# D1.2: Robotics-related Technologies Mapping for application in the Agri-Food sector

## WP1 – Competence Centers and Technical Expertise Management

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# Executive Summary

This deliverable takes the reader through our efforts to collect, analyse and map data about various available and upcoming European robotic technologies applicable to the agri-food sector, as described in Task 1.1. The intent of creating this catalogue is to promote robot deployment in agri-food and to create better solutions with improved flexibility and effectiveness, better interfacing, standardization, etc., and all for a lower purchase price.

This is the second version of this deliverable. Version 1 described our attempt to collect data using an interactive PDF and questionnaire, sent out to the agROBOfood network in Spring 2020. The 39 agROBOfood partner organisations come from 14 countries and each partner is acting as the main contact point for agri-food robotics in its region. Only 16 replies were received and several of these were rather generic.

A new ontology was designed, and a new method of encouraging entries was devised, notably creating an online survey in several languages, and bootstrapping some of the content via internet searches. This work was completed, and the new survey was sent out in June 2021 in nine languages: Danish, English, French, German, Greek, Italian, Polish, Serbian, and Spanish. A total of 126 technologies were entered into the catalogue, including 42 extensive replies to the survey with relevant details for analysis.

The analysis of the survey results shows that 50% of the responses come from organisations based in countries whose language was a survey language. It is unclear whether this was due to the ease of replying in people's local language or whether the agROBOfood hubs in those countries were just more active. Ten countries are represented, eight from the EU27, and from the United Kingdom and Norway. 93% of the replies were from tech developers and 7% from distributors. By far the most replies (84%) advertised agricultural robots, which is seemingly a fair representation of the use of robots across the agri-food spectrum. 35% advertised upcoming technologies that are not yet commercially available, but all the technologies are expected to be available by the end of 2023.

The 126 technologies have been organised to create an online catalogue. We are promoting this catalogue throughout the agROBOfood network, Basecamp and when opportunities arise (e.g., at professional trade fairs and events, at academic conferences and workshops, and as part of relevant courses). We hope that organisations with similar technologies will be inspired to get their entry as the catalogue becomes more visible.

Link: https://agrobofood.eu/agricultural-robotics-a-european-catalogue/

The main aim is to make it easy for agROBOfood hubs to know what is available and to be able to answer agri-food automation inquiries from their local ecosystem.

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# Introduction

***Task 1.1: Mapping of robotic technologies and competencies in the Agri-food sector***
*(Leader: DTI; Participants: TUD, FhG, Eurocat, JR; Duration: M01-M36)*

*This task will map actual robotic technologies available in the Agri-Food sector, as well as potential ones from the robotic community in other sectors that could be applied within the agri- and food sector (e.g. manufacturing, including connecting to the agile manufacturing DIH network). The objective is to map relevant technologies for their maturity, expected development, and potential to benefit the Agri-Food domain. Moreover, knowledge on interfacing, re-use, and standardization will be included, as this is a very important issue to facilitate the creation of real and improved solutions.*

*A report detailing new technologies and innovations would be disseminated to DIHs and CCs in the established network. A short version of these reports will also be posted on the project portal.*

***D1.1: Robotics-related Technologies Mapping for application in the Agri-Food sector***
***D1.2: Robotics-related Technologies in the Agri-Food sector (an update) and additional potential for innovation***

## Purpose

The intent with mapping available technologies in the agri-food sector is to promote robot deployment and ultimately, to create better solutions with improved flexibility and effectiveness, better interfacing, standardization, etc., and all for a lower purchase price. The scope of the technology map that we want to build includes robot solutions for all aspects of agri-food from planning and production through processing, packing, and transportation and up to the food being served at the table. It includes technologies that are already commercially available and those expected to become market-ready over the next two years. It does not include lower Technology Readiness Levels (TRLs).

Initially, we foresee consortium partners using this catalogue to find suitable robots for their work and suitable partners for future research collaborations. The catalogue is now (October 2021) publicly visible, and its website will hopefully become a go-to site for information about agri-food robotics. End users, systems integrators, and organisations offering consultancy can use the technology map to find the best system for their customers' needs; tech developers can use it to see what can be purchased instead of developed.

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# Background

## First report

The data collection for our first report (D1.1, May 2020) was based on a survey in PDF format because it could be nicely formatted and kept to two pages. Keywords were selected to be relevant and comprehensive. The survey was supplied in English only and emailed to the 143 people on the Basecamp communication portal used by agROBOfood. In addition, some partners forwarded the survey to external contacts. The survey was sent out in February 2020 with reminders sent in March and April 2020.

Disappointingly, only 16 replies were received, nine of which came via the five RTOs responsible for the deliverable. 12 tech developer companies were represented and 10 of these were not directly connected to agROBOfood. Of the 12, six were large enterprises (AEF, CLAAS, Continental, Fendt, BA systems, and Veris), two were SMEs, three were start-ups and one was unknown.

Descriptions of the 16 technologies showed that 6 were for arable (field) technologies, two were livestock, one was for food preparation (low-TRL), four were fairly generic ideas suggesting technology side-stepping from the industrial domain, two were about data security and certification, and the last one recommended ROS for prototyping.

## Lessons learned

In D1.1 we suggested several ways of increasing the number of responses:

1. Improve the survey so that only relevant replies are collected
   a) Narrowing the scope so that only mature technologies are accepted
   b) Narrowing the scope away from general technologies to focus on complete robot systems
   c) Widening the scope to ensure that all relevant robots are included
   d) Asking the consortium what types of information they would like us to collect
   e) Consider the JRC keyword selection
2. Bootstrapping the catalogue entries
   a) Contact university partners asking for their literature reviews, to create an initial list of European agrifood robots
   b) Search the internet for commercially available agrifood robot
3. Dissemination and advertising
   a) Make the survey more visually attractive. Add branding
   b) Translate the survey into local languages, to remove a barrier to replying
   c) Make the catalogue publicly visible to incentivize tech developers to reply
   d) Remind partners that the survey is meant for their ecosystem to fill out, not primarily for them to fill out themselves.
   e) Presenting the catalogue at trade fairs such as GreenTech (NL) and Salon International de l'Agriculture (FR)
   f) “A serious communication effort will encourage tech providers to advertise their products on this [catalogue] site”
4. Discussing our proposed improvements with the project coordinator and agROBOfood steering group

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# Methodology

From D1.1. we changed the survey to an online format to create higher attractiveness and to make it as easy as possible to fill out. Additionally, to increase the relevance of data output the scope of the technology mapping process was narrowed to robotics systems with an TRL 6+.

The following definition was displayed at the survey's frontpage and used to scope the technology entries:

> Agri-food: anything involved in the processes that result in human food ready to be eaten, from soil preparation through plants (through fodder and animal care) through "harvesting" and raw preparation through cooking and shops to dining table
>
> Robot: a machine programmed by computer, that:
>
> Reliably* performs complex physical action in the real world
>
> Automatically adjusts at some of its actions according to sensor input
>
> * Reliable: can work as intended for as many hours as needed with only vary rare stops for unscheduled maintenance. In practice, this means that robots that are already commercially available or nearly so, e.g., in field trials

The Joint Research Centre (JRC) datasets (https://data.jrc.ec.europa.eu/) were investigated in the keyword selection of the survey.

In order to bootstrap the catalogue, extra manpower was allocated for internet search and for contact initiation with DIHs and entities beyond the agROBOfood network. These contacts were identified as knowledgeable of relevant technology systems and to encourage companies and DIHs to partake in the European catalogue. To ensure technology coverage, a high level of detail and to validate the search results all contact points were asked to participate in the survey and further distribute the survey in their network.

More action points were incorporated in the process, as described below in the walk-through of the methodology used.

## Bootstrapping

During February-May 2021 DTI searched the internet for European agri-food robots and collected URLs, contact information, and some information about the types of tasks these robots could do and their capabilities. Approximately 120 robots were found that were mature enough to be included in the catalogue. This information was used to guide the survey design and to define boundaries regarding the survey scope. The technology developers were contacted directly via e-mail and invited to provide more information about their products.

The agROBOfood partners and associated members that publish papers (e.g. FhG and WUR) were asked to add robots to the catalogue from relevant, recent literature reviews.

Several universities (three Danish universities, two German, three Swedish, and one Dutch) were contacted as a mediator for further dissemination and contact initiation with emerging technologies developed by researcher and/or start-ups. To further the identification of start-ups besides internet

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search we reached out to several innovation clusters scattered across Europe and asked if they could share the survey within their network.

## New survey design

An ontology for agri-food robots was developed during May-June 2020 (see appendix A) and used to inform the survey structure. This ontology was sent out for internal review and expanded considerably. When we received the reviewers' evaluation of D1.1, we also examined the JRC keywords, but most of them were already included in the new ontology.

A new survey push began in April 2021 with the initial results of the internet search. We decided that representing the whole ontology in survey questions would make a survey that was too heavy and take too long to fill in, so people would not do it. During the redesign phase, we realised that interested parties could collect most of this information from the robot website, once they had identified an interesting robot – and since all the technologies are supposed to be commercially available or nearly so, we could reasonably expect that all the technologies had a related webpage describing their main characteristics. We, therefore, reviewed the questions and sent them out for review again. Of course, reviewers wanted more information about their areas of interest, but we decided they could fetch most of this from the robot developers themselves when they needed this information.

We put the most important basic information on the first few pages so that partial replies would still contain the most useful information.

## Survey software and trial run

We were determined to translate the survey into various European languages to remove one of the barriers that make surveys harder to fill in (see appendix B for the exported survey questions and translations). We started with English and Danish (since DTI was doing the work). This immediately raised the question of how the different-language surveys were to be combined, as the information should be pooled to create a Europe-wide picture. SurveyXact (online survey software offered by ramboll) was suggested, as this allows for identical surveys in different languages to be treated as the same survey. So, all the checkbox information can be analysed automatically, and only free-text boxes need manual attention.

A SurveyXact license was purchased, and the questions were entered. This Danish/English combo was sent to DTI's agROBOfood ecosystem as a test case, with the option for respondents to comment on the survey itself.

The first version of the survey was published on the Danish market and 11 replies were received. Only five completed every question, and another 4 were at least 75% complete. Only three commented on the survey itself. Minor edits were made to a couple of questions and then the survey was considered ready for translation and release.

The catalogue entries were made for these Danish replies. Two of these catalogue entries was selected to be sent around with the survey link, to show what the catalogue would look like (see Figure 1). Since SurveyXact does not allow pictures to be uploaded, the pictures will have to be uploaded manually for future entries also.

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*Figure 1 – Advertising page based on responses gathered from the DTI network.*

Based on this preliminary visualization of the European catalogue, the number of fully completed survey responses increased by approximately 37%.

## Translation

We reached out to the partners on BaseCamp (communication platform for the agROBOfood platform) for volunteers to translate the survey into their native languages. We also leaned on DTI staff with other language backgrounds. This resulted in eight languages -- Danish, English, French, Greek, Italian, Polish, Serbian, and Spanish. We felt that German was also needed (as a major European language) and this was added to the survey as well.

The final survey can be found at: https://www.survey-xact.dk/LinkCollector?key=6CY3K6XPJ692

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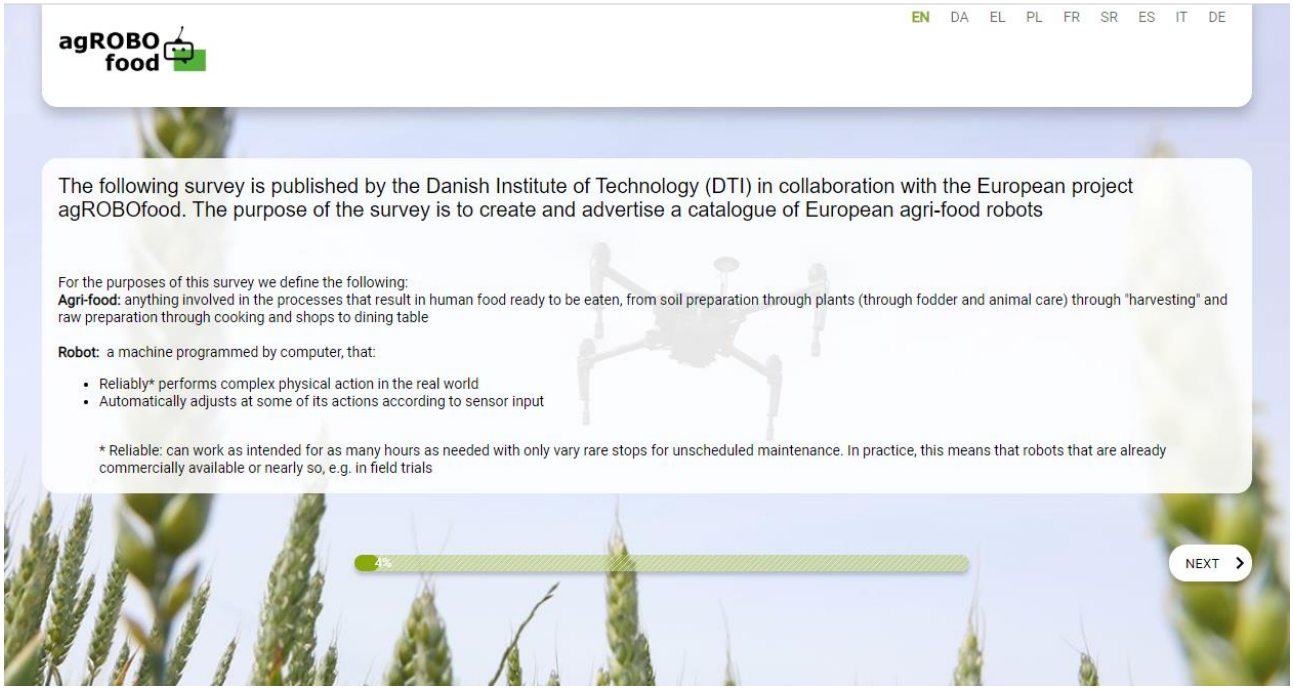


*Figure 2 - front page of v2 survey (EN)*

## Dissemination of the survey

The new survey was distributed via email to agROBOfood members (194 members) in June 2021 and sent by personal email to approximately 130 tech developing companies identified via internet search. The message included the two example catalogue entries and asked people to pass the survey on to their local tech developers.

The survey was advertised on DTI's website in May 2021 (for the trial run) both in English[1] and Danish[2]. The catalogue and survey were advertised in the agROBOfood newsletter[3] in July 2021. DTI has 6,000 monthly subscribers to their newsletter, and agROBOfood has approximately 1,000 which would provide a high reach potential. The agROBOfood newsletter article about the survey got in total 101 views. Furthermore, each partner organisation was asked to advertise the catalogue and the survey on their websites and within their network.

Reminders were sent out in August and twice in September via BaseCamp and email. The second reminder contained all collected responses at that point, which were presented in a first draft of the catalogue (European catalogue v1). The first draft of the catalogue contained a total of 28 robotic systems and additional robotic technologies.

Similar to the illustration shown in Figure 1, the first version of the European catalogue increased awareness about the catalogue. The result was approximately 46% increase in survey participation. Hereof, several companies contacted us to give feedback on the catalogue, asked where to sign up for the agROBOfood network, or to confirm that they had completed the survey.

Additionally, two companies sent links of where to find high-quality pictures of their robotic solution to be included in the catalogue.

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[1] LINK: DTI Newsletter

[2] LINK: DTI Newsletter Danish

[3] LINK: agROBOfood newsletter

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# Results and discussion

A total of 126 robotic technologies and systems were identified for the catalogue. 33 of the identified system owners chose to provide further information (of one or more of their solutions) via survey participation and directly added 38 detailed robotics entries.

Before diving into the results, it is essential to discuss the data gathering process to understand the disposition of the data:

### Internet research process

Even though 126 robots were identified and included during bootstrapping, it is highly likely that not all available robotic systems on the European market were identified in this manner. The technical information might not be available online for emerging systems and some systems might not be searchable with English keywords. Internet search algorithms include geographical location of where the search originated when presenting results. To improve the bootstrapping coverage, more agROBOfood partners should have been involved from different regions and languages.

To overcome the challenge of reaching the emerging systems, several universities, start-up hubs, and robotic clusters were contacted for additional information (see *Methodology* > *Bootstrapping* above). This initiative did not yield the expected amount of data, although we did gain information about three additional tech developers.

The scope of the search was highly orientated towards “traditional” agri-robotics in the sense of autonomous machinery for crop cultivation and soil management, which is also noticeable in the data collection. However, solutions across the field-to-table supply chain were included as well. The idea was to use the technology owners as entry opportunities hereby as granting access to the network with that specific industry.

### Survey distribution process

The distribution of the second version of the survey was done more proactively compared to D1.1, this time with a direct personal email and direct contact with relevant companies, by advocating the benefits of survey participation while communicating visually what the participation output would look like by sending out drafts of the catalogue.

Direct contact with tech developers had a positive effect on the level of responses and increased the interaction between us and the technology owners. Roughly 65% of the responses were gathered as a result of direct contact with companies. Reflecting upon why only 33 chose to provide additional information, the risk of “being lost in transaction” is the most obvious. Most of the direct email to the companies was sent to their “info”-email and might not have reached the intended recipient. To avoid this, more personal emails distributed through network contacts would be preferable to increase survey participation in the future.

When disseminating the survey, everybody was encouraged to share it within their network. The previous agreement of every agROBOfood partner having to share the survey to at least 2 recipients within their network, was still current for this second distribution. Based on the survey results, we cannot conclude that network sharing was performed to the extent intended. It is not possible to determine if the survey was not distributed, or the recipients were not interested.

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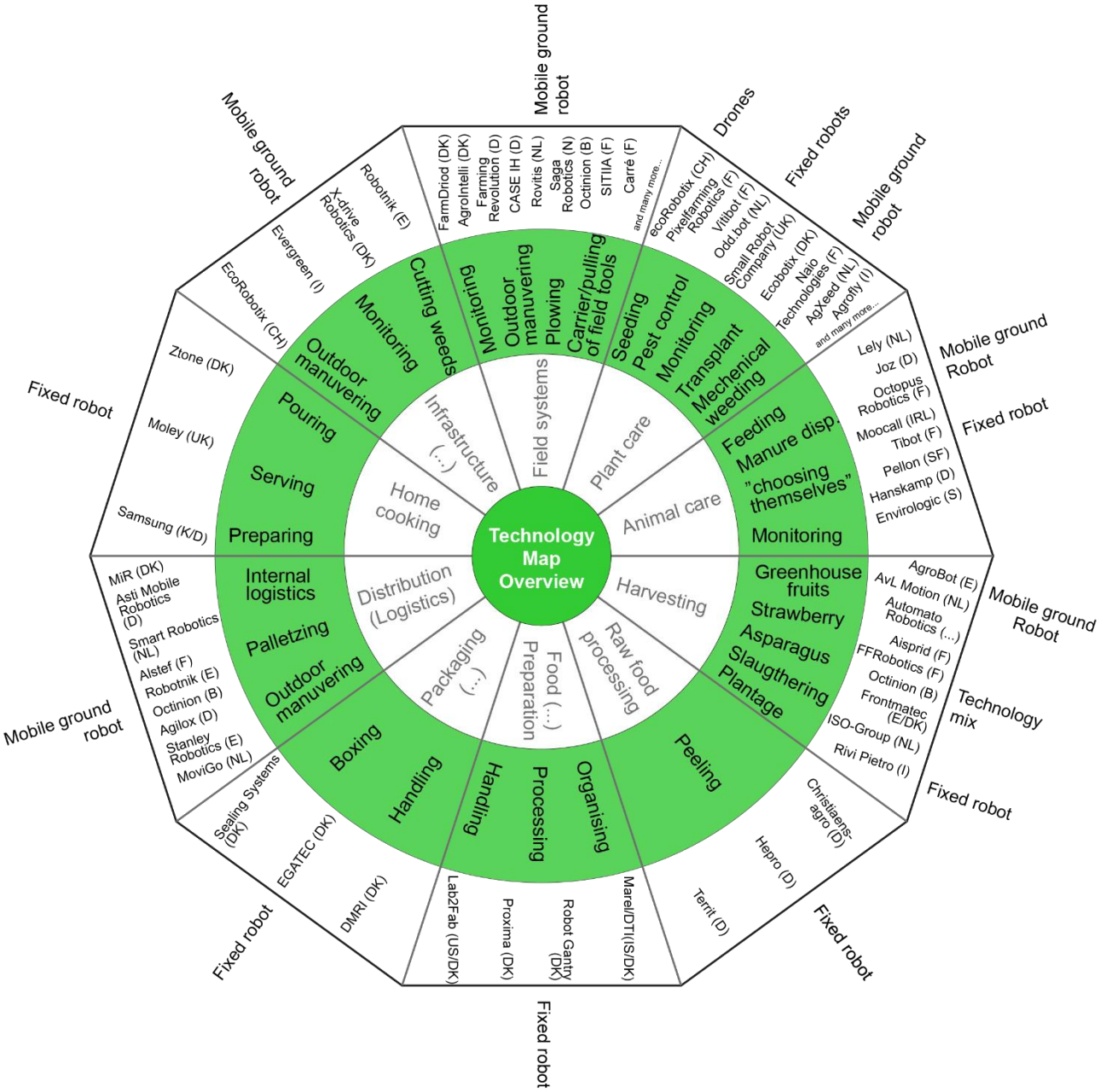
# Catalogue with 126 technologies for Technology Map

The following map is used to summarise our findings in a simple overview, providing the main applications, sub-application categorizes, companies, and lastly the technology types within the field of application (see fig. 3. The full detailed list can be found in the catalogue (Appendix C).




Other:

| | |
|---|---|
| Cleaning of production facilities; Zenzoe( D) | Support to manual labour; Comau (I) |
| Multi application AGV; Acrobat (P) | Chicken picker; Farm Robotics and Automation (E) |
| Autonomous monitoring of sea; Martime Robotics (S) | Automation for vertical farming; Codema (NL) |

*Figure 3 - Complied Technology map of European Agri-robotic systems*

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From the robots identified we find that a higher percentage of the robotics are used for plant care, logistics, and fieldwork. Nonetheless, the statistical distribution of robotics covering the various applications areas is scattered. This implies that robots have been implemented or will be implemented across the agricultural supply chain within the near future.

