologies. Examples of those sectors include but not limited to healthcare, construction and logistic robotics. Moreover, the experience gathered on the "robotization" of market ready solutions will benefit the DTI to provide these services to Danish and European companies that either require special robotic solutions (not available in the market) or want to develop a robot from their current product.

Expected Benefits: Generating and transferring knowledge to industry and society through the creation of novel robotic solutions for end-users in numerous domains, consultancy, innovation & business service, and networking & events, and academically through participation in R&D&I projects with industrial and academic partners.

PALEBLUE

Exploitation Plan: From the technical perspective, PaleBlue is advancing the technology for multi-user collaboration and interaction between human and robotic participants in a simulated virtual environment. This technology can further be used in other projects of the company.

PaleBlue will be able to introduce the support of robotic components in its simulation stack.

PaleBlue will be able to include advanced kinematic physics with the goal of developing more complex simulation projects, and to commercialize new features that include feedback in order to calibrate robot behavior.

PaleBlue will interact with other parties in the consortium in order to market the VR simulation solution, developed in the Canopies project, in Precision Agriculture and robotic workshops and/or seminars.

Expected Benefits: PaleBlue simulation platform and company's technology stack will be enhanced with the following:

- Advancing hand interaction for human VR participants.
- Advancing kinematic physics engine for improving the capabilities of modeling and simulating the physical interactions.

- Improving robotic modelling capabilities.
- Advancing technology in the multiplayer interaction.
- Wide range of sensors used in the virtual environment.
- The company is also advancing the competence of virtualizing different sensors related to different applications, like navigation, human interaction and perception, and agronomic perception.
- PaleBlue will be able to establish services for a customer base, within testing of Robot Operating System (ROS) in collaborative environments and to calibrate robot behavior through feedback from users.

Pal Robotics (PAL)

Exploitation Plan: In CANOPIES, PAL wants to further advance its manipulator platform and develop a product in a new niche that will create opportunities in worldwide markets in the agricultural segment, especially in agronomic manipulation where market ready solutions are scarce. New opportunities will be also enhanced by the occasion to create a version of the upper-body of their robot that is standalone, independent by the base, that can be mounted on several mobile bases. This covers market segments that are beyond PAL's current portfolio like the agricultural field. Using this project PAL will perform alterations in the mechanical design of their original robot in order to increase its capabilities, i.e., for the upper-body to have a torque sensor in each joint of the arm, adding two DOFs in the base of the torso for rotation and height and improving the IP rating. This will allow us to operate in compliant control, making it safer for users to share the same environment of the robot. This design will prevent the exert of any high forces against a person or obstacles, which is a very important asset in several fields of application, such as healthcare, retail, agile manufacturing, among others. The agronomically adapted dual arm design will be accompanied by custom gripper designs that will allow the execution of the harvesting and pruning tasks.

Here Fig.2, you can see the concept of these robots used in a vineyard environment for harvesting and pruning tasks that is the final goal of the project to demonstrate the CANOPIES approach and robots in a real agricultural environment.

Figure 2 – Robots in vineyard environment

PAL will take part in the economic exploitation of the results of this project by producing a new line of robots equipped with dedicated grippers. PAL will constantly investigate the exploitation potential of the proposed outcomes (overall and partial results) along with the duration of the project, with the main objective of integrating these results in other robots of the Company. PAL is both interested in the exploitation of the overall project outcome, together with other partners of the project and in accordance with the IPR defined during the project, and also for other components and constituent technologies that will result from the project. PAL is interested in the operation of the generated outcome (robot platform and software applications) in end-user set-up to gather relevant end-user feedback to prepare a comprehensive business plan. PAL steps to get from research results to successful marketing are 'business as usual': (a) market research among potential buyers to determine functional requirements and acceptable price levels, (b) desk research into existing products and competitive developments, (c) engineering, to proceed from the research prototypes towards a software application ready for release, including functional and usability testing and (d) marketing communication, sales, distribution, and after-sales support.

Internal exploitation activities for PAL will include regular meetings with the other PAL Robotics business units and managers to show the case studies and the methodology applied within the project, highlighting the possible benefits coming from the approach and technologies developed for the project. The field validations will be useful to get the possibility to execute more tests for our platform in complex environments including the presence of humans, that is the basis of the targeted PAL roadmap for service robots. We would like to put forward the effort that we started in other fields and bring it to the agriculture sector and focus on commercializing our robots making easier their use in an unpredictable outdoor environment. In order to achieve this, we foresee a market analysis that will be done to define, characterize and segment the potential opportunities for different solutions developed in the project, as well as describe the value chains serving each technology. We will carry out a feasibility study in order to assess the pros and cons of different aspects of the commercialization of the developed technology. Preliminary business models will be identified taking into account the outcomes of the market analysis and the identified new value chains. We also will study the possibility to extend the tests to the real-world environment with different scenarios as well as other potential applications so as to ensure full functionality of all features of the technology.
Moreover, work will be done in CANOPIES to improve the perceptual sensors used to extend the robotic platform performances to perform outdoor tasks where sunlight, shadows and partial occlusions can make them difficult to work well. The study of the use of extra devices like a light to work in night or dark conditions, a wrist camera for fine manipulation and so on will also be conducted, to improve the execution performances for the precise agriculture tasks.