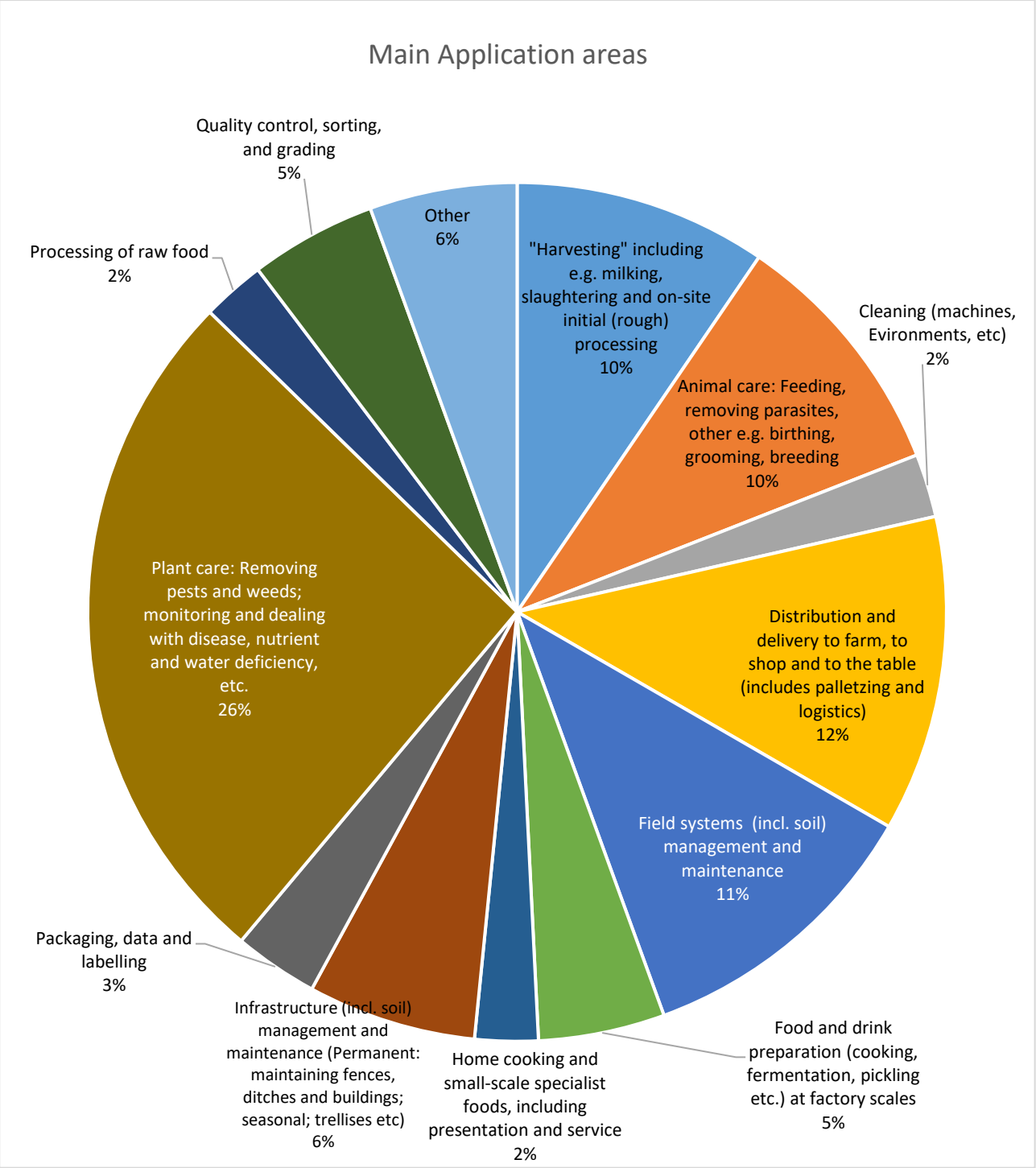


*Figure 4 - Application areas for identified robotic systems in European catalogue v2*

Further exhaustive reach through networks would however create a higher statistical significance, which is not possible at this stage without validation from survey participation.

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From the robots identified we find that 58% of the agricultural robots are mobile ground robots The second technology type categorized is fixed robotics systems (27%) and so forth (see Figure 5). The "Other" robotics category covers technology solutions such as automated tools dragged by tractors, exoskeletons, automated frying pan systems, and ceiling-suspended systems on rails for poultry welfare monitoring.

All the robotic systems used for Fieldwork, infrastructure management, logistics and cleaning tasks goes into the *mobile ground robot* category. Eight out of 12 harvesting robots are mobile ground robot technologies as well – likewise, we see 8 out of 12 animal care technologies within the same technology type.

For plant care applications we find that 20 out of 33 technologies are mobile ground robots. Out of these 20 robot solutions for plant care, 15 are used for mechanical weeding and the remaining five outdoor plant care robots are used for monitoring and/or pest control. Pest control solutions like BugVac and Ecobotix have furthermore found a sustainable approach to this without the use of pesticides.

For Food preparation, Packaging, Processing of raw food, and quality control applications, fixed robots are commonly used in a production facility set-up. Fixed robotic systems occurred less frequently in harvest (three out of 12), animal care (three out of 12), and plant care (4 out of 33) applications. Most of the fixed systems used for plant care are owned by ISO-group, which specializes in high-tech solutions for horticulture.

Considering the animal care category, we find Lely to be one of the leading providers of autonomous solutions for beef/dairy production.

Within animal care for poultry, we find several French tech developers, which have developed mobile ground solutions, like Tibot Spoutnic, to improve the indoor climate with the goal of reducing the occurrences diseases and stimulate a higher egg-laying rate. For pork solutions, autonomous feeders, mobile cleaning robotics, and mobile platforms for moving/transport of pigs were found. Pork solutions were often coming from Denmark and Germany.

Every Aerial/flying system (also covered by the term: Drones) – corresponding to 5% of the robotic systems (see Figure 5) - is used for plant care for monitoring and pest control where four out of six are equipped with spraying tools for pesticides. A majority of these solutions are applied in vineyards or for strawberry cultivation.

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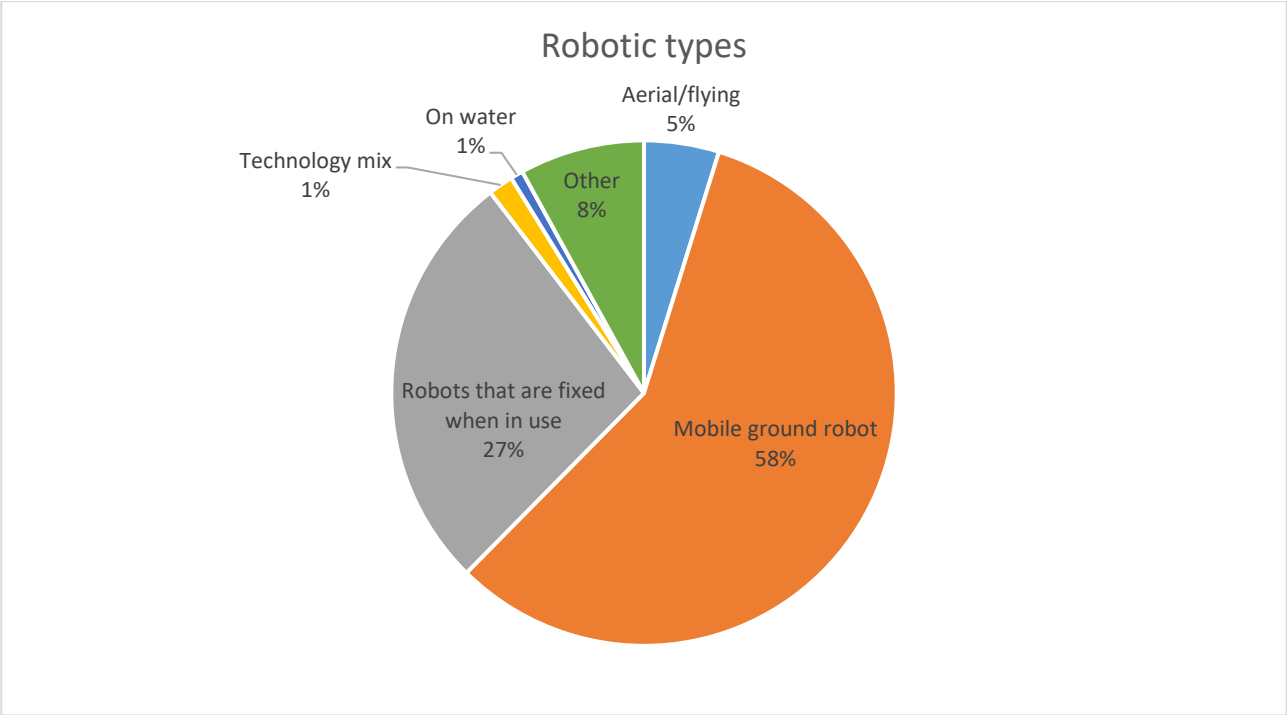


*Figure 5 - Type of robotics included in the European agri-robotics catalogue*

## Analysis of survey results

Most of the survey responses originated from the bootstrapping process of scouting the internet for tech developers.

Figure 6 shows the overall rate of participation. The value of 187 surveys distributed is a lower bound, as the SuveyXact software counts one “distribution” as one sharing of the link, whereas the number of people with access to the link is expected to be higher due to sharing the survey in newsletters and network distributions which is often done by forwarding the link by e-mail rather than via SurveyXact.

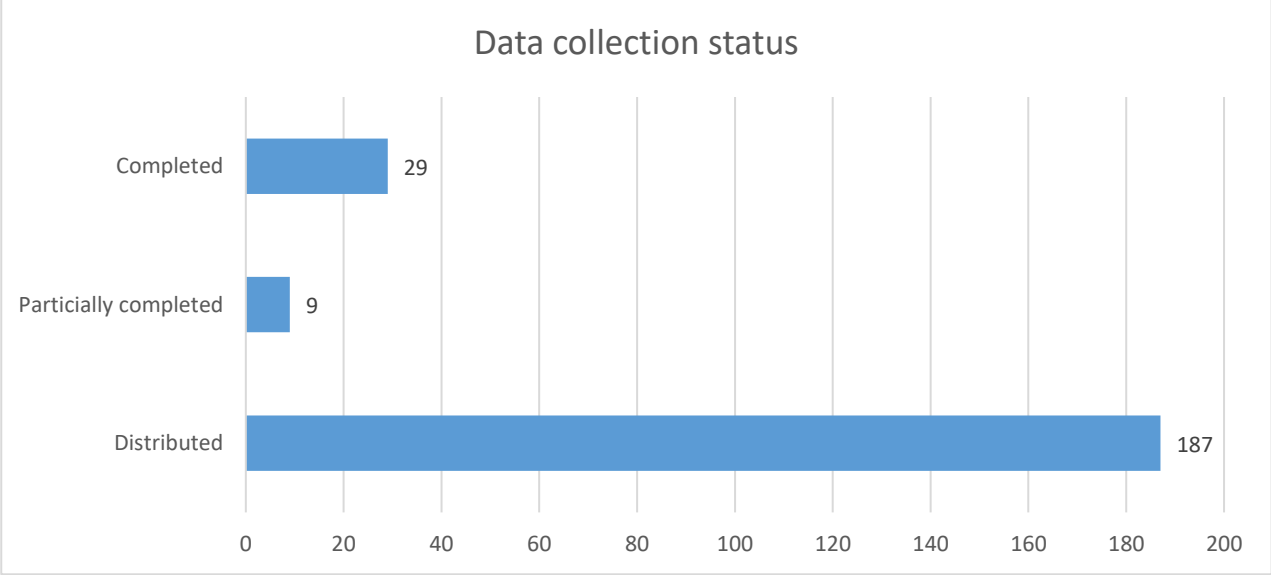


*Figure 6 - Survey status including partially completed entries*

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## Respondent category

93% of the respondents were technology developers, due to the direct contact based on internet research. The tech developers were presented with the catalogue as an opportunity for them to promote their technologies or upcoming solutions to the agROBOfood ecosystem, other potential collaboration partners, and end-users.

Regarding the nationalities of the replies, we see that the largest response (25%) came from Denmark (see figure 7). This is most likely due to DTI being responsible for the survey so pushing it hard through their ecosystem. Spain (22%) and France (19%) also provided several responses, perhaps because they are large countries with strong agricultural industries. 31% of the respondents

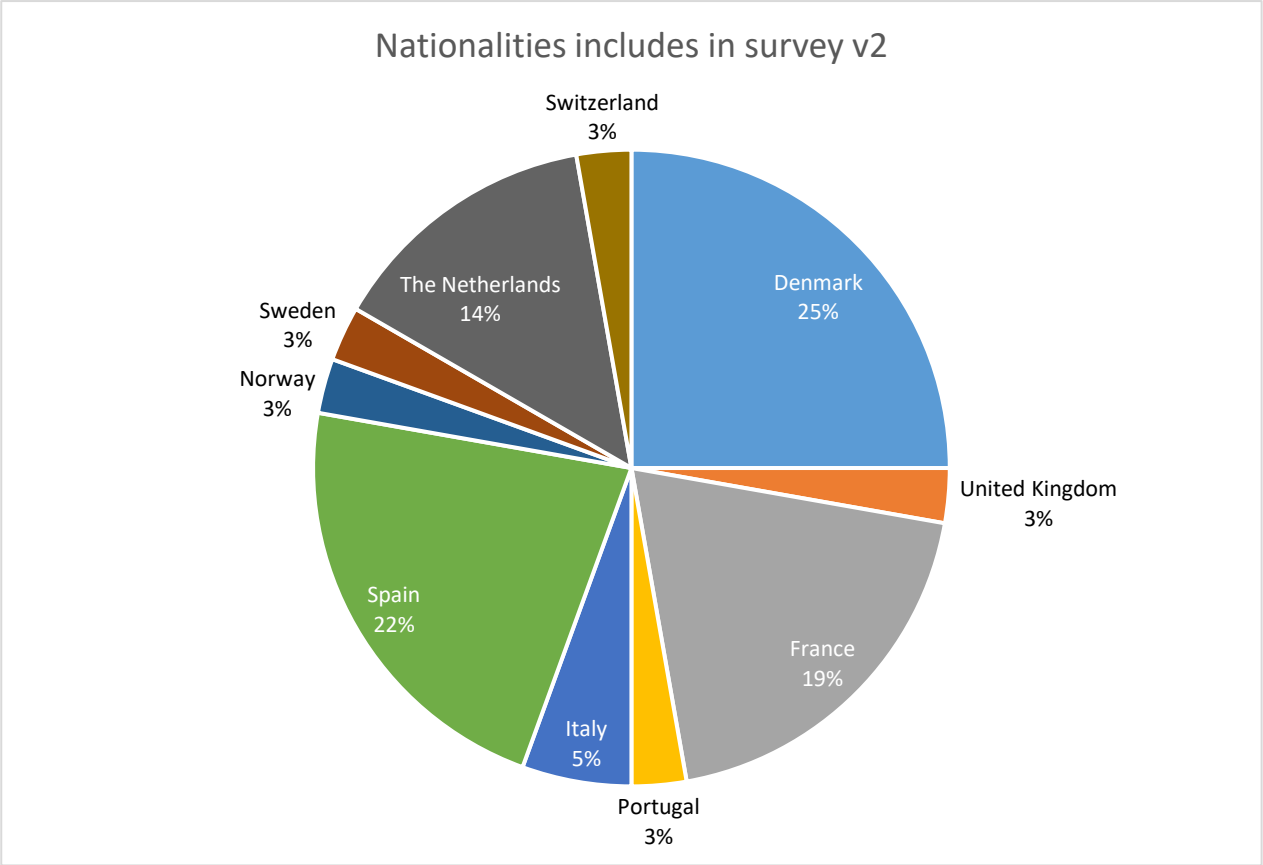


*Figure 7 – Nationality of survey entries*

come from the southern part of Europe (Italy, Portugal, and Spain combined). The absence of responses from Eastern Europe (EU-13) is noticeable, but perhaps not surprising as agROBOfood only has two partners from the EU-13 countries and these countries was neither found to have many robotics solutions in the internet search. The fact that no responses from Germany were registered is however surprising. Germany is a large country and has an extensive assortment of both agri-food robotics and robotics in general.

When analysing nationality distribution, language selection and survey entries, we see that most respondents chose their language when answering the survey – presented in percentages the distribution is as follows:

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- 58% of the respondent chose their language
- 20% did not choose their language
- 22% did not have their language as a translation option

Most respondents who did not choose their language chose English instead. This primarily corresponds to respondents from the Scandinavian area. Every respondent who did not have their language as an option chose to answer in English as well.

### Analysis of survey responses

Listed in the ontology (see appendix A) a criterion for entry was a minimum TRL level of 6 and/or that the robotic systems are expected to be in full trials within 2 years and available commercially within 4. Of the replies, 65% of the solutions have completed the market launch, where 35% of the robots are in the late prototyping stage with expected market realisation within the next 3 years (Figure 8).

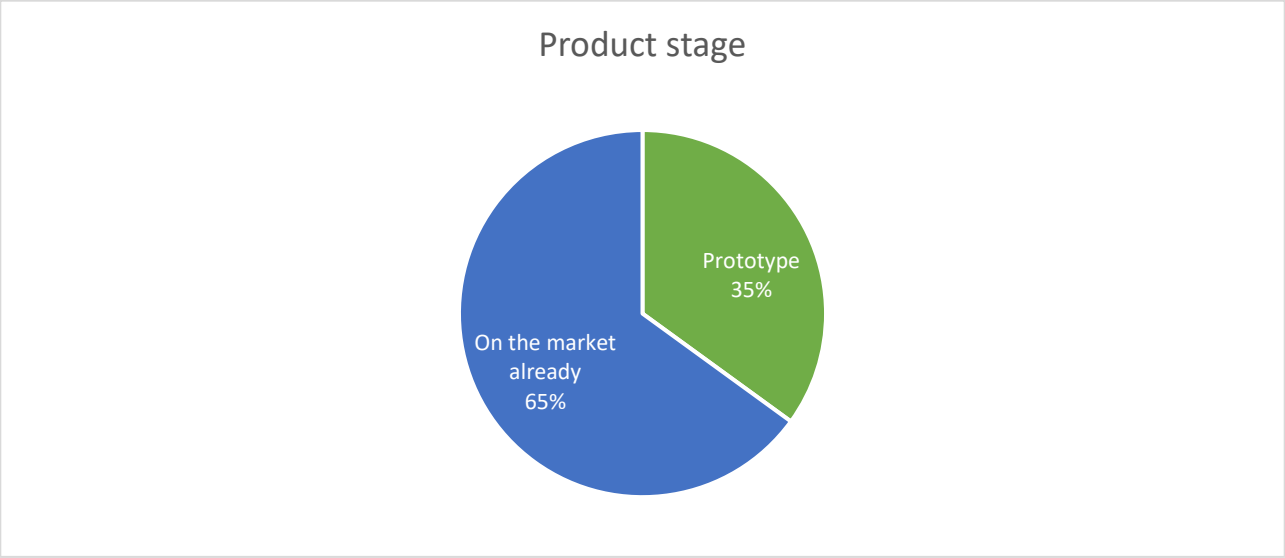


*Figure 8 - Answer distribution of question s_2*

This shows that the new scoping worked because all responses were relevant according to the criteria set agROBOfood, and the choice of questions (which included several close-to-market questions) probably helped.

### Technology specification

Diving into the technical specifications of the robotics entries of the survey, we find that 54% of the 38 robotic systems are completely autonomous and do not require interaction nor assistance from human operators while operating (see Figure 9).

90% of the robots used for plant care use visual sensors to navigate, whereas robot systems for soil maintenance and management use primarily GPS/radar for navigating larger areas/fields.
Furthermore, we see that plant care robotics solutions utilize sprayers and fans as the main type of actuators. Blades and surveillance cameras are also included however less frequently.
For soil-orientated robot systems, the manipulators are mainly conventional tools attached to the robot, like a plough, harrow, etc.
However, there are multipurpose solutions like the Robotti 150D from AgroIntelli and Farmdroid in the plant care category, which can cultivate, execute mechanical weeding, and prepare a seedbed autonomously using blades.

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64% of the robots used for harvesting utilize advanced vision sensors like LIDAR, high precision 3D cameras, etc for fruit/vegetable detection and maturity assessments. Of harvesting robot entries, 50% consist of a modular set-up with numerous tool options, resulting in high customization opportunities for the end-user. However, the sensor calibration can be challenging if changing crop type.

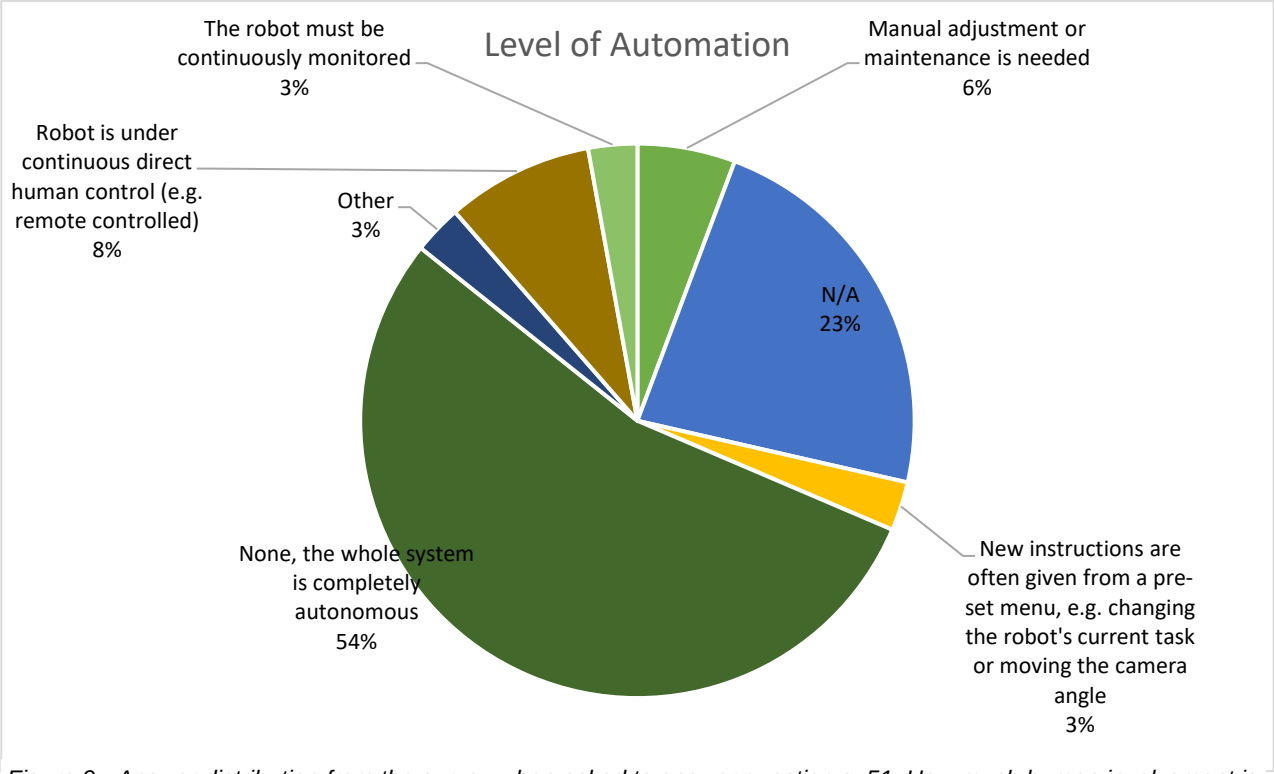


*Figure 9 - Answer distribution from the survey when asked to answer question s_51; How much human involvement is needed in robot use? "*

23% of the entries did not answer the question “How much human involvement is needed in robot use?” (s_ 51). This corresponds to the number of partially completed answers and could be the result of this question being one of the last questions. Since this information was not available from the website of these robotic solutions, it was not possible to complete this question without further contact with the developer/supplier.