Expected Benefits:

According to Statista; notably, by 2025, the global agricultural robots' market is expected to grow to around 18.5Bn €, for which PAL is eager to become a leading actor. Furthermore, even though outdoor applications in agriculture are surely very challenging, we expect that CANOPIES results could be also applied in other urban markets, e.g., smart cities for which the forecast of the global market 4 will grow from 480Bn € in 2015 to 3,100Bn € by 2026, thus creating another great business opportunity for PAL.

This project would give PAL Robotics the possibility to explore and approach totally new markets, considering that we will be developing a robotic solution for outdoor applications, which is currently not available in our commercial portfolio of products.

The new designed robot improvement will allow PAL to better market its products to potential clients and allow for internal improvements on existing products unrelated to the CANOPIES project. All of this will inevitably lead to a growth in sales, as improved capabilities provide a broader market and allows for word-of-mouth marketing to be more effective.

For what concerns the economic exploitation, the industrial partners PAL will benefit from the knowledge and technological development gained during the project to propose new products and services in the fast-growing agriculture market. More specifically PAL, intends to expand its large experience in the development of cobots and robots in general, in design and develop advanced manipulators, humanoid robots and human-robot interaction algorithms.

Agrimessina

Exploitation Plan: Agrimessina is interested in both social and economic exploitation. In the high labor demand industry of table grapes, the worldwide shortage of workers is already threatening the whole production of many countries where farmers are not able to find enough skilled people to pick ripe fruit. Also, the new generation of farmers is not willing to work in the fields as their predecessors and are much more willing to use new technologies and Precision Agriculture. According to this the economic exploitation of Canopies will be a great opportunity to explore the fast-growing sector of the PA; cooperating with other industrial partners Agrimessina would like to develop the achievements of CANOPIES into a real robot to implement in its own fields and to distribute through its partners in the most interesting countries for table grapes.

Expected Benefits: Agrimessina expected benefits are increasing company visibility through articles and publications and developing its network in the Precision Agriculture field to explore partnership and business opportunities.

3.4 Conclusions

This document serves as an initial version for the exploitation plan of the CANOPIES consortium members. This exploitation plan highlights how PPs will exploit the CANOPIES results to the target group identified. It is drafted in the M3 of the project.

At this point of the project, the plan identifies an overall exploitation strategy for CANOPIES, and reports the individual strategy of each project partner. In order to ensure the sustainability of the project this exploitation plan will be updated taking into consideration dissemination and communication plan. Thanks to a strong collaboration among project partners' results will be shared to several target groups allowing to reach a wider number of beneficiaries.

The overall exploitation and individual exploitation plans will be adapted and refined at the end of the project (M48) according to the progress of the project.

The community developed and synergies created will allow visibility to projects services and values that CANOPIES Project Partners will actively communicate. To this end, all Project Partners will share information with their network to ensure the well-implementation of the plan described in the present document.

4 Appendix

Question:

In the exploitation plan, an analysis of the investment freedom of the farmers is missing. The replacement of manual labor gives a total amount of money available for purchasing the robotic system, which determines the price of the system and also the level of high tech possible.

Reply:

Following the Reviewers request, only a limited set of information can be provided because of the actual state of the art of the project implementation. Furthermore, the following conditions, which apply to CANOPIES, must be considered:

- *The final output of the project, as far as the robotic platform is concerned, is to deliver a TRL 5/6 prototype, thus, not to be considered as system prototype to be tested in a real operational environment.*
- *The above robotic platform to be developed by project's beneficiary PAL Robotics is to be considered as a very first release, being it a new of the kind. More specifically this new platform will represent a thoroughly innovative product if compared with the standard items currently included in PAL Robotics products available for the market.*
- *As stated in the Annex I to the GA, the development of this new prototype represents indeed a pivotal aspect of the exploitation plan for targeting novel business sectors, such as precision agriculture, while at the same time introducing a technological breakthrough to improve the current robotics solutions of the Company portfolio.*

Given the above, the Consortium has collected, by consulting the relevant Beneficiaries, some data to be shared with the Reviewer, namely focused on the harvesting task. More specifically, beneficiary AGRIMESSINA has carried out an internal survey to compute the actual costs to be sustained to carry out the typical agronomic tasks that are expected to be eventually implemented by the robotic platform in collaboration with the human workers.

Manpower		
Description	**Qt.**	**[Unit]**
Representative size of the vineyard	1,00	Ha
Average Yield / Ha	30.000	Kg/Ha
Average Harvested Kg / Work Hours	75	Harvested Kg / Work Hours
Total Work Hours / Ha	400	Work Hours
Hourly Rate Labor Work	10,31	€/Hours
Total Cost Harvesting / Ha	4.124	€/Ha
Average Time Ripe Fruit Can Hang on the Vine	240	Hours

Given the final TRL 5/6 delivered prototype, data and metrics relating to the platform's actual structural capabilities, performance level and reliability will be only estimated at the final stage of the project's activities. This will de facto prevent the Consortium from providing a sound analysis to size the convenience for the farmer to start investing in the purchase of the robotic platform to use it to assist the manual labor as per the CANOPIES Vision.