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The autonomy level is highly correlated with the programming flexibility of the robot. 32% did not answer the question about program flexibility of the robot, creating an imbalance in the dataset.

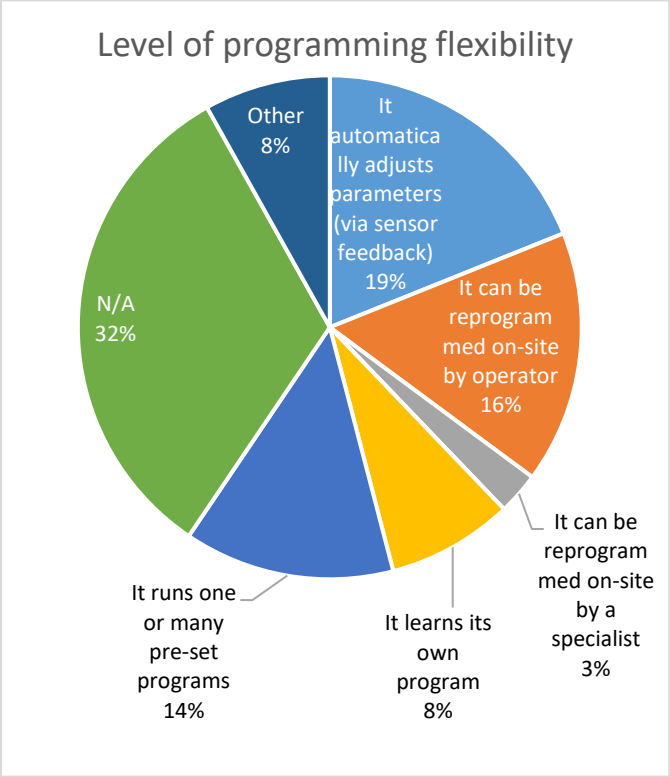


*Figure 10a – Answer distribution to question s_48: "What level of program flexibility does the robot have?"*

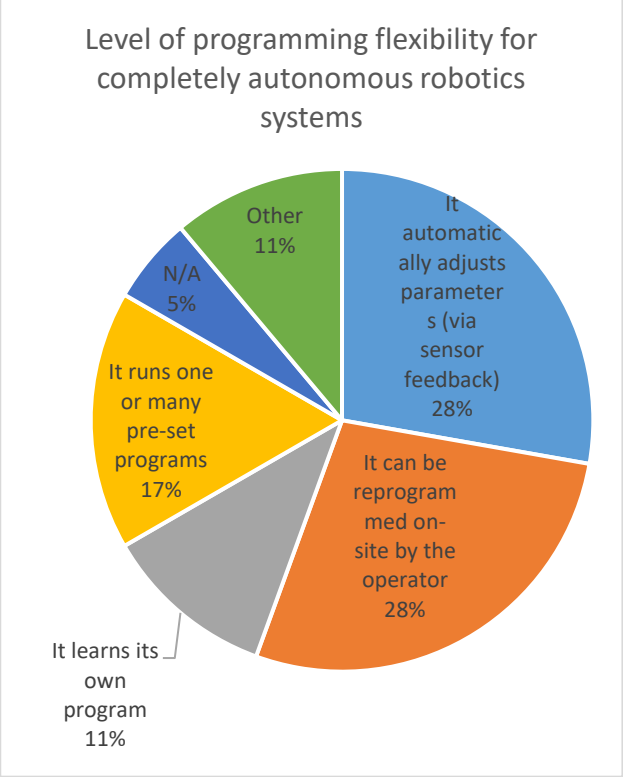


*Figure 10b - close up of programming flexibility of completely autonomous solutions*

For the 54% of the robotic entries which are marked as completely autonomous, we find that 28% automatically respond to sensor input or can be reprogrammed on-site (see figure 10**Error! Reference source not found.**).

## Human interaction level of entries

Safety measures are increasingly in focus when operating robots and therefore highly important to address. Here it is found that 29% of the robots either stop or slow down when a person is detected

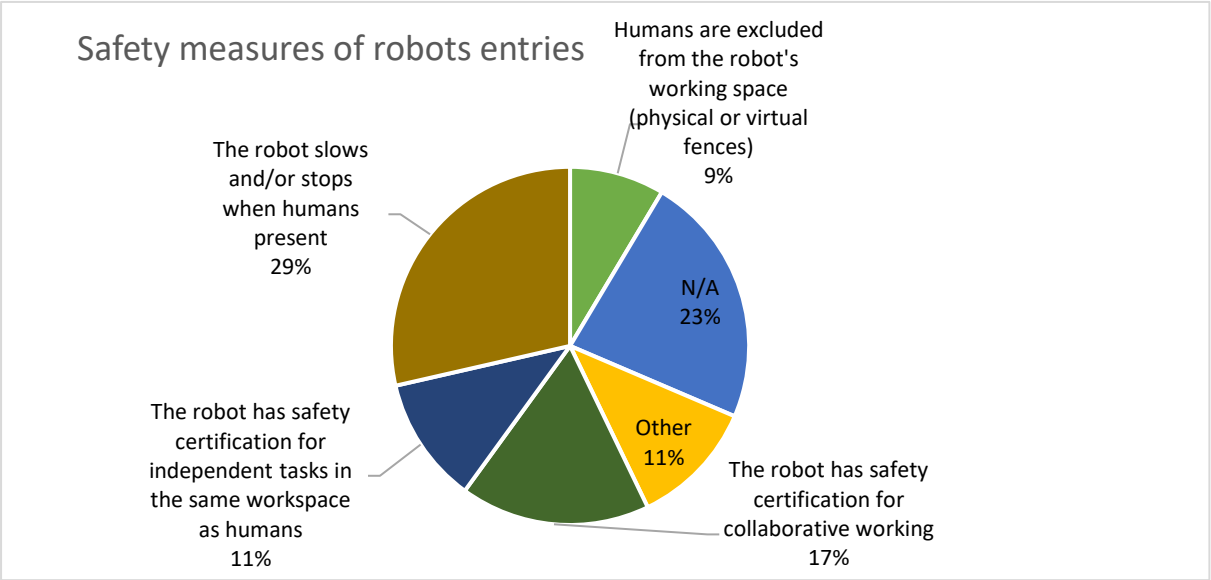


*Figure 11- Answer distribution to questions s_54: "What keeps the human (operator) safe?"*

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within the operation sphere. 17% have a safety certification for collaborative working (Figure 11). All mobile robot entries, which completed question s_54, utilize one (or both) of these measures while operating. Moreover, a strong correlation between fixed robotics and human exclusion while operating was found based on survey data.

Lastly, we find that most of the robotics entries use separate computers or tablets as control interfaces (29%) (Figure 12). All of the 29% which utilize separate computer or tablets are mobile ground robots, however several of the mobile ground robots also utilizes joystick or (mobile) app control.
"Other" user interfaces include a combination of the control options: cloud-based solutions, web-based portable, etc.

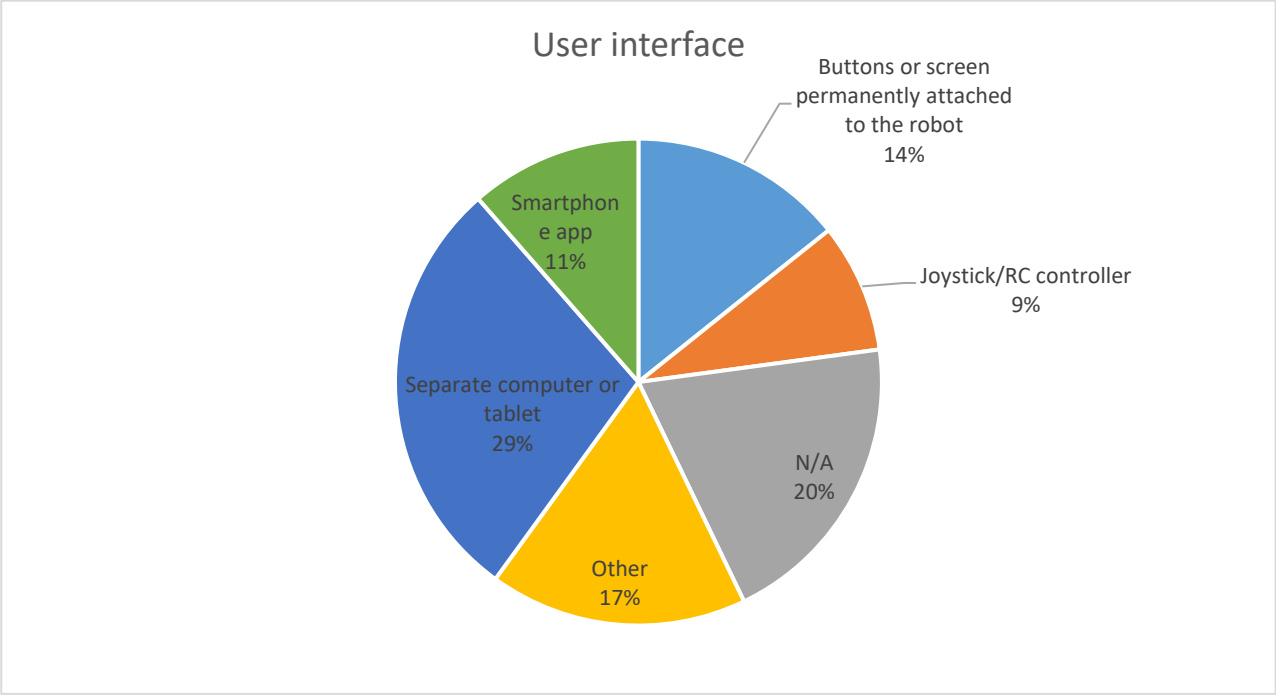


*Figure 12 - Answer distribution to questions s_54: "What keeps the human (operator) safe?"*

## Perspectives and future use of the catalogue

The purpose and use of the catalogue are to provide a collected overview of the Agri-food robots in Europe and ideally turn into a one-stop catalogue for developers, end-users, suppliers, etc for inspiration, purchase, or collaboration. For now, it is divided into **chapter 1** (see example in Figure 12 ); consisting of survey entries with a high level of information detail, and **chapter 2** (See example in Figure 13); consisting of identified systems found by bootstrapping with a low level of information.

Each robot entry in chapter 1 is created in two blocks (see Figure 12 ), one containing a picture and the keywords, the other containing a quote and some factual information. These were organised so that the pictures run down the outsides of the pages. New entries can easily be created by making the two blocks. Adding the entry into the correct place in the logical sequence of work is done manually. Currently, the adjustment of the downstream block pairs so that pictures remain on the outside of the page is done manually – ideally, this should be automated as the catalogue becomes exhaustive for the European market.

In chapter 1 entries are presented in a logical order according to application - the farming year from start to end and then food processing - makes it easy for people to find robot systems that interest

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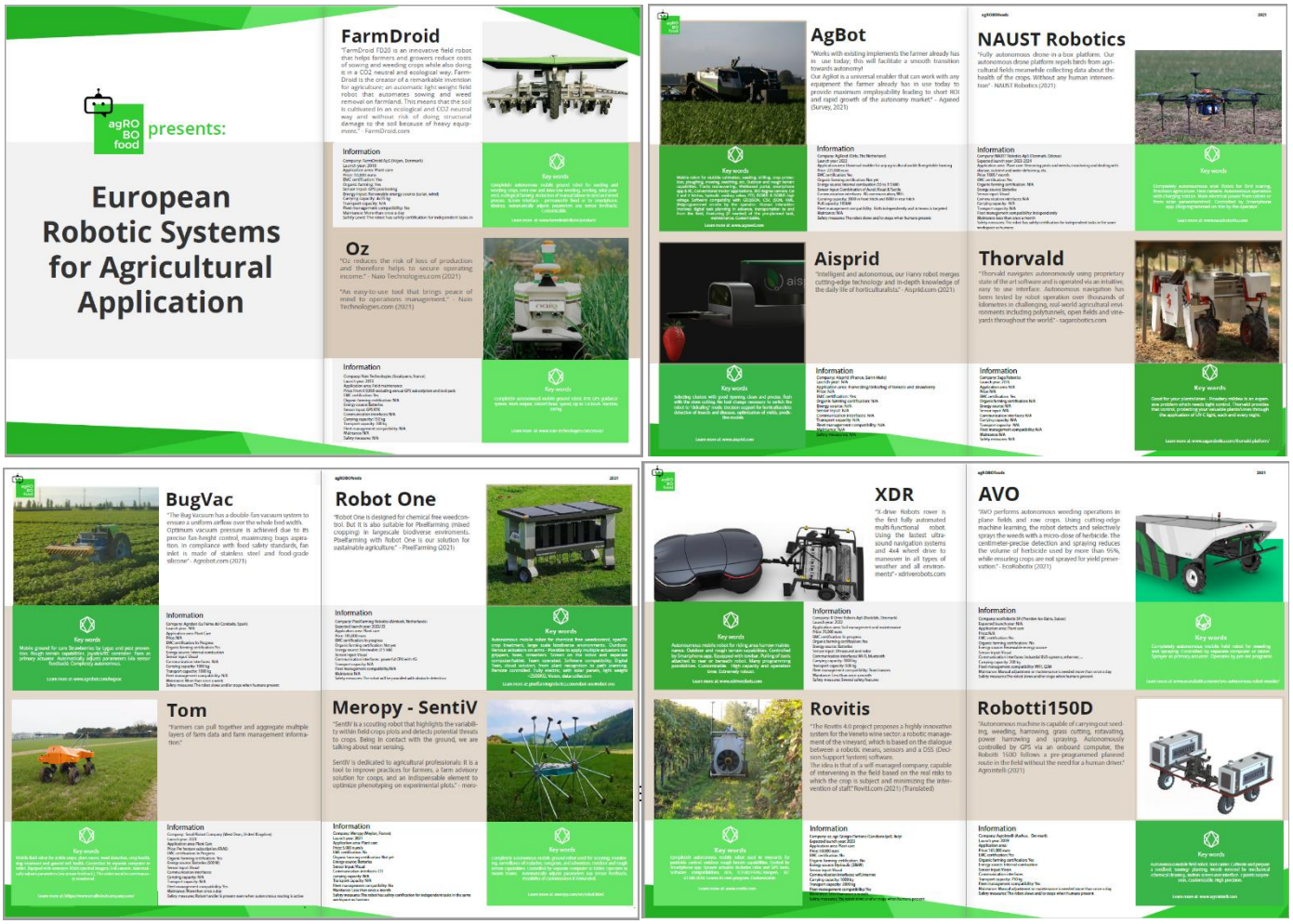
them. Ultimately the catalogue should be machine-searchable, however, it was decided to keep the catalogue as a classic catalogue with a magazine-like layout for now to improve user-friendliness and further dissemination. Online version of the catalogue is here: [https://agrobofood.eu/agricultural-robotics-a-european-catalogue/](https://agrobofood.eu/agricultural-robotics-a-european-catalogue/)




The first version of the catalogue was sent to the technology owners for feedback, and to give them the option of editing, redacting, or if having any injections to text or photos.

Figure 13 shows snippets the chapters including chapter 2 of the Robotic systems which with have not (as of yet) provided additional information via the survey.

# Conclusion

In conclusion, 126 robotic technologies were identified via internet search and survey distribution. To specify the analysis of the European robotic systems, it is essential to validate the technology findings by survey participation whilst identifying more solutions to the catalogue through network distribution.

Based on the identified robotics systems and survey entries, we see that most robotics used for agricultural applications are mobile ground robots. Most of the identified mobile robotic systems are utilized for fieldwork, plant care, infrastructure, and logistics.

Mobile ground robots across application areas are similar in their level of autonomy, actuators, and programming flexibility. The similarity provides the option for customizability. Based on market available solutions we find that the majority of the European robotic mobile systems for plant care

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are designed for mechanical weeding, either in the form of completely autonomous AGVs or automated tools to be dragged by a tractor.

Harvesting robotics systems are in general more advanced in terms of sensors and manipulators. Especially the subcategory “crop/fruit harvesting” presents the state-of-the-art in vision technologies, which can identify ripeness, humidity, and occurrence of diseases. Due to the level of modularity, these autonomous harvesters can be adapted to new use cases/customer needs. However, the compatibility with crop types comes down to sensor calibration and software specifications.

For animal care solutions we see the highest level of automation and use of robotics within the dairy and pork industry. Especially technologies that improve the indoor climate and autonomous feeders are the focus here, based on the technologies identified.

Home cooking autonomy has not reached a substantial market size/innovation level for it to be prominent. On the contrary, logistics AGVs are highly accessible on the market, and inclusion of these was limited, as this area of the supply chain is not the primary focus of our technology mapping.

Food preparation systems in Europe (incl. for raw food) typically utilize fixated robots which typically consist of a type of robotic arm and a conveyor belt. Often, we find that these system lines incorporate quality, sorting, and grading systems as well as packaging and labelling technologies. However, the geographical location of the tech providers for automated elements in a production line is not clustered and may prove to be difficult for customers to navigate.

To ease the ability to discover Agri-robotics and food production system, the catalogue was compiled as a one-stop catalogue, providing an overview of the newest technologies. Ideally, the catalogue will be converted into a searchable database for continuous updates and the inclusion of emerging technologies, whilst furthering future European trade and collaboration.

Looking at the geographical distribution of the robotic solutions we see most of the field systems owners for pre-cultivation maintenance/management are in Germany, Denmark, and the Netherlands. Whereas smaller AGV solutions for monitoring and plant care seem to be clustered in France and Spain. Several drone solutions are based out of Switzerland, and solutions for internal logistics are mainly from Germany or Spain. The technologies that were specific to vineyard applications are developed in France and Italy.

The main provider of autonomous solutions for the dairy/beef industry is located in the Netherlands. There is a tendency for autonomous pork production systems are developed in Denmark, whereas France is the leading country for poultry automatization.

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# Appendix A

This ontology was abandoned before completion, as we felt that it was getting too detailed and too unwieldy. However, it was an important part of the survey development process as it made us focus in on the most important questions. Final survey questions are included in Appendix B.

## Definitions

**Agri-food** comprises all the steps in preparing human food, from soil preparation through to food on the table. Major sections are:

- managing farmed animals (including fish)
- growing and harvesting plant-based human food and animal fodder
- food processing
- food delivery and home cooking

**A robot** is a machine that takes user-reprogrammable action in the real world

## Scope:

Complete TRL6+ robot systems for use in agri-food. Robot systems have to be expected to be in full trials within 2 years and available commercially within 4 -- We want to map a) ***available*** technologies and b) those that will be ***upcoming*** within a reasonable time, not good ideas.

We do NOT include technologies unless they are an integrated part of the robot system.

Normal animal food counts because humans eat the animals so it is part of the agri-food chain.

We do NOT include flowers etc, only food – though many of the technologies here will easily sidestep to flower production.

[**Note:** Several tasks are automated without using what I would consider a robot – but the definition given above includes several of them e.g. an industrial mixer. Change the definition? There seem to be many definitions for "robot"]

## Axes:

1. Primary **working environment** –
    a. structured, semi-structured, unstructured
    b. in homes etc, in factories, in warehouses, greenhouses etc, outdoors (roads etc), outdoors (fields and forest), sky, water, underwater …
    c. **Interactions with people and other technologies** : none, work in cooperation with other robots and machines, in shared spaces with trained/untrained people, in close cooperation with people, physical HRI;
2. Application **domain** –
    a. primary agriculture: row crops, tree (and other overhead/permanent) crops, individual non-tree plants, mushrooms etc; fish, farmed animals (including insects), wild crops, … other;
    b. food: raw food preparation, cooking,
    c. transport, logistics…
    d. application **tasks:** for each of the subdomains above
        i. primary agriculture: plants: sowing, watering, tending, harvesting; animals: feeding, cleaning, immunising; soil health, fertiliser/pesticide application, cleaning animal enclosures, cleaning fields, maintaining infrastructure, …

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ii. basic preparation: washing, cutting, "cleaning" (removing debris), chopping, …
iii. further preparation: fine preparation, cooking … (mostly by machines?)
iv. packaging, labelling, robot use data, crop price, …
v. food delivery: warehousing, distribution

3. Robot competencies **task(s)** –
   a. data collection: monitoring of crop/animal health and growth, other monitoring (pests, invasive species, weather?),
   b. safety, communication, navigation, locomotion …
4. **Physical characterisation :**
   a. arm, mobile base, drone;
   b. ROBOT sensors, gripper, etc.,
   c. task-specific tooling;
   d. standardisation? Of physical mountings, software communication etc
5. "Value drivers"?

●

**Also collect in the survey**

- contact details (for purchasers, researchers, etc to make contact)
- Location (city) where the robot system "lives", for putting on a geographical map?
- product name and website
- a free-text description of up to 1000 chars (for advertising)?

## Survey questions (direct from the ontology axes)

### Primary working environment

| | |
|---|---|
| outdoors or nearly so | underwater (fresh or salt) |
| | on water (fresh or salt) |
| | sky (flying) |
| | amongst trees or other high plants |
| | fields for other permanent plants e.g. grass |
| | fields for temporary plants |
| | small areas e.g. gardens, rooftops |
| | roads, tunnels and other hard level surfaces |
| | greenhouses |
| | sheds and animal stalls |
| | other outdoor e.g. mud, tidal flats, very rough ground, sand |
| indoors | warehouses |
| | factories |
| | canteens |
| | shops |
| | homes |
| Interactions | none |
| | with machines and/or other robots |
| | in spaces shared with humans |
| | direct interactions with humans e.g. handovers |
| | direct physical interactions e.g. exoskeletons |

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## Intended main agri-food sector and tasks

[Some things happen for all subsectors e.g. monitoring <the growth / process> and monitoring for contaminants. What else is in this category? Transport/logistics (how much, what types)? Infrastructure maintenance?]

[Should monitoring etc. appear in every task list or as a separate line(s)? I've left it out of the task lists for now but it should probably be added to make the survey conceptually easier to answer]

| Sector | Subsector | Examples | Tasks |
|---|---|---|---|
| Agriculture | soil health | | adjusting chemistry<br>adjusting ploughing depth |
| | permanent crops | apples, olives, berry bushes, vines, etc; | weeding<br>pollinating?<br>harvesting<br>pruning<br>infrastructure maintenance |
| | field/ row crops | monocultures e.g. cereals, beet; or intercropping | sowing / replanting<br>weeding<br>spraying chemicals/manure<br>harvesting<br>ploughing / digging<br>harrowing |
| | plants grown in small scale | rooftop, gardens, herbs, vertical- or micro-farming | |
| | hydroponics, aquaponics | | adjusting chemical balance<br>planting<br>harvesting<br>infrastructure maintenance |
| | mushrooms, fungi, algae | | inoculation<br>harvesting |
| | river and sea plants and creatures, farmed or wild | shellfish, fish, sea mammals | catching / collecting<br>measuring |
| | farmed mammals | cows, sheep, pigs, goats, horses | inseminating?<br>inoculating<br>feeding<br>grooming?<br>shearing?<br>mucking out<br>maintaining infrastructure (fences, housing) |
| | farmed birds | chickens, ducks, quail | hatching (incubating)<br>feeding<br>boxing, transport |
| | other primary production | insects,<br>wild food, etc | feeding, |
| | Organic farming | | |
| horticulture? | | greenhouse plants for food | environment control<br>watering<br>moving from area to area |
| Food processing | carcase preparation | all animals | "skin" removal including removing shells<br>main splitting and cutting |

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| | | | |
|---|---|---|---|
| | | | deboning<br>cleaning<br>microbial analysis etc |
| | basic preparation | plants and fungi | cleaning/washing<br>separating e.g. leaves from stem, removing roots …<br>cutting up the edible parts ("comminution") |
| | preservation? | | |
| | making drinks | brewing, wine-making, syrup-making | |
| | cooking | | for individual meals in home or restaurant<br>in a factory/shop |
| | packaging at consumer level | | measuring<br>assembly e.g. lasagne<br>laying out for display e.g. sliced meats<br>wrapping<br>quality control<br>composition check<br>labelling |
| Transport and storage | transport | | living animals<br>packing into and out of transport containers<br>logistics – perishable food<br>logistics -- fleet management<br>other |
| | warehousing | | inventory / stocktaking<br>logistics |
| Other | | | |

**Comments:** a lot of food processing is automated but by large machines that are not robots.

## Robot competences

| | | |
|---|---|---|
| Basic competences | safety (equipment and behaviours and protocols) | human safety<br>self-safety<br>environment safety |
| | communications (sensors and physical interfaces, bus and protocols)? | with people<br>with other machines<br>with management software |
| | navigation | GPS etc<br>visual landmark-based<br>purely directional |
| | obstacle avoidance | visual<br>sonar<br>physical bump |
| visual perception for… | crop plant recognition | crop monitoring, ripeness,<br>multi-spectral vision,<br>other? |

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| | | |
|---|---|---|
| | animal recognition | individuals<br>growth, health etc |
| | pest recognition | invasive plant species detection, poisonous plants, destructive beetles, nematodes, larvae, etc |
| | food purity | detecting contaminants for removal, confirming species |
| | food presentation and packaging quality | check packaging completeness, content completeness, visual attractiveness, label correctly placed and not damaged, etc |
| non-visual perceptive tasks | food purity | biochemical analysis,<br>checking composition, origin etc matches labelling |
| | weights and measures check | |
| | food tracing | |
| | monitoring for danger? Of what kinds | |
| other? | | |

## The robot system

| | | | |
|---|---|---|---|
| Robot hardware | mobile base | wheels<br>tracks<br>legs<br>for work in/on water<br>other | |
| | arm | DOF<br>gripper | <number><br>parallel<br>3-fingered<br>suction<br>"coffee bean"<br>specialised for task<br>other |
| | flying drone | with/without tether<br>flying time? | |
| | soft robot | | |
| safety system | | hardware limits<br>software limits<br>no humans in the area | |
| Sensors | visual | human wavelengths | |
| | | thermal/ IR | |
| | | UV | |
| | | LIDAR | |
| | audio | active (sonar) | |

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| | | | |
|---|---|---|---|
| | | passive | |
| | mechanical/ tactile | [stops, odometers, etc] | |
| | magnetic | compass | |
| | other | GPS<br>other | |
| Actuators? | [the tooling is very tied to the task. So is some of the sensing] | | |
| Software? | digital twin | | |
| | learning | | |
| | classifier systems | | |
| | robot management systems | | |
| power system? | | | |
| other? | | | |

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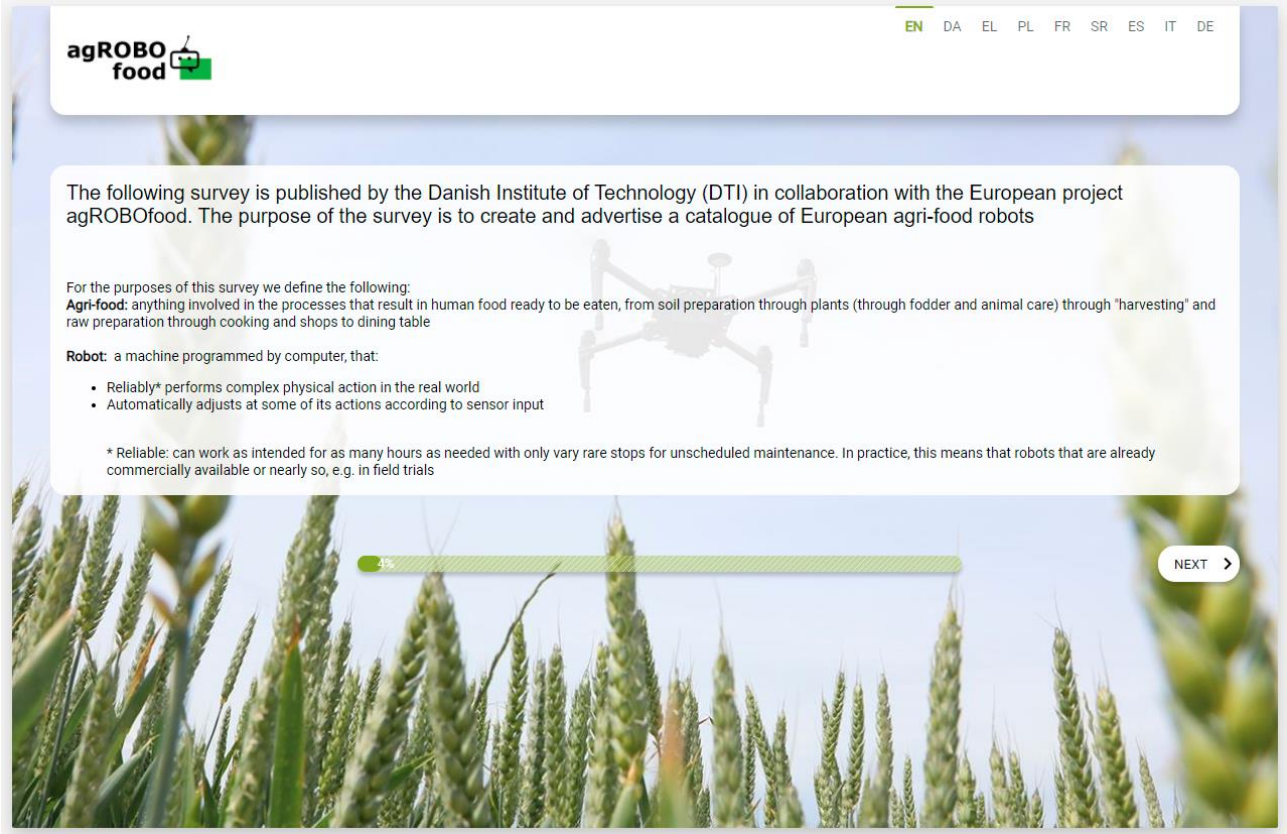
# Appendix B

## Survey questions including all languages – exported from SurveyXact




| QuestionName | variableDescription (English) | variableDescription (Danish) | variableDescription (Greek) | variableDescription (Polish) | variableDescription (French) | variableDescription (Serbian) | variableDescription (Spanish) | variableDescription (Italian) | variableDescription (German) |
|---|---|---|---|---|---|---|---|---|---|
| **s_1** | What is the name of the robot? | Hvad er navnet på robotten? | Ποιο είναι το όνομα του ρομπότ; | Jak nazywa się Robot? | Quel est le nom du robot (fabricant, modèle, etc.)? | Koji je naziv Vašeg robota? | ¿Cómo se llama el robot? | Come si chiama il robot? | Wie lautet der Name des Roboters? |
| **s_2** | Has the robot been launched commercially? | Er robotten lanceret på markedet? | Είναι το ρομπότ εμπορικά διαθέσιμο? | Czy robot miał już premierę komercyjna? | Le robot est-il disponible commercialement? | Da li je robot lansiran komercijalno? | ¿El robot ha sido lanzado comercialmente? | Il robot è stato lanciato commercialmente? | Ist der Roboter bereits kommerziell verfügbar? |
| **s_3** | What year was/is the robot expected to be launched) | Hvad år blev robotten lanceret på markedet/hvornår forventes den at blive? | Ποιο έτος αναμενόταν/αναμένεται να κυκλοφορήσει το ρομπότ) | W którym roku odbyła się/planowana jest premiera Robota? | Quand le robot doit-il être commercialisé ? | Koje godine je robot lansiran / koje godine planirate da lansirate robota? | ¿Qué año fue lanzado o se espera que el robot sea lanzado? | In che anno è stato/ è previsto il lancio sul mercato del robot? | In welchem Jahr wurde/wird der Roboter voraussichtlich auf den Markt kommen) |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **s_4** | Please add a link to: - The robot's advertising website | Tilføj gerne links til: - Robottens annoncerings side | Παρακαλώ παραθέσετε σύνδεσμο για: - Ιστότοπος διαφήμισης ρομπότ | Proszę o podanie linka do: - Strony internetowej Robota: | Précisez s'il-vous-plait: - Le site internet commercial du robot utilisé | Molimo Vas dodajte link koji vodi na - Sajt za oglašavanje robota | Por favor, introduzca un enlace a: - El sitio web de publicidad del robot | Si prega di aggiungere il link a: - Il sito web di pubblicità del robot | Bitte fügen Sie einen Link zu: - Die Werbe-Website des Roboters |
| **s_61** | Please add a link to: - The robot's technical information / website | Tilføj gerne links til: | Παρακαλώ παραθέσετε σύνδεσμο για: | Proszę o podanie linka do: - Strony z informacjami techniczny mi Robota | Précisez s'il-vous-plait: - Le site internet technique du robot utilisé | Molimo Vas dodajte link koji vodi na - Tehnički sajt robota | Por favor, introduzca un enlace a: - El sitio web técnico del robot | Si prega di aggiungere il link a: - Il sito web tecnico del robot | Bitte fügen Sie einen Link zu: - Die technische Website des Roboters |
| **s_6** | What is the basic sales price of the robot? (€) | Hvad koster basispakken af robotten (€)? | Ποια είναι η βασική τιμή πώλησης του ρομπότ; (€) | Jaka jest podstawowa cena detaliczna Robota? (€) | Quel est le prix de base du robot ? (€) | Koja je osnovna prodajna cena robota? (€) | ¿Cuál es el precio de venta básico del robot? (€) | Qual è il prezzo base di vendita del robot? (€) | Wie hoch ist der Grundverkaufspreis des Roboters? (€) |
| **s_7** | Does the robot already comply with regulations (such as EMC, safety etc.) and been certified? | Overholder robotten regulationer såsom EMC og sikkerhedskrav? | Τα ρομπότ συμμορφώνονται με τους κανονισμούς (όπως EMC, ασφάλεια κ.λπ.); Έχουν πιστοποιηθεί; | Czy Robot przestrzega przepisów bezpieczeństwa (takich jak kompatybilność elektromagnetyczna (EMC) itp.) oraz został już certyfikowany? | Le robot obéit-il à certaines régulations (directive CEM, sécurité, etc.) et est-il certifié? | Da li se roboti pridržavaju propisa (poput EMC, bezbednost itd.) i da li su sertifikovani? | ¿Cumple el robot con las regulaciones (como EMC, seguridad, etc.) y ha sido certificado? | I robot sono conformi alle normative (come EMC, sicurezza ecc.) e sono stati certificati? | Entspricht der Roboter geltenden Vorschriften und Standards (für EMV, Sicherheit etc.) und ist er zertifiziert? |
| **s_8** | Which company/ organization owns the IPR to the robot? | Hvad er virksomhedens/organisations navn? | Ποια εταιρεία / οργανισμός διαθέτει τα πνευματικά δικαιώματα (IPR) του ρομπότ; | Która firma/organizacja jest właścicielem praw własności intelektualnej (IPR) Robota? | 11. A quelle organisation appartient la propriété intellectuelle relative au robot? | Koja kompanija /organizacija poseduje pravo intelektualne svojine robota? | ¿Qué empresa/ organización posee el DPI del robot? | Quale azienda/organizzazione possiede il DPR del robot? | Welches Unternehmen/ Organisation besitzt die Schutzrechte an dem Roboter? |
| **s_9** | Is this company based in Europe? | Er virksomheden baseret i Europa? | Η εταιρεία εδρεύει στην Ευρώπη; | Czy firma ma siedzibę w Europie? | 12. Le siège de cette organisation est-il basé en Europe? | Da li je sedište kompanije u Evropi? | ¿La empresa tiene su sede en Europa? | L'azienda ha sede in Europa? | Ist das Unternehmen in Europa ansässig? |
| **s_10** | Where is (the European division of) the company based? - Country | Hvor er (den europæiske afdeling af) virksomheden lokaliseret? - Land | Πού εδρεύει η εταιρεία (ή το ευρωπαϊκό τμήμα της); - Χώρα | Gdzie znajduje się Europejski oddział firmy? - Kraj | 13. Où est située la division européenne de cette organisation? - Pays | Gde je (evropski ogranak) sedište kompanije ? - Država | ¿Dónde está la división europea de la empresa? - país | Dove ha sede (la divisione europea de) l'azienda? - Paese | Wo befindet sich der Sitz (der europäischen Abteilung) des Unternehmens ? - Land |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **s_11** | Where is (the European division of) the company based? - City | Hvor er (den europæiske afdeling af) virksomheden lokaliseret? - By | Πού εδρεύει η εταιρεία (ή το ευρωπαϊκό τμήμα της); - Πόλη | Gdzie znajduje się Europejski oddział firmy? - Miasto | 13. Où est située la division européenne de cette organisation? - Ville | Gde je (evropski ogranak) sedište kompanije? - Grad | ¿Dónde está la división europea de la empresa? - ciudad | Dove ha sede (la divisione europea de) l'azienda? - Città | Wo befindet sich der Sitz (der europäischen Abteilung) des Unternehmens? - Stadt |
| **s_12** | Where is (the European division of) the company based? - The company is based outside Europe in: | Hvor er (den europæiske afdeling af) virksomheden lokaliseret? - Afdelingen er placeret udenfor Europa i (by, land): | Πού εδρεύει η εταιρεία (ή το ευρωπαϊκό τμήμα της); - Η εταιρεία εδρεύει εκτός Ευρώπης (Χώρα): | Gdzie znajduje się Europejski oddział firmy? - Firma znajduje się poza Europą, w kraju: | 13. Où est située la division européenne de cette organisation? - L'organisation est basée hors de l'Europe, dans le pays suivant: | Gde je (evropski ogranak) sedište kompanije? - Sedište kompanije je van Evrope | ¿Dónde está la división europea de la empresa? - La empresa tiene su sede fuera de Europa en | Dove ha sede (la divisione europea de) l'azienda? - L'azienda ha sede fuori dall'Europa in: | Wo befindet sich der Sitz (der europäischen Abteilung) des Unternehmens? - Das Unternehmen hat seinen Sitz außerhalb Europas in: |
| **s_13** | Would you like to collaborate with other organizations to develop the robot and its capabilities further? | Ville samarbejde med andre organisationer vedr. videreudvikling af robotten og dens muligheder være interessant for dig/virksomheden? | Θα θέλατε να συνεργαστείτε με άλλους οργανισμούς για την περαιτέρω ανάπτυξη του ρομπότ και των δυνατοτήτων του? | Czy był/była byś zainteresowany/na współpracą z innymi organizacjami w celu dalszego rozwoju robota i jego możliwości? | Aimeriez-vous collaborer avec d'autres organisations pour continuer de développer le robot et ses fonctionnalités? | Da li biste želeli da sarađujete sa drugim organizacijama na daljem razvoju robota i njegovih mogućnosti? | ¿Le gustaría colaborar con otras organizaciones para desarrollar el robot y sus capacidades aún más? | Vorresti collaborare con altre organizzazioni per sviluppare il robot e le sue capacità? | Würden Sie gerne mit anderen Organisationen zusammenarbeiten, um den Roboter und seine Fähigkeiten weiterzuentwickeln? |
| **s_14** | Please give contact details below: - E-mail | Indtast gerne kontaktoplysninger på kontaktperson herunder - E-mail | Παρακαλούμε δώστε τα στοιχεία επικοινωνίας παρακάτω: - E-mail | Proszę podać poniżej dane kontaktowe: - E-mail | Précisez vos coordonnées ci-dessous: - E-mail | Molimo Vas ostavite kontakt podatke: - E-mail | Por favor, proporcione los datos de contacto a continuación: - Correo electrónico | Si prega di fornire i dettagli di contatto qui sotto: - e-Mail: | Bitte geben Sie unten Ihre Kontaktdaten an: - E-Mail |
| **s_15** | Please give contact details below: - Telephone | Indtast gerne kontaktoplysninger på kontaktperson herunder - Telefon | Παρακαλούμε δώστε τα στοιχεία επικοινωνίας παρακάτω: - Τηλέφωνο | Proszę podać poniżej dane kontaktowe: - Telefon | Précisez vos coordonnées ci-dessous: - Téléphone | Molimo Vas ostavite kontakt podatke: - Broj telefona | Por favor, proporcione los datos de contacto a continuación: - Teléfono | Si prega di fornire i dettagli di contatto qui sotto: - Telefono: | Bitte geben Sie unten Ihre Kontaktdaten an: - Telefon |
| **s_16** | What is the main focus of the robot application task? | Hvad er robottens primære type af opgave(r)? | Ποιος είναι ο κύριος στόχος της εφαρμογής του ρομπότ; | Proszę podać główne zastosowanie dla Robota? | Quelle est la tâche principale que le robot doit réaliser? | Koji je glavni fokus primene zadatka robota? | ¿Cuál es el enfoque principal de la tarea de aplicación de robots? | Qual è l'obiettivo principale del compito dell'applicazione del robot? | Was ist der Einsatzbereich des Roboters? |

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| **s_5** | What is the main focus of the robot application task? - Other | Hvad er robottens primære type af opgave(r)? - Andet | Ποιος είναι ο κύριος στόχος της εφαρμογής του ρομπότ; - Άλλο | Proszę podać główne zastosowanie dla Robota? - Inne | Quelle est la tâche principale que le robot doit réaliser? - Autre | Koji je glavni fokus primene zadatka robota? - Ostale opcije | ¿Cuál es el enfoque principal de la tarea de aplicación de robots? - Otros | Qual è l'obiettivo principale del compito dell'applicazione del robot? - Altro | Was ist der Einsatzbereich des Roboters? - Sonstiges |
| **s_18** | Please add some keywords to clarify (e.g. strawberries, fencing, slug removal, organic, cake decoration ...) | Tilføj gerne nogle nøgleord for at specificere robottens opgaver - f.eks. jordbær, hegn, fjernelse af snegle, organisk, kagedekoration etc... | Προσθέστε μερικές λέξεις-κλειδιά για να διευκρινίσετε την εφαρμογή π.χ. φράουλες, περίφραξη, αφαίρεση γυμνοσάλιαγκα, οργανικό, διακόσμηση κέικ | Proszę podać kilka słów kluczowych do powyższej odpowiedzi (np. truskawki, szermierka, usuwanie ślimaków, ekologiczne, dekoracja ciast) | Ajoutez ici si besoin les mots clés permettant de mieux expliciter la tâche que le robot doit réaliser (par exemple : fraises, clôture, élimination des limaces, bio, décoration de gâteaux) | Molimo Vas dodajte ključne reči kako biste bolje pojasnili npr. jagode, postavljanje ograde, uklanjanje puževa, organska hrana, ukrašavanje torte | Por favor, introduzca algunas palabras clave para aclarar, por ejemplo, fresas, esgrima, eliminación de, orgánico, decoración de pasteles | Si prega di aggiungere alcune parole chiave per chiarire, per esempio fragole, recinzione, rimozione delle lumache, organico, decorazione di torte | Bitte ergänzen Sie einige Stichwörter zur Verdeutlichung, z.B. Erdbeeren, Umzäunung, Schneckenentfernung, Bio, Kuchendekoration |
| **s_19** | What is the robot's main category type? | Hvilken slags robot-type er robotten primært klassifikeret som? | Ποιος είναι ο κύριος τύπος κατηγορίας του ρομπότ; | | Quelle catégorie de robot utilisez-vous ? | Kojoj kategoriji pripada robot? | ¿Cuál es el tipo de categoría principal del robot? | Qual è il tipo di categoria principale del robot? | Welches ist die Hauptkategorie des Roboters? |
| **s_17** | What is the robot's main category type? - Technology mix (e.g. drone with mobile base) | Hvilken slags robot-type er robotten primært klassifikeret som? - Blandet - består af elemeter af de listede typer - f.eks. drone med mobil platform base (uddyb gerne) | Ποιος είναι ο κύριος τύπος κατηγορίας του ρομπότ; - Τεχνολογικός συνδυασμός (π.χ. drone με κινητή βάση) | Mix (na przykład dron z mobilna bazą ) | Quelle catégorie de robot utilisez-vous ? - Mix technologique, par exemple drone couplé avec base mobile (précisez ) | Kojoj kategoriji pripada robot? - Tehnološki miks (npr. dron sa mobilnom bazom) | ¿Cuál es el tipo de categoría principal del robot? - Mezcla tecnológica (por ejemplo, dron con base móvil) | Qual è il tipo di categoria principale del robot? - Mix di tecnologie (ad esempio, drone con base mobile) | Welches ist die Hauptkategorie des Roboters? - Technologiemix (z. B. Drohne mit mobiler Basis) |
| **s_20** | What is the robot's main category type? - Other | Hvilken slags robot-type er robotten primært klassifikeret som? - Andet | Ποιος είναι ο κύριος τύπος κατηγορίας του ρομπότ; - Άλλο | Inne | Quelle catégorie de robot utilisez-vous ? - Autre | Kojoj kategoriji pripada robot? - Ostale opcije | ¿Cuál es el tipo de categoría principal del robot? - Otros | Qual è il tipo di categoria principale del robot? - Altro | Welches ist die Hauptkategorie des Roboters? - Sonstiges |
| **s_22_1** | Technologies within aerial/flying - Camera | Teknologispecificering af flyende/drone teknologi - Inkluderer kamera | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Κάμερα | Wykorzystywane technologie należace do Aero/Lotnictwo - Kamera | Drone : technologie(s) supplémentaire(s) utilisée(s) - Camera | Tehnologije u okviru vazdušnog /letećeg - Kamera | Tecnologías disponibles del robot aéreo - Cámara | Tecnologie in ambito aereo/ volante - Camera | Technologien im Bereich der Luft/Flugtechnik - Kamera |

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| **s_22_2** | Technologies within aerial/flying - Sensors beside those needed for flying | Teknologispecificering af flyende/drone teknologi - Inkluderer sensorer som ikke kun bliver brugt til manøvrere | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Αισθητήρας εκτός από αυτούς που χρειάζονται για πτήση | Wykorzystywane technologie należące do Aero/Lotnictwo - Czujniki oprócz tych potrzebnych do latania | Drone : technologie(s) supplémentaire(s) utilisée(s) - Capteurs non dédiés à la navigation | Tehnologije u okviru vazdušnog/letećeg - Senzor pored onog koji je potreban za letenje | Tecnologías disponibles del robot aéreo - Sensor además de los necesarios para volar | Tecnologie in ambito aereo/volante - Sensore oltre a quelli necessari per il volo | Technologien im Bereich der Luft/Flugtechnik - Sensor neben denen, die zum Fliegen benötigt werden |
| **s_22_3** | Technologies within aerial/flying - Manipulator(s) | Teknologispecificering af flyende/drone teknologi - Manipulatorer | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Ρομποτικός βραχίονας (Manipulator(s)) | Wykorzystywane technologie należące do Aero/Lotnictwo - Manipulatory przemysłowe | Drone: technologie(s) supplémentaire(s) utilisée(s) - Manipulateur(s) | Tehnologije u okviru vazdušnog/letećeg - Opcija manipulator(a) | Tecnologías disponibles del robot aéreo - Manipulador(s) | Tecnologie in ambito aereo/volante - Manipolatore/i | Technologien im Bereich der Luft/Flugtechnik - Manipulator(en) |
| **s_22_4** | Technologies within aerial/flying - Sprayer | Teknologispecificering af flyende/drone teknologi - Sprøjtefunktion | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Σύστημα ψεκασμού | Wykorzystywane technologie należące do Aero/Lotnictwo - Opryskiwacz/spryskiwacz | Drone : technologie(s) supplémentaire(s) utilisée(s) - Pulvérisateur | Tehnologije u okviru vazdušnog/letećeg - Raspršivač | Tecnologías disponibles del robot aéreo - Pulverizador | Tecnologie in ambito aereo/volante - Atomizzatore | Technologien im Bereich der Luft/Flugtechnik - Sprüher |
| **s_22_5** | Technologies within aerial/flying - Actuators beside those needed for flying | Teknologispecificering af flyende/drone teknologi - Aktuator, som ikke kun er nødvendige for flyvning | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Ρομποτικός ενεργοποίησής (Actuators) εκτός αυτών που χρειάζονται για πτήση | Wykorzystywane technologie należące do Aero/Lotnictwo - Aktuatory oprócz tych potrzebnych do latania | Drone : technologie(s) supplémentaire(s) utilisée(s) - Actuateurs non dédiés à la navigation | Tehnologije u okviru vazdušnog/letećeg - Aktuatori, pored onih neophodnih za letenje | Tecnologías disponibles del robot aéreo - Actuadores además de los necesarios para volar | Tecnologie in ambito aereo/volante - Attuatori oltre a quelli necessari per il volo | Technologien im Bereich der Luft/Flugtechnik - Aktoren neben denen, die zum Fliegen benötigt werden |
| **s_22_6** | Technologies within aerial/flying - Other | Teknologispecificering af flyende/drone teknologi - Andet | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Άλλο | Wykorzystywane technologie należące do Aero/Lotnictwo - Inne | Drone : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnologije u okviru vazdušnog/letećeg - Ostale opcije | Tecnologías disponibles del robot aéreo - Otros | Tecnologie in ambito aereo/volante - Altro | Technologien im Bereich der Luft/Flugtechnik - Sonstiges |
| **s_21** | Technologies within aerial/flying - Other | Teknologispecificering af flyende/drone teknologi - Andet | Τεχνολογίες εντός των εναέριων/ιπτάμενων ρομπότ - Άλλο | Wykorzystywane technologie należące do Aero/Lotnictwo - Inne | Drone : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnologije u okviru vazdušnog/letećeg - Ostale opcije | Tecnologías disponibles del robot aéreo - Otros | Tecnologie in ambito aereo/volante - Altro | Technologien im Bereich der Luft/Flugtechnik - Sonstiges |
| **s_24_1** | Technologies within the mobile ground robot - Wheels | Teknologispecificering af mobil robot - Hjul | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Τροχοί | Wykorzystywane technologie należące do mobilnych naziemnych - Koła | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Roues | Tehnologije u okviru mobilnog kopnenog robota - Točkovi | Tecnologías disponibles del robot móvil terrestre - Ruedas | Tecnologie in ambito del robot terrestre mobile - Ruote | Technologien im Bereich mobile Bodenroboter - Räder |

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| **s_24_2** | Technologies within the mobile ground robot - Legs | Teknologispecificering af mobil robot - "Ben" | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Πόδια | Wykorzystywane technologie należące do mobilnych naziemnych - Nogi | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Jambes | Tehnologije u okviru mobilnog kopnenog robota - Noge | Tecnologías disponibles del robot móvil terrestre - Piernas | Tecnologie in ambito del robot terrestre mobile - Gambe | Technologien im Bereich mobile Bodenroboter - Beine |
| **s_24_3** | Technologies within the mobile ground robot - Manipulator(s) | Teknologispecificering af mobil robot - Manipulator | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Ρομποτικός βραχίονας (Manipulator(s)) | Wykorzystywane technologie należące do mobilnych naziemnych - Manipulatory przemysłowe | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Manipulateur(s) | Tehnologije u okviru mobilnog kopnenog robota - Opcija manipulator(a) | Tecnologías disponibles del robot móvil terrestre - Manipulador(s) | Tecnologie in ambito del robot terrestre mobile - Manipulatore/I | Technologien im Bereich mobile Bodenroboter - Manipulator(en) |
| **s_24_4** | Technologies within the mobile ground robot - Indoor terrain capabilities | Teknologispecificering af mobil robot - Indendørs terrænegenskaber | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Δυνατότητες σε εσωτερικούς χώρους | Wykorzystywane technologie należące do mobilnych naziemnych - Możliwość poruszania się wewnętrznie (indoor) | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Navigation possible en environnement intérieur | Tehnologije u okviru mobilnog kopnenog robota - Sposobnosti na zatvorenom terenu | Tecnologías disponibles del robot móvil terrestre - Capacidades indoor | Tecnologie in ambito del robot terrestre mobile - Capacità sul terreno interno | Technologien im Bereich mobile Bodenroboter - Fähigkeiten für Innenbereiche |
| **s_24_5** | Technologies within the mobile ground robot - Outdoor terrain capabilities | Teknologispecificering af mobil robot - Udendørs terrænegenskaber | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Δυνατότητες σε εξωτερικούς χώρους | Wykorzystywane technologie należące do mobilnych naziemnych - Możliwość poruszania się na zewnątrz (outdoor) | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Navigation possible en environnement extérieur | Tehnologije u okviru mobilnog kopnenog robota - Sposobnosti na otvorenom terenu | Tecnologías disponibles del robot móvil terrestre - Capacidades outdoor | Tecnologie in ambito del robot terrestre mobile - Capacità sul terreno esterno | Technologien im Bereich mobile Bodenroboter - Fähigkeiten für Außenbereiche |
| **s_24_6** | Technologies within the mobile ground robot - Rough terrain capabilities | Teknologispecificering af mobil robot - Svær terrænegenskaber | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Δυνατότητες σε τραχύ έδαφος | Wykorzystywane technologie należące do mobilnych naziemnych - Możliwość poruszania się na nierównym terenie | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - | Tehnologije u okviru mobilnog kopnenog robota - Sposobnosti na grubom terenu | Tecnologías disponibles del robot móvil terrestre - Capacidades en terrenos irregulares | Tecnologie in ambito del robot terrestre mobile - Capacità su terreno accidentato | Technologien im Bereich mobile Bodenroboter - Fähigkeiten für schwierige Gelände |

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| | | | | | Navigation possible en terrain difficile | | | | |
| **s_24_7** | Technologies within the mobile ground robot - Primarily intended for transport | Teknologispecificering af mobil robot - Primært tiltænkt til transport | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Προορίζεται για μεταφορές | Wykorzystywane technologie należące do mobilnych naziemnych - Przeznaczony głównie do transportu | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Principalement dédié au transport | Tehnologije u okviru mobilnog kopnenog robota - Prvenstveno namenjeno za transport | Tecnologías disponibles del robot móvil terrestre - Destinado principalmente al transporte | Tecnologie in ambito del robot terrestre mobile - Destinato principalmente al trasporto | Technologien im Bereich mobile Bodenroboter - Hauptsächlich für den Transport bestimmt |
| **s_24_8** | Technologies within the mobile ground robot - Other | Teknologispecificering af mobil robot - Andet | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Άλλο | Wykorzystywane technologie należące do mobilnych naziemnych - Inne | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnologije u okviru mobilnog kopnenog robota - Ostale opcije | Tecnologías disponibles del robot móvil terrestre - Otros | Tecnologie in ambito del robot terrestre mobile - Altro | Technologien im Bereich mobile Bodenroboter - Andere |
| **s_23** | Technologies within the mobile ground robot - Other | Teknologispecificering af mobil robot - Andet | Τεχνολογίες εντός των κινητών ρομπότ εδάφους - Άλλο | Wykorzystywane technologie należące do mobilnych naziemnych - Inne | Robot mobile se déplaçant au sol : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnologije u okviru mobilnog kopnenog robota - Ostale opcije | Tecnologías disponibles del robot móvil terrestre - Otros | Tecnologie in ambito del robot terrestre mobile - Altro | Technologien im Bereich mobile Bodenroboter - Andere |
| **s_26_1** | Technology specification of fixed robot - Permanently fixed the floor/surface | Teknologispecificering af fikseret robot - Permanet fikseret til gulvet/underflade | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Μόνιμα σταθερά στο πάτωμα / άλλη επιφάνεια | Specyfikacja technologiczna robota stacjonarnego - Trwale przymocowany do podłogi lub innej powierzchni | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - Fixation permanente au sol / à une surface | Tehnološke specifikacije fiksiranog robota - Trajno fiksiran na pod/površinu | Especificación tecnológica del robot fijo - Fijo permanente del suelo/superficie | Specifiche tecnologiche del robot fisso - Fissato in modo permanente il pavimento /superficie | Technologie-Spezifikation für feststehende Roboter - Dauerhaft am Boden/auf der Oberfläche befestigt |
| **s_26_2** | Technology specification of fixed robot - Permanent overhead fixture | Teknologispecificering af fikseret robot - Permanet fikseret til luftinstallationer | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Μόνιμα σταθερά σε υπερυψωμένη εγκατάσταση | Specyfikacja technologiczna robota stacjonarnego - Permanentne mocowanie nad głowa | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - Robot suspendu, accroché en hauteur | Tehnološke specifikacije fiksiranog robota - Trajno učvršćenje odozgo | Especificación tecnológica del robot fijo - Accesorio permanente al techo | Specifiche tecnologiche del robot fisso - Apparecchio fisso sopraelevato | Technologie-Spezifikation für feststehende Roboter - Dauerhaft über Kopf fixiert |

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| **s_26_3** | Technology specification of fixed robot - The whole robot is moveable | Teknologispecificering af fikseret robot - Hele robotinstallationen er flytbar | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Όλο το ρομπότ είναι κινητό | Specyfikacja technologiczna robota stacjonarnego - Cały robot jest ruchomy | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - L'ensemble du système robotique peut être déplacé manuellement | Tehnološke specifikacije fiksiranog robota - Ceo robot je pokretljiv | Especificación tecnológica del robot fijo - Todo el robot es móvil | Specifiche tecnologiche del robot fisso - Il robot è mobile | Technologie-Spezifikation für feststehende Roboter - Der gesamte Roboter ist beweglich |
| **s_26_4** | Technology specification of fixed robot - Includes manipulators | Teknologispecificering af fikseret robot - Manipulatorer | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Περιλαμβάνει ρομποτικούς βραχίονες (Manipulator(s)) | Specyfikacja technologiczna robota stacjonarnego - Zawiera manipulatory przemysłowe | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - Comprend des manipulateurs | Tehnološke specifikacije fiksiranog robota - Uključuje manipulator | Especificación tecnológica del robot fijo - Incluye manipuladores | Specifiche tecnologiche del robot fisso - Include manipolatori | Technologie-Spezifikation für feststehende Roboter - Beinhaltet Manipulatoren |
| **s_26_5** | Technology specification of fixed robot - Other | Teknologispecificering af fikseret robot - Andet | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Άλλο | Specyfikacja technologiczna robota stacjonarnego - Inne | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnološke specifikacije fiksiranog robota - Ostale opcije | Especificación tecnológica del robot fijo - Otros | Specifiche tecnologiche del robot fisso - Altro | Technologie-Spezifikation für feststehende Roboter - Andere |
| **s_25** | Technology specification of fixed robot - Other | Teknologispecificering af fikseret robot - Andet | Τεχνολογική προδιαγραφές ρομπότ που είναι σταθερά κατά τη χρήση - Άλλο | Specyfikacja technologiczna robota stacjonarnego - Inne | Robot stationnaire (fixe) : technologie(s) supplémentaire(s) utilisée(s) - Autre | Tehnološke specifikacije fiksiranog robota - Ostale opcije | Especificación tecnológica del robot fijo - Otros | Specifiche tecnologiche del robot fisso - Altro | Technologie-Spezifikation für feststehende Roboter - Andere |
| **s_28** | Number of manipulators | Hvor mange manipulatorer? | Αριθμός ρομποτικών βραχιόνων (Manipulator(s)) | Proszę podać, liczbę manipulatorów przemysłowych | Nombre de manipulateurs | Broj manipulatora | Número de manipuladores | Numero di manipulatori | Anzahl der Manipulatoren |
| **s_29** | What is the robot's main power system? | Hvad er robottens primære power system? | Ποιο είναι το κύριο σύστημα ισχύος του ρομπότ; | Proszę podać główne źródło zasilania robota: | Quel est le système d'alimentation principal du robot? | Koji je glavni sistem napajanja robota? | ¿Cuál es el principal sistema de energía del robot? | Qual è il sistema di potenza principale del robot? | Welches ist das Hauptenergiesystem des Roboters? |
| **s_27** | What is the robot's main power system? - Other | Hvad er robottens primære power system? - Andet | Ποιο είναι το κύριο σύστημα ισχύος του ρομπότ; - Άλλο | Proszę podać główne źródło zasilania robota: - Inne | Quel est le système d'alimentation principal du | Koji je glavni sistem napajanja robota? - Ostale opcije | ¿Cuál es el principal sistema de energía del robot? - Otros | Qual è il sistema di potenza principale del robot? - Altro | Welches ist das Hauptenergiesystem des Roboters? - Andere |

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| | | | | | robot? - Autre | | | | |
| **s_31** | What is the robot's power requirements? | Hvad er robottens strømkrav? | Ποιες είναι οι απαιτήσεις ισχύος του ρομπότ? | Proszę podać jakie jest zapotrzebowanie robota na zasilanie: | Quelle est la puissance requise du robot? | Koji su zahtevi za napajanje robota? | ¿Cuáles son los requisitos de energía del robot? | Qual è il fabbisogno energetico del robot? | Wie hoch ist der Energiebedarf des Roboters? |
| **s_32** | What is does the user interface include? | Hvad er robottens brugerinterface? | Τι περιλαμβάνει το περιβάλλον αλληλεπίδρασης χρήστη (user interface)? | Proszę podać, co obejmuje interfejs użytkownika: | Que comprend l'interface utilisateur? | Šta uključuje korisnički interfejs? | ¿Qué incluye la interfaz de usuario? | Cosa comprende l'interfaccia utente? | Was umfasst die Benutzeroberfläche? |
| **s_30** | What is does the user interface include? - Other | Hvad er robottens brugerinterface? - Andet | Τι περιλαμβάνει το περιβάλλον αλληλεπίδρασης χρήστη (user interface)? - Άλλο | Proszę podać, co obejmuje interfejs użytkownika: - Inne | Que comprend l'interface utilisateur? - Autre | Šta uključuje korisnički interfejs? - Ostale opcije | ¿Qué incluye la interfaz de usuario? - Otros | Cosa comprende l'interfaccia utente? - Altro | Was umfasst die Benutzeroberfläche? - Sonstiges |
| **s_33** | What is the transport capacity? - Max carry capacity (kg) | Hvad er robottens transportkapacitet? (hvis relevant) - Max. bærevægt (kg) | Ποια είναι η ικανότητα μεταφοράς /ωφέλιμου φορτιού του ρομπότ; - Μέγιστο φορτίο (kg) | Jaka jest pojemność transportowa robota? - Maksymalny udźwig (kg) | Quelle est la capacité de transport du robot? - Capacité de charge maximale (kg) | Kolika je transportna nosivost? - Maksimalni kapacitet nosivosti (kg) | ¿Cuál es la capacidad de transporte? - Capacidad máxima de transporte (kg) | Qual è la capacità di trasporto? - Capacità massima di trasporto (kg) | Wie hoch ist die Transportkapazität? - Max. Tragekapazität (kg) |
| **s_34** | What is the transport capacity? - Max pull capacity (kg) | Hvad er robottens transportkapacitet? (hvis relevant) - Max. trækvægt (kg) | Ποια είναι η ικανότητα μεταφοράς /ωφέλιμου φορτιού του ρομπότ; - Μέγιστη ικανότητα έλξης (kg) | Jaka jest pojemność transportowa robota? - Maksymalna siła uciągu (kg) | Quelle est la capacité de transport du robot? - Capacité de traction maximale (kg) | Kolika je transportna nosivost? - Maksimalni vučni kapacitet (kg) | ¿Cuál es la capacidad de transporte? - Capacidad máxima de tracción (kg) | Qual è la capacità di trasporto? - Capacità massima di tiro (kg) | Wie hoch ist die Transportkapazität? - Max. Zugkapazität (kg) |
| **s_35** | What is the main mode of sensing mode in use for the task? | Hvad er det primære "sanse input" robotten bruger til at udføre en opgave? | Ποιος είναι ο κύριος τρόπος λειτουργίας ανίχνευσης που χρησιμοποιείται για την εργασία του ρομπότ; | Jakie jest główne źródło percepcji Robota? | Quelle est la principale modalité de détection utilisée pour la tâche? | Koji je glavni senzorni režim koji se koristi za obavljanje zadatka? | ¿Cuál es el modo principal de detección para realizar una tarea? | Qual è la principale modalità di rilevamento in uso per il compito? | Welcher Abtastmodus wird für die Aufgabe hauptsächlich verwendet? |

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| **s_36** | What is the main mode of sensing mode in use for the task? - Other | Hvad er det primære "sanse input" robotten bruger til at udføre en opgave? - Andet | Ποιος είναι ο κύριος τρόπος λειτουργίας ανίχνευσης που χρησιμοποιείται για την εργασία του ρομπότ; - Άλλο | Jakie jest główne źródło percepcji Robota? - Inne | Quelle est la principale modalité de détection utilisée pour la tâche? - Autre | Koji je glavni senzorni režim koji se koristi za obavljanje zadatka? - Ostale opcije | ¿Cuál es el modo principal de detección para realizar una tarea? - Otros | Qual è la principale modalità di rilevamento in uso per il compito? - Altro | Welcher Abtastmodus wird für die Aufgabe hauptsächlich verwendet? - Andere |
| **s_37** | What is the main type of actuator? | Hvad er robottens primære type af aktuator? | Ποιος είναι ο κύριος τύπος ενεργοποιητή (actuator); | Proszę, podać główny typ aktuatora: | Quel est le type d'actuateur principal? | Koji je glavni tip aktuatora? | ¿Cuál es el tipo principal de actuador? | Qual è il principale tipo di attuatore? | Was ist der Typ des Hauptaktors? |
| **s_38** | What is the main type of actuator? - Other | Hvad er robottens primære type af aktuator? - Andet | Ποιος είναι ο κύριος τύπος ενεργοποιητή (actuator); - Άλλο | Proszę, podać główny typ aktuatora: - Inny | Quel est le type d'actuateur principal? - Autre | Koji je glavni tip aktuatora? - Ostale opcije | ¿Cuál es el tipo principal de actuador? - Otros | Qual è il principale tipo di attuatore? - Altro | Was ist der Typ des Hauptaktors? - Andere |
| **s_39** | What is the type of gripper? | Hvilken type af griber har robotten? | Ποιος είναι ο τύπος του μηχανισμού αρπαγής (Gripper); | Proszę podać typ chwytaka: | Quel est le type de pince de préhension robotique utilisé? | Koja je vrsta hvataljke? | ¿Cuál es el tipo de pinza? | Qual è il tipo di pinza? | Um welche Art von Greifer handelt es sich? |
| **s_40** | What is the type of gripper? - Other | Hvilken type af griber har robotten? - Andet | Ποιος είναι ο τύπος του μηχανισμού αρπαγής (Gripper); - Άλλο | Proszę podać typ chwytaka: - Inny | Quel est le type de pince de préhension robotique utilisé? - Autre | Koja je vrsta hvataljke? - Ostale opcije | ¿Cuál es el tipo de pinza? - Otros | Qual è il tipo di pinza? - Altro | Um welche Art von Greifer handelt es sich? - Andere |
| **s_41** | What additional tools and sensor options are available from the manufacturers? | Hvilke ekstra værktøjer og sensorindstillinger er tilgængelige fra producenterne? | Ποια πρόσθετα εργαλεία και επιλογές αισθητήρων είναι διαθέσιμα από τους κατασκευαστές; | Proszę podać jakie dodatkowe części oraz czujniki są dostępne u producenta? | Quels outils et capteurs supplémentaires sont disponibles auprès des fabricants du robot? | Koje dodatne alatke i senzorne opcije su dostupne od strane proizvođača? | ¿Qué herramientas adicionales y opciones de sensores están disponibles de los fabricantes? | Quali strumenti aggiuntivi e opzioni di sensori sono disponibili dai produttori? | Welche zusätzlichen Werkzeuge und Sensoroptionen gibt es von den Herstellern? |
| **s_42** | What standard interfaces does the robot have for adding extra tools or sensors from other manufacturers? | Hvilke standard platforme har robotten til at tilføje ekstra værktøjer eller sensorer fra andre producenter? | Ποια πρόσθετα εργαλεία και επιλογές αισθητήρων είναι διαθέσιμα από τους κατασκευαστές? | Proszę podać jakie dodatkowe części oraz czujniki są dostępne u producenta? | De quelles interfaces standard le robot dispose-t-il pour ajouter des outils ou des capteurs supplémentaires d'autres | Koje standardne interfejse za dodavanje dodatnih alata ili senzora drugih proizvođača robot ima? | ¿Qué interfaces estándar tiene el robot para agregar herramientas o sensores adicionales de otros fabricantes? | Quali interfacce standard ha il robot per aggiungere strumenti extra o sensori di altri produttori? | Über welche Standardschnittstellen verfügt der Roboter, um zusätzliche Werkzeuge oder Sensoren von anderen Herstellern anzuschließen? |

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| | | | | | fabricants? | | | | |
| **s_43** | If multiple copies are purchased, do your robots work cooperatively as: | Hvordan fungerer dine robotter, hvis der købes flere kopier? | Εάν πολλά αντίγραφα των ρομπότ σας αγοραστούν, τα ρομπότ σας λειτουργούν ως συνεργατικά ως: | Jeżeli zostało zakupionych więcej robotów niż jeden, proszę podać jak one współpracują ze sobą: | Si plusieurs robots sont nécessaires pour réaliser la tâche, vos robots travaillent-ils de manière collaborative ? | Ukoliko se kupi više primeraka, da li vaši roboti funkcionisu kao: | ¿Si se compran diferentes unidades, sus robots funcionen de forma colaborativa? | Se si acquistano più copie, i robot lavorano in modo cooperativo come: | Wenn mehrere Exemplare gekauft werden, arbeiten die Roboter kooperativ als: |
| **s_44** | If multiple copies are purchased, do your robots work cooperatively as: - Other | Hvordan fungerer dine robotter, hvis der købes flere kopier? - Andet | Εάν πολλά αντίγραφα των ρομπότ σας αγοραστούν, τα ρομπότ σας λειτουργούν ως συνεργατικά ως: - Άλλο | Jeżeli zostało zakupionych więcej robotów niż jeden, proszę podać jak one współpracują ze sobą: - Inaczej | Si plusieurs robots sont nécessaires pour réaliser la tâche, vos robots travaillent-ils de manière collaborative ? - Mix (à préciser) | Ukoliko se kupi više primeraka, da li vaši roboti funkcionisu kao: - Ostale opcije | ¿Si se compran diferentes unidades, sus robots funcionen de forma colaborativa? - Depende: | Se si acquistano più copie, i robot lavorano in modo cooperativo come: - Altro | Wenn mehrere Exemplare gekauft werden, arbeiten die Roboter kooperativ als: - Andere |
| **s_45** | Does the robot offer software compatibility e.g. with different forms of data analysis system or fleet management system? | Tilbyder robottens software kompatibilitet med f.eks. med forskellige former for dataanalysesystemer eller flådestyringssystem? | Προσφέρει το ρομπότ σας συμβατότητα λογισμικού π.χ. με διαφορετικές μορφές συστήματος ανάλυσης δεδομένων ή συστήματος διαχείρισης στόλου; | Czy robot oferuje kompatybilność oprogramowania, np. z różnymi formami systemu analizy danych lub systemi zarządzania flotą (fleet management) ? | Le robot permet-il une compatibilité logicielle avec, par exemple, différentes formes de système d'analyse de données ou de système de gestion de flotte? | Da li robot nudi softversku kompatibilnost npr. sa različitim oblicima analize podataka ili sistema upravljanja flotom? | ¿El robot ofrece compatibilidad de software, por ejemplo, con diferentes formas de sistema de análisis de datos o sistema de gestión de flotas? | Il robot offre compatibilità software, ad esempio con diverse forme di sistema di analisi dei dati o di gestione della flotta? | Bietet der Roboter Softwarekompatibilität, z. B. mit verschiedenen Formen von Datenanalysesystemen oder Flottenmanagementsystemen? |
| **s_46** | Please elaborate on the software compatibility with few key words | Uddyb gerne softwarens kompatibilitet med få nøgleord | Παρακαλούμε αναφέρετε σχετικά με τη συμβατότητα του λογισμικού με λίγες λέξεις-κλειδιά | Proszę opisać kompatybilność oprogramowania w kilku słowach: | Explicitez cette éventuelle compatibilité logicielle via quelques mots clés: | Molimo Vas obrazložite detaljnije kompatibilnost softvera koristeći nekoliko ključnih reči | Por favor, explique la compatibilidad del software con pocas palabras clave | Si prega di elaborare la compatibilità del software con poche parole chiave | Bitte erläutern Sie die Softwarekompatibilität mit wenigen Stichworten |

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| **s_47** | Does the robot use AEF ISOBUS certified Tractor-implement-Management (TIM) communication when working in a fleet? | Bruger robotten AEF ISOBUS-certificeret Tractor-implement-Management (TIM) kommunikation, når den arbejder i en flåde? | Χρησιμοποιεί το ρομπότ σας επικοινωνία AEF ISOBUS με πιστοποίηση Tractor-implement-Management (TIM) όταν εργάζεται σε στόλο? | Proszę podać, czy robot korzysta z komunikacji Tractor-Implement-Management (TIM) z certyfikatem AEF ISOBUS podczas pracy we flocie? | Le robot utilise-t-il la communication TIM (Tractor-Implement-Management) certifiée AEF ISOBUS, lorsqu'il travaille au sein d'une flotte? | Da li robot koristi AEF ISOBUS sertifikovani vid komunikacije Traktor-Implementacija-Upravljanje (TIM) kada funkcioniše kao flota? | ¿Utiliza el robot la comunicación tractor-implement-management (TIM) certificada por AEF ISOBUS cuando trabaja en una flota? | Il robot utilizza la comunicazione Tractor-implement-Management (TIM) certificata AEF ISOBUS quando lavora in una flotta? | Verwendet der Roboter die AEF ISOBUS-zertifizierte Tractor-Implement-Management (TIM)-Kommunikation, wenn er in einer Flotte arbeitet? |
| **s_48** | What level of program flexibility does the robot use? | Hvad niveau af program flexibilitet har robotten? | Τι επίπεδο ευελιξίας προγραμματισμού χρησιμοποιεί το ρομπότ? | Proszę określićstopień elastycznośći oprogramowania Robota? | Quel niveau de flexibilité de programmation le robot présente-t-il? | Koji nivo fleksibilnosti programa robot koristi? | ¿Qué nivel de flexibilidad del programa utiliza el robot? | Che livello di flessibilità del programma utilizza il robot? | Welchen Grad an Programmflexibilität verwendet der Roboter? |
| **s_49** | What level of program flexibility does the robot use? - Other | Hvad niveau af program flexibilitet har robotten? - Andet | Τι επίπεδο ευελιξίας προγραμματισμού χρησιμοποιεί το ρομπότ? - Άλλο | Proszę określićstopień elastycznośći oprogramowania Robota? - Inne | Quel niveau de flexibilité de programmation le robot présente-t-il? - Autre | Koji nivo fleksibilnosti programa robot koristi? - Ostale opcije | ¿Qué nivel de flexibilidad del programa utiliza el robot? - Otros | Che livello di flessibilità del programma utilizza il robot? - Altro | Welchen Grad an Programmflexibilität verwendet der Roboter? - Andere |
| **s_50** | What standard communication interfaces does the robot have? | Hvilken standard kommunikationsinterface har robotten? | Τι τυπικές διεπαφές επικοινωνίας (communication interfaces) έχει το ρομπότ; | Prosze podać jakie standardowe interfejsy komunikacyjne posiada Robot: | Quelles interfaces de communication standards le robot comprend-il? | Koje standardne komunikacione interfejse ima robot? | ¿Qué interfaces de comunicación estándar tiene el robot? | Quali interfacce di comunicazione standard ha il robot? | Über welche Standard-Kommunikationsschnittstellen verfügt der Roboter? |
| **s_51** | How much human involvement is needed in robot use? | Hvor meget menneskelig involvering har robotten behov for? | Πόση ανθρώπινη συμμετοχή απαιτείται στη χρήση ρομπότ; | Proszę podać, jak duże zaangażowanie człowieka jest potrzebne w użytkowaniu robota: | Quelle est l'implication humaine nécessaire vis-à-vis de l'utilisation du robot? | Koliko ljudskog delovanja je potrebno za korišćenje robota? | ¿Cuánta participación humana se necesita en el uso del robot? | Quanto è necessario il coinvolgimento umano nell'uso dei robot? | Wie viel menschliche Beteiligung ist bei der Verwendung des Roboters erforderlich? |
| **s_52** | How much human involvement is needed in robot use? - Other | Hvor meget menneskelig involvering har robotten behov for? - Andet | Πόση ανθρώπινη συμμετοχή απαιτείται στη χρήση ρομπότ; - Άλλο | Proszę podać, jak duże zaangażowanie człowieka jest potrzebne w użytkowaniu robota: - Inne | Quelle est l'implication humaine nécessaire vis-à-vis de l'utilisation du robot? - Autre | Koliko ljudskog delovanja je potrebno za korišćenje robota? - Ostale opcije | ¿Cuánta participación humana se necesita en el uso del robot? - Otros | Quanto è necessario il coinvolgimento umano nell'uso dei robot? - Altro | Wie viel menschliche Beteiligung ist bei der Verwendung des Roboters erforderlich? - Andere |

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| **s_53** | How often is manual adjustment or maintenance needed? | Hvor ofte skal robotten manuelt justeres eller vedligholdes? | Πόσο συχνά απαιτείται χειροκίνητη ρύθμιση ή συντήρηση; | Proszę podać jak często wymagana jest ręczna regulacja lub utrzymanie stanu zdatności Robota: | Combien de fois un ajustement ou un travail de maintenance manuel est-il nécessaire? | Koliko često je neophodno ručno podešavanje ili održavanje? | ¿Con qué frecuencia se necesita ajuste o mantenimiento manual? | Quanto spesso è necessaria la regolazione manuale o la manutenzione? | Wie oft ist eine manuelle Justierung oder Wartung erforderlich? |
| **s_54** | What keeps the humans safe? | Hvilket sikkerhedssystem benytter robotten? | Αυτό που κρατά τους ανθρώπους ασφαλείς; | Proszę podać co zapewnia ludziom bezpieczeństwo przy użytkowaniu Robota? | Comment la sécurité des personnes évoluant autour du robot est-elle assurée? | Šta je to što čini ljude bezbednima? | ¿El robot dispone de sistemas de seguridad para la integridad de los humanos? | Cosa tiene al sicuro gli umani? | Wie wird die Sicherheit des Menschen gewährleistet? |
| **s_55** | What keeps the humans safe? - Other | Hvilket sikkerhedssystem benytter robotten? - Andet | Αυτό που κρατά τους ανθρώπους ασφαλείς; - Άλλο | Proszę podać co zapewnia ludziom bezpieczeństwo przy użytkowaniu Robota? - Inne | Comment la sécurité des personnes évoluant autour du robot est-elle assurée? - Autre | Šta je to što čini ljude bezbednima? - Ostale opcije | ¿El robot dispone de sistemas de seguridad para la integridad de los humanos? - Otros | Cosa tiene al sicuro gli umani? - Altro | Wie wird die Sicherheit des Menschen gewährleistet? - Andere |
| **s_56** | Is your robot's work permissible under strict organic farming regulations? | Er det tilladt for din robot at arbejde indenfor økologisk landbrug? | Επιτρέπεται η εργασία του ρομπότ σας σύμφωνα με αυστηρούς κανονισμούς βιολογικής καλλιέργειας; | Proszę podać, czy praca Robota jest dozwolona zgodnie z surowymi przepisami dotyczącymi rolnictwa ekologicznego? | Le robot que vous utilisez est-il certifié conforme vis-à-vis des réglementations strictes en matière d'agriculture biologique (à l'échelle européenne mais aussi à celle de la France)? | Da li je rad Vašeg robota dozvoljen po strogim propisima organske poljoprivrede? | ¿El robot puede trabajar siguiendo las regulaciones de agricultura ecológica? | Il lavoro del vostro robot è ammissibile secondo i rigidi regolamenti dell'agricoltura biologica? | Ist die Arbeit Ihres Roboters unter den strengen Vorschriften des ökologischen Landbaus zulässig? |
| **s_57** | Do you customize your robot for new customers? | Tilpasses robotten til kunderne eller til specifikke brugsscenarier? | Προσαρμόζετε το ρομπότ σας για νέους πελάτες? | Proszę podać, czy Robot zostaje dostosowywany do nowych klientów? | Personnalisez-vous votre robot pour de nouveaux clients (d'un point de vue technique, | Da li prilagođavate robota novim kupcima? | ¿Personalizas tu robot para nuevos clientes? | Personalizzate il vostro robot per I nuovi clienti? | Passen Sie Ihren Roboter für neue Kunden an? |

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 825395

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | esthétique, etc.)? | | | | |
| **s_58** | Do you customize your robot for new customers? - Sometimes, depends on the type of customer | Tilpasses robotten til kunderne eller til specifikke brugsscenarier? - Nogle gang - afhængig af typen af kunde | Προσαρμόζετε το ρομπότ σας για νέους πελάτες? - Μερικές φορές, εξαρτάται από τον τύπο του πελάτη | Proszę podać, czy Robot zostaje dostosowywany do nowych klientów? - Czasami zależy to od rodzaju klienta | Personnalisez-vous votre robot pour de nouveaux clients (d'un point de vue technique, esthétique, etc.)? - Quelques fois, cela dépend du type de clients | Da li prilagođavate robota novim kupcima? - Ponekad, zavisi od kupca | ¿Personalizas tu robot para nuevos clientes? - A veces, depende del tipo de cliente | Personalizzate il vostro robot per I nuovi clienti? - A volte, dipende dal tipo di cliente | Passen Sie Ihren Roboter für neue Kunden an? - Manchmal, hängt von der Art des Kunden ab |
| **s_59** | Do you have any other important key words about the robot you wish to add? | Er der andre vigtige nøgleord til beskrivelsen af robotten? | Έχετε άλλες σημαντικές λέξεις κλειδιά για το ρομπότ σας που θα θέλετε να προσθέσετε; | Czy chciał/a Pan/Pani dodać jakieś inne ważne słowa dotyczące robota | L'enquête étant presque terminée, avez-vous d'autres mots clés importants au sujet du robot que vous souhaitez ajouter, pour compléter cette étude? | Da li imate još neku ključnu reč koju želite da dodate o Vašem robotu? | ¿Tienes otras palabras clave importantes sobre el robot que deseas añadir? | Hai altre parole chiave importanti sul robot che vorresti aggiungere? | Haben Sie weitere wichtige Stichwörter zum Roboter, die Sie hinzufügen möchten? |
| **s_60** | Please add a few sentences about the way that this robot will benefit agri-food robotics in Europe | Hvilket potentiale/fordele har robotten specifikt for agri-food industrien? | Προσθέστε μερικές προτάσεις σχετικά με τον τρόπο με τον οποίο αυτό το ρομπότ θα ωφελήσει τη ρομποτική γεωργίας και τροφίμων (agri-food) στην Ευρώπη; | Proszę dodać kilka zdań o tym, w jaki sposób ten Robot przyniesie korzyści robotyce rolno-spożywczej w Europie: | Veuillez décrire ici de manière un peu plus explicite la manière dont ce robot profitera à la robotique dans le domaine agroalimentaire en Europe | Molimo Vas, u nekoliko rečenica objasnite na koji način će Vaš robot doprineti poljoprivredno-prehrambrenoj robotici u Evropi | Por favor, introduzca algunas frases sobre la forma en que este robot beneficiará a la robótica agroalimentaria en Europa. | Si prega di aggiungere qualche frase sul modo in cui questo robot gioverà alla robotica agroalimentare in Europa | Bitte fügen Sie ein paar Sätze darüber hinzu, wie dieser Roboter der Agrar- und Lebensmittelrobotik in Europa zugutekommen wird. |

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# Appendix C

## Full catalogue and survey results

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 825395

# AGRICULTURAL ROBOTICS

## A European Catalogue

agRO
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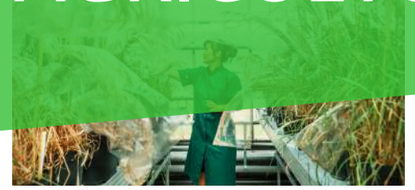
food

# Why AGRICULTURAL ROBOTICS?



In the years to come, the agriculture industry will be facing some major challenges. One factor is the expected growth of the world's population which is expected to grow to more than 9 billion people in 2050. Growing prosperity is the developing economies which is accompanied with diet changes and increased food demand combined with the higher educational expectancy and later job requirements. Labour participation in the agricultural sector has decreased considerably: e.g. the Netherlands in 1900 it was 30%, now it is 2.6% - when GDP increases, labour participation in agriculture decreases (EU, 2021). Therefore, the positioning of human labour is an important issue in the European agricultural sector. Until recently, agricultural technology was mostly based on mechanical engineering. However, this is gradually changing into electronics, sensors, computing hardware and software, the Internet and wireless communications which have entered the agricultural domain. It is expected that this evolution of technology will continue to advance towards sensing, artificial intelligence, advanced mechatronics and with connectivity as key component. These technologies expected to impact on future agricultural production and the food industry - nonetheless the future is now.

## Purpose of the Catalogue

The intent with mapping available technologies in the agri-food sector is to promote robot deployment and ultimately, to create better solutions with improved flexibility and effectiveness, better interfacing, standardization, etc., and all for a lower purchase price. The scope of the technology map that we want to build includes robot solutions for all aspects of agri-food from planning and production through processing, packing, and transportation and up to the food being served at the table. It includes technologies that are already commercially available and those expected to become market-ready over the next two years. It does not include lower TRLs.

### Definitions

For the purposes of this catalogue we define the following:

**Agri-food:** anything involved in the processes that result in human food ready to be eaten, from soil preparation through plants (through fodder and animal care) through "harvesting" and raw preparation through cooking and shops to dining table

**Robot**: a machine programmed by computer, that:

Reliably* performs complex physical action in the real world

Automatically adjusts at some of its actions according to sensor input

* Reliable: can work as intended for as many hours as needed with only vary rare stops for unscheduled maintenance. In practice, this means that robots that are already commercially available or nearly so, e.g. in field trials.

### Is your robot not here?

If you have additions or corrections to the catalogue, please fill out this survey (www.survey-xact.dk/LinkCollector?key=6CY3K6XPJ692) to have it included in a later version of the catalogue. For other questions related to this report, contact Rune Hahn Kristensen (rhk@dti.dk).

agRO BO food presents:

# European Robotic Systems for Agricultural Application

## FarmDroid

"FarmDroid FD20 is an innovative field robot that helps farmers and growers reduce costs of sowing and weeding crops while also doing it in a CO2 neutral and ecological way. FarmDroid is the creator of a remarkable invention for agriculture; an automatic light weight field robot that automates sowing and weed removal on farmland. This means that the soil is cultivated in an ecological and CO2 neutral way and without risk of doing structural damage to the soil because of heavy equipment." - FarmDroid.com

### Information

Company: FarmDroid ApS (Vejen, Denmark)
Launch year: 2018
Application area: Plant care
Price: 50,000 euro
EMC certification: Yes
Organic farming: Yes
Sensor input: GPS positioning
Energy input: Renewable energy source (solar, wind)
Carrying capacity: 4x35 kg
Transport capacity: N/A
Fleet management compatibility: No
Maintance: More than once a day
Safety Level: The robot has safety certification for independent tasks in

### Key words

Completely autonomous mobile ground robot for seeding and weeding crops, inter-row and intra-row weeding, seeding, solar-powered, ecological farming. Reduction of manual labour in seed and weed process. Screen interface - permanently fixed or by smartphone. Blade(s). Automatically adjusts parameters (via sensor feedback). Customizable.

Learn more at: www.farmdroid.dk/en/product/

## Oz

"Oz reduces the risk of loss of production and therefore helps to secure operating income." - Naïo Technologies.com (2021)

"An easy-to-use tool that brings peace of mind to operations management." - Naïo Technologies.com (2021)

### Information

Company: Naïo Technologies (Escalquens, France)
Launch year: 2013
Application area: Field maintenance
Price: From € 9,950 excluding annual GPS subscription and tool pack
EMC certification: Yes
Organic farming certification: N/A
Energy source: Batteries
Sensor input: GPS RTK
Communication interfaces: N/A
Carrying capacity: 150 kg
Transport capacity: 300 kg
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

### Key words

Completely autonomousl mobile ground robot. RTK GPS guidance system. Work output; 1000m²/hour. Speed; Up to 1.8 km/h. Traction; 300 kg.

Learn more at: www.naio-technologies.com/en/oz/

# AgBot

"Works with existing implements the farmer already has in use today; this will facilitate a smooth transition towards autonomy!
Our AgBot is a universal enabler that can work with any equipment the farmer already has in use today to provide maximum employability leading to short ROI and rapid growth of the autonomy market." - Agxeed (Survey, 2021)

## Key words

Mobile robot for stubble cultivation, seeding, drilling, crop protection, ploughing, mowing, swathing, etc. Outdoor and rough terrain capabilities. Tracks maneuvering.. Webbased portal, smartphone app & RC, Conventional tractor applications. 360 degree camera. Cat 2 and 3 hitches, hydraulic auxiliary valves, PTO, ISOBUS & ISOBUS high voltage. Software compability with GEOJSON, CSV, JSON, KML. (Re)programmed on-site by the operator. Human interaction involves: digital task planning in advance, transportation to and from the field, finetuning (if needed) of the pre-planned task, maintenance. Customizable.

Learn more at: www.agxeed.com

## Information

Company: AgXeed (Oirlo, The Netherland)
Launch year: 2022
Application area: Universal enabler for any agricultural arable & vegetable farming
Price: 225.000 euro
EMC certification: Yes
Organic farming certification: Not yet
Energy source: Internal combustion (55 to 115kW)
Sensor input: Combination of Aural, Visual & Tactile
Communication interfaces: 4G communication, WiFi.
Carrying capacity: 3000 in front hitch and 8000 in rear hitch
Pull capacity: 105kW
Fleet management compatibility: Both independently and in teams is targeted
Maintance: N/A
Safety measures: The robot slows and/or stops when humans present

# NAUST Robotics

"Fully autonomous drone-in-a-box platform. Our autonomous drone platform repels birds from agricultural fields meanwhile collecting data about the health of the crops. WIthout any human intervention" - NAUST Robotics (2021)

## Information

Company: NAUST Robotics ApS (Denmark, Odense)
Expected launch year: 2023-2024
Application area: Plant care: Removing pests and weeds; monitoring and dealing with disease, nutrient and water deficiency, etc.
Price: 1000 / month
EMC certification: Yes
Organic farming certification: N/A
Energy source: Batteries
Sensor input: Visual
Communication interfaces: N/A
Carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: Independently
Maintance: Less than once a month
Safety measures: The robot has safety certification for independent tasks in the same workspace as humans

## Key words

Completely autonoumous arial Robot for Bird scaring, Precision agriculture. Hest camera. Autonomous operation with charging station. Main electrical power from cables or from solar panels/windmill. Controlled by Smartphone app. (Re)programmed on-site by the operator.

Learn more at: www.naustrobotics.com

# Aisprid

"Intelligent and autonomous, our Harvy robot merges cutting-edge technology and in-depth knowledge of the daily life of horticulturalists." - Aisprid.com (2021)

## Key words

Selecting clusters with good ripening, clean and precise, flush with the stem cutting. No tool change necessary to switch the robot to "deleafing" mode. Decision support for horticulturalists: detection of insects and diseases, optimization of yields, predictive models

Learn more at: www.aisprid.com

## Information

Company: Aisprid (France, Saint-Malo)
Launch year: N/A
Application area: Harvesting/deleafing of tomato and strawberry
Price: N/A
EMC certification: Yes
Organic farming certification: N/A
Energy source: N/A
Sensor input: N/A
Communication interfaces: N/A
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

# Thorvald

"Thorvald navigates autonomously using proprietary state of the art software and is operated via an intuitive, easy to use interface. Autonomous navigation has been tested by robot operation over thousands of kilometres in challenging, real-world agricultural environments including polytunnels, open fields and vineyards throughout the world." - sagarobotics.com

## Information

Company: Saga Robotics
Launch year: 2016
Application area: N/A
Price: N/A
EMC certification: Yes
Organic farming certification: N/A
Energy source: N/A
Sensor input: N/A
Communication interfaces: N/A
Carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

## Key words

Good for your plants/vines - Powdery mildew is an expensive problem which needs tight control. Thorvald provides that control, protecting your valuable plants/vines through the application of UV-C light, each and every night.

Learn more at: www.sagarobotics.com/thorvald-platform/

# Vitirover

"VITIROVER robots are eco-friendly and cost effective.
They preserve the environment and precisely control soil grassing without using glyphosate. Their light weight prevents soil squeezing that will occur with tractors or horses." - Vitirover.com (2020)

## Key words

Completely autonomous mobile robot. Separate computer or tablet for control, cameras, meteo, son, radar tools, operates in teams/swarm, on-site programming. Customizable. Modifies the process of pruning vine plantations

Learn more at: www.vitirover.com

## Information

Company: VITIROVER SAS (Saint Emilion, France))
Launch year: N/A
Application area: Plant care
Price: 2000 euro
EMC certification: Yes
Organic farming certification: Yes
Energy source: Renewable (20w)
Sensor input: Tactile
Communication interfaces: 2-3-4G, Bluetooth, wifi, et GNSS
Transport capacity: N/A
Fleet management compatibility: Yes
Maintance: More than once a month
Safety measures: The robot has safety certification for independent tasks in the same workspace as humans

# SUMMIT-XL

"SUMMIT-XL is a highly versatile Autonomous Mobile Robot (AMR) capable of carrying loads of up to 65 Kg. The mobile robot can navigate autonomously or be teleoperated by means of a Pan-Tilt-Zoom camera that transmits video in real time. The platform allows two types of configurations: with mecanum wheels or with rubber wheels. (...) makes the robot an agile and highly mobile vehicle." - Robotnik.com (2021)

## Information

Company: Robotnik Automation S.L.L. (Valencia, Spain)
Launch year: N/A
Application area: Plant care
Price: N/A
EMC certification: Yes
Organic farming certification : N/A
Energy source: Battery
Sensor input: Hokuyo laser scanner and RTK-DGPS kits
Communication interfaces: WiFi 802.11n
Carrying capacity: 65 kg
Transport capacity: 65 kg
Fleet management compatibility: Yes
Maintance: N/A
Safety measures: N/A

## Key words

Completely autonomous mobile field robot. Indoor, Outdoor and rough terrain capabilities. Internal and external connectivity to easily connect all kinds of components. Traction motors: 4 x 500 W brushless servomotors. Temperature range: 0° to +50 °C. . Controller: Open architecture ROS and/or PC with Linux integrated. Autonomy: 10 h

Learn more at: https://robotnik.eu/products/mobile-robots/summit-xl-en-2/

# MIXTY

"The system is economically accessible for small and medium farmers, able to enhance the eco-friendly growth and suitable for the steep terrains of the most exquisite European vineyards. MIXTY differs from similar technologies already present on the market thanks to the specific system design and technology implemented, guaranteeing a more precise and accurate farm monitoring (versus the standard based on drones

## Key words

Completely autonomous Mobile robot for plant care - specifically vineyard disease prevention monitoring. Controled by Separate computer or tablet. Outdoor with rough terrain capabilities. Automatically adjusts parameters (via sensor feedback). Precise and accurate farm monitoring.

## Information

Company: Barbieri srl (Rome, Italy)
Expected launch year: 2022-2023
Application area: Plant care
Price: 15,000 euro
EMC certification: In progress
Organic farming certification: Not yet
Energy source: Batteries
Sensor input: Visual
Communication interfaces: N/A
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: More than once a week
Safety measures: The robot slows and/or stops when humans present

# Ecobotix bio control

Bio-control agents, such as ladybirds, predators and parasitic wasps, provide a strong alternative to the use of chemical insecticides. With the help of our unique drone-based solutions, we are able to ensure an even and rapid spread of useful animals over your fields, which will effectively protect your crops from pests such as aphids and mites." - Ecobotix (2021)

## Information

Company: Ecobotix SA (Slagelse, Denmark)
Expected launch year: 2021
Application area: Plant care
Price: 4,000 euro
EMC certification: Yes
Organic farming certification : Yes
Energy source: Batteries
Sensor input: Visual
Communication interfaces: MQTT
Carrying capacity: 200 kg
Fleet management compatibility: N/A
Maintance: Less than once a month
Safety measures:The robot has safety certification for collaborative working

## Key words

Autonomous drone bio-control-applicator. Controlled by Smartphone app (remote control). GPS. Can operate in swam teams. Automatically adjusts parameters (via sensor feedback).

Learn more at: www.Ecobotix.com

# BugVac

"The Bug Vacuum has a double-fan vacuum system to ensure a uniform airflow over the whole bed width. Optimum vacuum pressure is achieved due to its precise fan-height control, maximizing bugs aspiration. In compliance with food safety standards, fan inlet is made of stainless steel and food-grade silicone" - Agrobot.com (2021)

## Key words

Mobile ground for care Strawberries by Lygus and pest prevention. Rough terrain capabilities. Joystick/RC controller. Fans as primary actuator. Automatically adjusts parameters (via sensor feedback). Completely autonomous.

Learn more at: www.agrobot.com/bugvac

## Information

Company: Agrobot (La Palma del Condado, Spain)
Launch year: N/A
Application area: Plant Care
Price: N/A
EMC certification: In Progress
Organic farming certification: Yes
Energy source: Internal combustion
Sensor input: Visual
Communication interfaces: N/A
Carrying capacity: 1000 kg
Transport capacity: 1000 kg
Fleet management compatibility: N/A
Maintance: More than once a week
Safety measures: The robot slows and/or stops when humans present

# Robot One

"Robot One is designed for chemical free weedcontrol. But it is also suitable for Pixelfarming (mixed cropping) in largescale biodiverse enviroments. Pixelfarming with Robot One is our solution for sustainable agriculture." - PixelFarming (2021)

## Information

Company: PixelFarming Robotics (Almkerk, Netherlands)
Expected launch year: 2022/23
Application area: Plant care
Price: 185,000 euro
EMC certification: In progress
Organic farming certification: Not yet
Energy source: Renewable (2-5 kW)
Sensor input: Visual
Communication interfaces: powerful CPU with 4G
Transport capacity: N/A
Fleet management compatibility:N/A
Maintance: N/A
Safety measures: The robot will be provided with obstacle detection

## Key words

Autonomous mobile robot for chemical free weedcontrol, specific crop treatment, large scale biodiverse environments. Ourdoor. Various actuators on arms - Possible to apply multiple actuators like grippers, hoes, streamers. Screen on the robot and seperate computer/tablet. Team operated. Software compatibility; Digital Twin, cloud solution, from plant recognition to path planning. Remote controlled. Fully electric, with solar panels, light weight <2500KG, Vision, data collection

Learn more at: pixelfarmingrobotics.com/robot-one#robot-one

# Tom

"Farmers can pull together and aggregate multiple layers of farm data and farm management information."

## Key words

Mobile field robot for arable crops, plant count, weed detection, crop health, slug treatment and general soil health. Controlled by separate computer or tablet. Equiped with conveyor. Multi spectral imagery. Soil sensors. Automatically adjusts parameters (via sensor feedback). The robot must be continuously monitored

Learn more at: https://www.smallrobotcompany.com/

## Information

Company: Small Robot Company (West Dean, United Kingdom)
Launch year: 2021
Application area: Plant Care
Price: Per hectare subscription (FAAS)
EMC certification: In Progress
Organic farming certification: Yes
Energy source: Batteries (500 W)
Sensor input: Visual
Communication interfaces:
Carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: Yes
Maintance: More than once a day
Safety measures: Robot handler is present even when autonomous routing is active

# Meropy - SentiV

"SentiV is a scouting robot that highlights the variability within field crops plots and detects potential threats to crops. Being in contact with the ground, we are talking about near sensing.

SentiV is dedicated to agricultural professionals: it is a tool to improve practices for farmers, a farm advisory solution for coops, and an indispensable element to optimize phenotyping on experimental plots." - meropy.com (2021)

## Information

Company: Meropy (Meylan, France)
Launch year: 2021
Application area: Plant care
Price: 5.000 euro/y
EMC certification: No
Organic farming certification: Not yet
Energy source: Batteries
Sensor input: Visual
Communication interfaces: LTE
carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: No
Maintance: Less than once a month
Safety measures: The robot has safety certification for independent tasks in the same workspace as humans

## Key words

Completely autonomous mobile ground robot used for scouting, monitoring, surveillance of maladies, ravageurs, and adventices. Outdoor and rough terrain capabilities. Controlled by separate computer or tablet. Operates in swarm teams. Automatically adjusts parameters (via sensor feedback). Possibility of customization if demanded.

Learn more at: meropy.com/en/robot.html

# XDR

"X-drive Robots rover is the first fully automated multi-functional robot. Using the lastest ultra-sound navigation systems and 4x4 wheel drive to maneuver in all types of weather and all environments" - xdriverobots.com

### Key words

Autonoumous mobile robot for riding area harrow maintenance. Outdoor and rough terrain capabilities. Controlled by Smartphone app. Equipped with towbar. Pulling of tools attached to rear or beneath robot. Many programming possibilities. Customizable. High capacity and operation time. Extremely robust.

Learn more at: www.xdriverobots.com

### Information

Company: X-Drive Robots ApS (Roskilde, Denmark)
Launch year: 2022
Application area: Soil management and maintenance
Price: 70.000 euro
EMC certification: In progress
Organic farming certification: Yes
Energy source: Batteries
Sensor input: Ultrasound and radar
Communication interfaces: Wi-Fi, bluetooth
Carrying capacity: 1000 kg
Transport capacity: 500 kg
Fleet management compatibility: Team/swarm
Maintance: Less than once a month
Safety measures: Several safety features

# AVO

"AVO performs autonomous weeding operations in plane fields and row crops. Using cutting-edge machine learning, the robot detects and selectively sprays the weeds with a micro-dose of herbicide. The centimeter-precise detection and spraying reduces the volume of herbicide used by more than 95%, while ensuring crops are not sprayed for yield preservation." - EcoRobotix (2021)

### Information

Company: ecoRobotix SA (Yverdon-les-Bains, Suisse)
Expected launch year: N/A
Application area: Plant care
Price: N/A
EMC certification: No
Organic farming certification : No
Energy source: Renewable energy source
Sensor input: Visual
Communication interfaces: industrial BUS-systems; ethernet; ...
Carrying capacity: 200 kg
Fleet management compatibility: WIFI, GSM
Maintance: Manual adjustment or maintenance is needed more than once a day
Safety measures:The robot slows and/or stops when humans present

### Key words

Completely autonomous mobile field robot for weeding and spraying. Controlled by separate computer or tablet. Sprayer as primary actuator. Operates by pre-set programs

Learn more at: www.ecorobotix.com/en/avo-autonomous-robot-weeder/

# Rovitis

"The Rovitis 4.0 project proposes a highly innovative system for the Veneto wine sector: a robotic management of the vineyard, which is based on the dialogue between a robotic means, sensors and a DSS (Decision Support System) software.
The idea is that of a self-managed company, capable of intervening in the field based on the real risks to which the crop is subject and minimizing the intervention of staff." Roviti.com (2021) (Translated)

### Key words

Completely autonomous mobile robot used in vineyards for pesticide control. outdoor rough terrain capabilities. Control by Smartphone app. Sprayer actuator. Includes Lidar and GPS tools, Software compatibilities; ROS, TCP/IP,J1939,CANopen, IEC 61508:2010. Learns its own program. Customizable.

Learn more at: www.rovitis.com

### Information

Company: az. agr. Giorgio Pantano (Candiana (pd), Italy)
Expected launch year: 2023
Application area: Plant care
Price: 50,000 euro
EMC certification: No
Organic farming certification : No
Energy source: Hydraulic (28kW)
Sensor input: Visual
Communication interfaces: wifi,Internet
Carrying capacity: 1000 kg
Transport capacity: 2000 kg
Fleet management compatibility: Yes
Maintance: Less than once a month
Safety measures: The robot slows and/or stops when humans present

# Robotti150D

"Autonomous machine is capable of carrying out seeding, weeding, harrowing, grass cutting, rotavating, power harrowing and spraying. Autonomously controlled by GPS via an onboard computer, the Robotti 150D follows a pre-programmed planned route in the field without the need for a human driver." Agrointelli (2021)

### Information

Company: AgroIntelli (Aarhus, Denmark)
Launch year: 2019
Application area:
Price: 161,000 euro
EMC certification: Yes
Organic farming certification: Yes
Energy source: Internal combustion
Sensor input: Vision
Communication interfaces
Transport capacity: 750 kg
Fleet management compatibility: Yes
Maintance: Manual adjustment or maintenance is needed more than once a day
Safety measures: The robot slows and/or stops when humans present

### Key words

Autonomous mobile field robot. Tool carrier. Cultivate and prepare a seedbed. Sowing/ planting. Weeds removal by mechanical /chemical cleaning,. Button-screen user interface. 3 points suspension.. Customizable. High precision.

Learn more at: www.agrointelli.com

# FFRobot

"FFRobotics presents a unique and patented Robotic Fruit Harvester – the FFRobot: A reliable, robust harvesting platform emulating human-hand picking process for efficient, cost-effective and bruise-free fruit harvesting. opportunity for farmers/growers to meet challenges of finding and retaining labor, rising labor costs and potential damage to hand-picked fruit - by reducing, supplementing or replacing human pickers from the dwindling pool of harvesting labor." - FFRobotics.com (2021)

## Information

Company: FFRobotics Ltd. (Isreal)
Expected launch year: 2021 (late)
Application area: Harvesting
Price: A service fee per bin of picked fruit
EMC certification: Yes
Organic farming certification: Not yet
Energy source: Internal combustion (petrol/diesel/biogas/other)
Sensor input: Visual
Communication interfaces: N/A
Carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: No
Maintance: More than once a month
Safety measures: Humans are excluded from the robot's working space

### Key words

Completely autonomous mobile ground robot for bloom thinning & pruning. Manipulators. Controlled by buttons or screen permanently attached to the robot. 3-fingergrippers as primary actuator. Automatically adjusts parameters (via sensor feedback). Emulates human mind-eye-hand interaction

Learn more at: www.ffrobotics.com

# EOX 175

"The first electric tractor with a hydrogen stack as its energy source, meaning no CO2 or NOx emissions. The pulling power is better distributed and the soil is less compacted so remains healthier.
EOX 175 can be delivered with a cabin and full GPS-RTK automation and without cabin for full autonomous driving on field." - H2Trac (2021)

## Information

Company: H2Trac bv (IJsselstein - Arnhem, The Netherlands)
Launch year: 2021
Application area: Operate as an general tractor
Price: 280.000 euro
EMC certification: Yes
Organic farming certification: Yes
Energy source: Range extender using hydrogen or diesel, biogas
Sensor input: GPS RTK
Communication interfaces: wifi, g3, g4 and g5
Carrying capacity: 7000 kg
Transport capacity: 7000 kg
Fleet management compatibility: Yes
Maintance: More than once a day
Safety measures: Robot is remote controlled by operator

### Key words

CTF, Infra, plant care, master slave, autonomous. 175 HP. Controlled by separate computer or tablet. Electric motors within the wheels. Tool interface; iso bus. Operates in swarm teams. Uses AEF ISOBUS certified TIM communication when working in a fleet. Learns its own program. Remote controlled. Customizable

Learn more at: www.e-ox.nl

# eTrac

"A first full electric demo model of the unmanned clean tech tractor, called the eTrac. Farmertronics will make a next step in smart and sustainable farming by the development of an unmanned clean tech robot tractor to work the land, not running on diesel but electrically driven. The electricity to drive this tractor will be generated and temporary stored at the farm. With this development a cross-over will be made between the sectors high tech, automotive and agriculture. " farmertronics.com (2021)

## Information

Company: Farmertronics Engineering BV (Deurne, The Netherlands)
Expected launch year: 2022
Application area: Plant care
Price: 80.000 euro
EMC certification: In progress
Organic farming certification: No yet
Energy source: Batteries
Sensor input: Visual
Communication interfaces: CANopen, Wifi, 4G
Carrying capacity: 2000 kg
Transport capacity: N/A
Fleet management compatibility: No
Maintance: Less than once a month
Safety measures: The robot slows and/or stops when humans present

### Key words

Completely autonomous mobile ground robot/light weight tractor for caretaking of Apples, Pears, Rasberries, Blue berries. Outdoor and rough terrain capabilities. Controlled by separate computer or tablet. Sprayer as primary actuator. Mower as additional tools expansion. Tool interfaces; CANopen, 400VAC, 24VDC. Operates on pre-set programs. Customizable.

Learn more at: www.farmertronics.com/

# TREKTOR

"Trektor is hybrid, autonomous and it uses the farmer's existing tools" - SITIA (2021)

"(...) Trektor is a tractor, it makes it possible to fill the shortage of personnel, to reduce the arduousness of the work and to help the farmer on a daily basis. TREKTOR can change it width (wheelbase) or his height (adjustable ground clearance) to adapt himself to the crop." - SITIA (2021)

## Information

Company: SITIA (Bouguenais, France)
Launch year: N/A
Application area: Harvesting (of livestock)
Price: N/A
EMC certification: Yes
Organic farming certification : Not yet
Energy source: Hybride Rechargeable Diesel/électrique
Sensor input: Visual
Communication interfaces: N/A
Carrying capacity: 700 kg
Transport capacity: 1000 kg
Fleet management compatibility: Yes
Maintance: More than once a month
Safety measures: Humans are excluded from the robot's working space

### Key words

Fully autonomous mobile field robot. Indoor, Outdoor and rough terrain capabilities. Control proposed options; buttons, tablet, app and remote control. Blade actuator, hydraulic, electrical, mechanical interfaces as well as a CAN network allowing the addition of inputs / outputs. Operates in swam teams. On-site programming by operator. Customizable

Learn more at: www.sitia.fr/en/innovation-2/trektor/

# Acrobat

"Acrobat is the newest transportation vehicle for greenhouses, agriculture and logistics management. Like Ants it can work as one peace of a big system connect with more robots to allow a eficient and simple management in production site. It is able to follow workers and drive in tight spaces deu to his optmized ackerman steering system." - ANTRobotics (2021)

## Key words

Completely autonomous mobile robot for fruits transportation. Outdoor and Indoor (greenhouses). Rough terrain capabilities. Precise RTK localization. Autonomy to 8h. Person following capabilities. 48V batteries supply. Wi-Fi. CANopen. Pre-set programs. Controlled by separate computer or tablet. On site programming by specialist. Customizable

Learn more at: www.antrobotics.pt

## Information

Company: Amorins, LDA (Póvoa de Varzim, Portugal)
Expected launch year: 2022-2023
Application area: Transport, operator following and sorting
Price: N/A
EMC certification: In progress
Organic farming certification: Not yet
Energy source: Batteries
Sensor input: GPS RTK
Communication interfaces: USB, CANopen, Wi-Fi
Carrying capacity: 250 kg
Transport capacity: N/A
Fleet management compatibility: Team/Swarm
Maintance: Less than once a month
Safety measures: The robot slows and/or stops when humans present

# RB-VOGUI

"RB-VOGUI is a general purpose mobile platform designed to target logistics tasks.

The robot has a relevant mobility and is able to follow a human operator autonomously and to navigate autonomously indoor and outdoor. In this sense, RB-VOGUI is suitable for logistics tasks in warehouses or pick & transport & place application" Robotnik.com (2021)

## Information

Company: Robotnik Automation S.L.L (Valencia, Spain)
Launch year: N/A
Application area: Plant Care/General
Price: N/A
EMC certification: N/A
Organic farming certification: N/A
Energy source: Batteries
Sensor input: Visual
Communication interfaces: WiFi 802.11n
Carrying capacity: Up to 150 kg
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

## Key words

Completely autonomous mobile robot. Indoor and outdoor capabilities. Autonomy: Up to 8h. Temperature range: -10°C a +45°C. Connectivity: Internal: USB, RS232, RJ45 / External: 2x USB, 2x RJ45, 1X hdmi + USD, 5, 12 VDC and 48v power supplies

Learn more at: https://robotnik.eu/products/mobile-robots/rb-vogui-en/

# MiR

"User-friendliness and safety of mobile robots help companies addressing workforce challenges.
(...) AMRs actually offers a way of collaborating with people in a safe way. The mobile robots don't take over jobs but injury-prone and monotonous tasks that are related to internal transportation. In this way, the employees get more time to focus on higher-value tasks. Moreover, the mobile robots from MiR are extremely user-friendly and can be programmed without prior programming experience." mobile-industrial-robots.com (2021)

## Key words

Completely autonomous mobile ground robot for internal logistics of e.g. sparepart, goods, ingredients etc. Controlled by separate computer or tablet. Several equiqment options like conveyor belt, rack, grip etc. Can be connected to e.g. ERP- and WMS systems. Can be reprogrammed on-site by the operator

Learn more at: www.mobile-industrial-robots.com

## Information

Company: Mobile Industrial Robots A/S (Odense, Denmark)
Launch year: 2015
Application area: Internal logistics
Price: from 33.000 euro
EMC certification: Yes
Organic farming certification: Not yet
Energy source: Batteries (100-230V)
Sensor input: Visual
Communication interfaces: REST API, Modbus
Carrying capacity: 1350 kg
Transport capacity: 500 kg
Fleet management compatibility: Team/Swarm
Maintance: Less than once a month
Safety measures: The robot has safety certification for collaborative working

# Ŝharko10

"The indoor pallet AGV Ŝharko10 is especially designed to support the transport of goods and materials in production environments. It will operate on the factory floor, where it will replace the use of manual pallet trucks or pallet jacks to support a regular supply or discharge of pallets or racks" - Movigorobotics.com (2021)

## Information

Company: Movigo Robotics (Haarlem, The Netherlands)
Launch year: 2018
Application area: Internal Logistics
Price: N/A
EMC certification: Yes
Organic farming certification: N/A
Energy source: Batteries
Sensor input: N/A
Communication interfaces: WiFi
Carrying capacity: 1000 kg
Transport capacity: N/A
Fleet management compatibility: Team/Swarm
Maintance: N/A
Safety measures: N/A

## Key words

Completely autonomous mobile ground robot for minimizing manual pallet management. 9 hours operating time on full battery Charging time >95% in 50 minutes (opportunity charging possible). Can transport more than just pallets.
Easy integration with back office systems like ERP & WMS
Flexible adding and removing of pick up & drop off points

Learn more at: www.movigorobotics.com/sharko10-agv/

# RB-CAR

"The mobile robot RB-CAR has RWD Ackermann kinematics. (...)
(...) mechanical structure and the rear drawer, this mobile platform can carry heavy loads. With the configuration of suitable sensors, the robot can be programmed to navigate autonomously or teleoperated with a joystick or a steering wheel." - Robotnik.com (2021)

## Key words

Completely autonomous mobile robot. Indoor and outdoor capabilities. Autonomy: Up to 8h. Temperature range: -10°C a +45°C. Connectivity: Internal: USB, RS232, RJ45 / External: 2x USB, 2x RJ45, 1X hdmi + USD, 5, 12 VDC and 48v power supplies

Learn more at: robotnik.eu/products/mobile-robots/rb-car-en/

## Information

Company: Robotnik Automation S.L.L (Valencia, Spain)
Launch year: N/A
Application area: Plant Care/General
Price: N/A
EMC certification: N/A
Organic farming certification: N/A
Energy source: Batteries
Sensor input: Visual
Communication interfaces: WiFi 802.11n
Carrying capacity: Up to 150 kg
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

# EGAPacker

"EGApacker is a fully automated packaging robot that can be customized to all
needs. The product tool can use either gripping, vacuum or a combination to
gentle handle the product.
At the same time it stores, opens, folds and tapes or glues all foldable carton
boxes suitable for automatic machinery handling eg. all FEFCO types of Fefco
0200 and 0201." - EGATEC.dk (2021)

## Information

Company: EgaTec AS (Odense, Denmark)
Launch year: 2017
Application area: Packaging
Price: N/A
EMC certification: N/A
Organic farming certification : N/A
Energy source: N/A
Sensor input: N/A
Communication interfaces: N/A
Carrying capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

## Key words

Learn more at:
https://egatec.dk/pakkelosninger/pakkemaskiner/egapacker/

# RB-EKEN

"RB-EKEN is a powerful mobile manipulator (4.800W of nominal power) designed to work in indoor and outdoor environments and adverse ambients.
GPS system, lasers and remote safety stop, among others.
The autonomy available is another of its main characteristics (2.880Wh of energy on board).
RB-EKEN is based on an omnidirectional platform that uses 4 high-power motorized wheels" - Robotnik.com (2021)

## Key words

Completely autonomous mobile robot. Outdoor rough terrain capabilities. Autonomy: 4 h. Controller: Open architecture ROS / PC with Linux integrated. Maximum slope: 60 % (with outdoor wheels). Speed: 2 m/s

Learn more at: robotnik.eu/products/mobile-manipulators/rb-eken-en/

## Information

Company: Robotnik Automation S.L.L (Valencia, Spain)
Launch year: N/A
Application area: Plant Care/General
Price: N/A
EMC certification: N/A
Organic farming certification: N/A
Energy source: Batteries
Sensor input: Visual
Communication interfaces: WiFi 802.11n
Carrying capacity: 300 kg
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

# ChickenBoy

"The ChickenBoy is the world's first ceiling-suspended robot that autonomously monitors broiler welfare and helps farmers improve the productivity of their farms. The patented robot monitors thermal comfort, air quality, health and welfare of animals and proper farm equipment function. Farmers, vets and stock persons interact with the robot through mobile alerts or through our cloud platform." - Faromatics.com (2021)

## Information

Company: Farm Robotics and Automation SL (Vilanova i la Geltru, Spain)
Launch year: 2021
Application area: Monitoring of animal welfare related measures
Price: N/A
EMC certification: Yes
Organic farming certification: Yes
Energy source: Batteries
Sensor input: Visual
Communication interfaces: HTTPS
Carrying capacity: N/A
Transport capacity: N/A
Fleet management compatibility: No
Maintance: Less than once a month
Safety measures: The robot slows and/or stops when humans present

## Key words

Completely autonomous system used for broiler chickens, animal welfare, productivity. Suspended from ceiling. Minimal user interface on robot, cloud system to interact. Learns its own program. Possibility of customization if demanded. Animal welfare, productivity, precision livestock farming

Learn more at: www.faromatics.com

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food

# Tibot - Spoutnic

"Spoutnic is the first born of our product range. It walks the floor to move your birds and to reduce the floor-egg rate. You are more at peace regarding the start and success of each flock. Spoutnic is plug & play. It starts with three buttons and does not require any technical installation. And yet, it adapts to your operaion whether you are in commercial turkeys, broiler breeders or layers thanks to its customization controller!
Spoutnic moves randomly and independently on any type of litter." Tibot.com (2021)

## Key words

Fully autonomous Indoor Mobile ground robot for Poultry care. Joystick/RC controlled. Offers software compatibility e.g. with different forms of data analysis system or fleet. Can be customized by demand. Accessorization according to breeding conditions

Learn more at: tibot.fr/fiche-technique-spoutnic-388.php

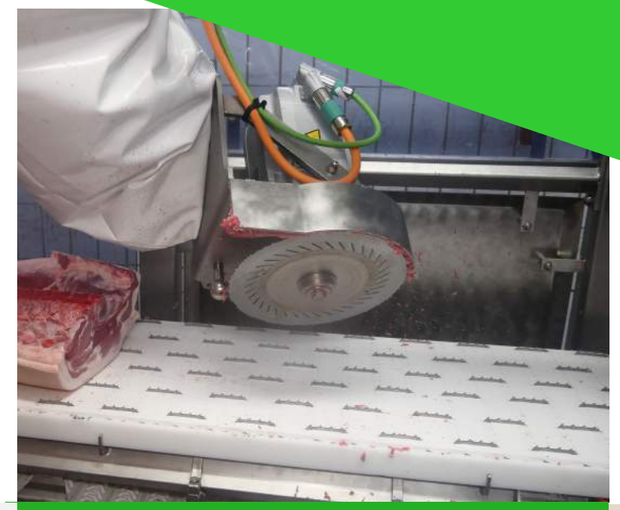
## Information

Company: Tibot (Cesson-Sévigné, France)
Launch year: 2016
Application area: Animal care
Price: N/A
EMC certification: Yes
Organic farming certification: Not yet
Energy input: Batteries
Sensor input: Tactile
Communication interfaces: N/A
Transport capacity: 750 kg
Fleet management compatibility: Yes
Maintance: Less than once a month
Safety measure: The robot has safety certification for collaborative working

# Robotic Chine Bone Saw

"The Autoline concept ensures uniform processing, accuracy and high-quality products.
With Autoline, continuous operation on the primal cutting and deboning line is maintained, as the Autoline robots are synchronized with the line movement (...)" - Frontmatic.com (2021)

"(...)The Autoline robots are all "plug and play", and can operate in any type of new or existing deboning lines." - Frontmatic.com (2021)



## Information

Company: Frontmatec Kolding A/S (Denmark, Kolding)
Launch year: 2021
Application area: Harvesting (of livestock)
Price: 750.000 euro
EMC certification: Yes
Organic farming certification : No
Energy source: Mains
Sensor input: Visual
Communication interfaces: industrial BUS-systems; ethernet; ...
Transport capacity: 300 kg
Fleet management compatibility: Yes
Maintance: Manual adjustment or maintenance is needed more than once a day
Safety measures: Humans are excluded from the robot's working space

## Key words

Fixed robot with cutting tool and using vision technology for meat processing, cutting and deboning. High capacity: 1,200 middles/hour. High yield due to consistent operation performance. Saw left and right middles in a mix. Compact unit, small foot print. Few parts to maintain. Easy setup of machine parameters at operator panel. Possibility of establishing of recipes

Learn more at: frontmatec.com/en/pork-solutions/deboning-trimming/automatic-deboning-trimming/autoline-chine-bone-saw

# AiRA

"Frontmatec offers a complete program of AiRA dressing-line robots. The AiRA robots is a concept based on more than 20 years of R&D in engineering of automated processing and is regarded as the world's unrivaled leader in dressing-line robotics. The AiRA robot program ensures continuous uniform processing, accuracy and high-quality products in every step" - Frontmatec (2021)

## Key words

Autonomous slaughtering production line. Homogeneous processing. High quality carcasses. Pork / beef processing Fleet operated. High hygiene level. Automatic cleaning and disinfection. Easy operation. User-friendly operator panels on the Frontmatec AiRA robots. Minimum noise emission.

Learn more at: frontmatec.com/en/pork-solutions/clean-line-chill-room/aira-robots#

## Information

Company: Frontmatic (Cardona, Spain)
Launch year: 2006
Application area: Harvesting (of livestock)
Price: 400,000-600,000 euro
EMC certification: Yes
Organic farming certification : No
Energy source: Mains
Sensor input: Visual
Communication interfaces: industrial BUS-systems; ethernet; ...
Transport capacity: 300 kg
Fleet management compatibility: Yes
Maintance: Manual adjustment or maintenance is needed more than once a day
Safety measures: Humans are excluded from the robot's working space

# BORS Robotic cell

"Custom made cells integrated with special machines and standard equipment operated with robot" - borsautomation.com (2021)

## Information

Company: Bors Automation & Tool AB (Drömminge Eklunden, Sweden)
Launch year: 2022
Application area: N/A
Price: N/A
EMC certification: N/A
Organic farming certification: N/A
Energy source: N/A
Sensor input: N/A
Communication interfaces: N/A
Transport capacity: N/A
Fleet management compatibility: N/A
Maintance: N/A
Safety measures: N/A

## Key words

Highly customizable, can be adapted to most production lines and connectered to BORS transfer lines

Learn more about the system: https://www.borsautomation.se/en/automation/

| | |
|---|---|
| | **Name:** Agrobot E-serie<br>**Company:** Agrobot (Spain)<br>**Application:** Autonomous strawberry harvestor<br>**Link:** https://www.agrobot.com/e-series |
| | **Name:** AgroFly<br>**Company:** AgroFly (Switzerland)<br>**Application:** Drone-based spraying (for vineyards)<br>**Link:** http://www.agrofly.aero/en/ |
| | **Name:** Alstef AGV<br>**Company:** Alstef Group (France)<br>**Application:** Completely automatic production line system (potential for food production) incl. Transport AGVs<br>**Link:** https://alstefgroup.com/intralogistics-solutions/our-solutions/production-flow/ |
| | **Name:** Anatis<br>**Company:** Carré (France)<br>**Application:** AGV tractor for field tasks<br>**Link:**https://www.carre.fr/entretien-des-cultures-et-prairies/anatis/?lang=en |

| | |
|---|---|
| | **Name:** Ara<br>**Company:** ecoRobotix (Switzerland)<br>**Application:** Precision sprayer for crops<br>**Link:**<br>www.ecorobotix.com/en/ara_mounted_sprayer/ |
| | **Name:** Astronaut A5<br>**Company:** Lely (The Netherlands)<br>**Application:** Automonous machine for cow wellfare<br>**Link:** https://www.lely.com/dk/losninger/malkning/astronaut-a5/ |
| | **Name:**<br>**Company:** Automato Robotics<br>**Application:** Tomato harvesting<br>**Link:** automatorobotics.com |
| | **Name:** AVL Compact S9000<br>**Company:** AvL motion (The Netherlands)<br>**Application:** Asparagus harvester<br>**Link:** https://www.avlmotion.com/nl/ |

# Chapter 2

## European Agricultural robotic systems

### A brief overview

This chapter of the catalogue adds to the previously presented Robotics systems and provides a brief overview of available European solutions within the agricultural and food processing sector.

The tech developers have been contacted for further information.

The solution is presented by alphabetical order based on the name of the systems

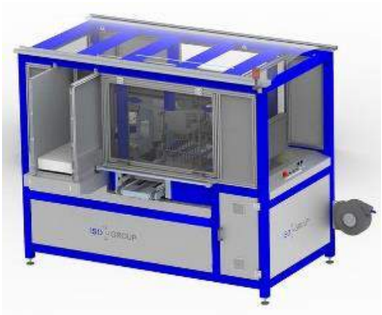
| | |
|---|---|
| | **Name:** Agilox OCF<br>**Company:** Agilox<br>**Application:** Intern logistic in production<br>**Link:** AGILOX OCF |
| | **Name:**<br>**Company:** AgriCirle<br>**Application:** Drone-based harvest optimization and hazard decetion<br>**Link:** Harvest optimization – AgriCircle |
| | **Name:**<br>**Company: AgriFac**<br>**Application:** Drone-assisted solutions for mapping<br>**Link:** Sustainable Farming - Agrifac United Kingdom |
| | **Name:** Agro<br>**Company:** Airboard<br>**Application:** Drone for crop spraying<br>**Link:** AIRBOARD AGRO – WORLD'S MOST POWERFUL AGRICULTURE CROP SPRAYING DRONE - YouTube |

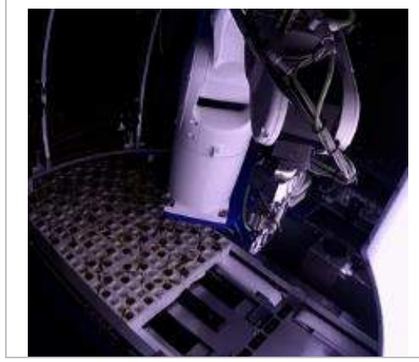
| | |
|---|---|
| | **Name:** AX-1<br>**Company:** Kilter (Norway)<br>**Application:** Weeding for crops<br>**Link:** www.kiltersystems.com |
| | **Name:** Bakus<br>**Company:** VitiBot (France)<br>**Application:** Mechanical Weedling for vine yards<br>**Link:** https://vitibot.fr/vineyards-robots-bakus/vineyard-robot-bakus-l/?lang=en |
| | **Name:** Bot Handy<br>**Company:** Samsung (Germany)<br>**Application:** Food preperation at consumer<br>**Link:** https://news.samsung.com/us/samsung-ces-2021-latest-innovations-for-a-better-normal/ |
| | **Name:** Bowmover line<br>**Company:** Asti mobile robotics (Germany)<br>**Application:** Internal logistics (potentially in food production)<br>**Link:** https://www.astimobilerobotics.com/boxmover |

| | |
|---|---|
| | **Name:** Case IH autonomous tractor<br>**Company:** Case IH (European division)<br>**Application:** Field tasks<br>**Link:** https://www.caseih.com/emea/en-me/News/Pages/2018-07-09-Case-IH-Defines-Categories-of-Autonomy-and-Announces-Pilot-Program.aspx |
| | **Name:** Cobot palletizing solution<br>**Company:** Sealing Systems (Denmark)<br>**Application:** Re-placing/picking product/boxes (potential for food production application)<br>**Link:** https://sealing-system.dk/da/pakkelinjer/palletering/robotpalletering |
| | **Name:** CORI<br>**Company:** Lab2Fab (US/DK collaboration)<br>**Application:** Autonomous solution for food preperation<br>**Link:** https://www.l2finc.com/kitchen-automation |
| | **Name:** CowToilet<br>**Company:** Hanskamp (Germany)<br>**Application:** Livestock welfare<br>**Link:** https://hanskamp.nl/en/cowtoilet |

| | |
|---|---|
| | **Name:** Deepfield Weeding robot<br>**Company:** Farming revolution GmbH (Germany)<br>**Application:** Mechanical weeding<br>**Link:** https://www.farming-revolution.com/ |
| | **Name:** Dick<br>**Company:** Small Robot Company (UK)<br>**Application:** Mechanical weeding<br>**Link:** |
| | **Name:** DINO<br>**Company:** Naio Technologies (France)<br>**Application:** Mechanical weeding<br>**Link:** https://www.naio-technologies.com/en/dino/ |
| | **Name:** Discovery collector<br>**Company:** Lely (The Netherlands)<br>**Application:** Livestock welfare – cleaning cow stables<br>**Link:** https://www.lely.com/solutions/housing-and-caring/discovery-collector/ |

| | |
|---|---|
| | **Name:** Disinfection line<br>**Company:** Zenzoe (Spain)<br>**Application:** Disinfection of areas (potential for food production)<br>**Link:** https://zenzoe.tech/robot/ |
| | **Name:** EvoCleaner<br>**Company:** Envirologic (Sweden)<br>**Application:** Livestock welfare Autonomous stable cleaner<br>**Link:** https://www.envirologic.se/da/vaskeroboter/evo-cleaner/ |
| | **Name:** GARotics<br>**Company:** Strauss/University of Bremen (Germany)<br>**Application:** Green asparagus harvesting robotic system<br>**Link:** |
| | **Name:** Greenbot<br>**Company:** Presision Makers (The Netherlands)<br>**Application:** Autonomous tractor<br>**Link:** precisionmakers.com |

| | |
|---|---|
| | **Name:** GRoW<br>**Company:** Metomotion<br>**Application:** Automatic tomato harvestor<br>**Link:** metomotion.com/ |
| | **Name:** Heat, Breeder<br>**Company:** Moocall (Ireland)<br>**Application:** Autonomous tracking of herd<br>**Link:** **https://moocall.com/** |
|  | **Name:** ISO 3D sorter<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Plant care; Sorting of plants<br>**Link:** www.iso-group.nl/en/machines/iso-3d-sorter |
| | **Name:** ISO cutting and Transplanter<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Plant care: transplant of rooted plants and sticking cuttings.<br>**Link:** www.iso-group.nl/en/machines/iso-cutting-and-transplanter |

| | |
|---|---|
| | **Name:** ISO Cutting Planter v. 1800, 2500 and 4000<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Plant care: automatic cutting planter<br>**Link:** https://www.iso-group.nl/en/machines/iso-cutting-planter-2500 |
| | **Name:** ISO grade<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Automatic sorting of young plants<br>**Link:** www.iso-group.nl/en/machines/iso-grade-7000 |
| | **Name:** ISO graft<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Plant care; blade change over function and the ability to disinfect with steam<br>**Link:** www.iso-group.nl/en/machines/iso-graft-1200 |
|  | **Name:** ISO Plantsampler<br>**Company:** ISO-Group<br>**Application:** Automates the gathering of DNA material from plants<br>**Link:** www.iso-group.nl/en/machines/iso-plantsampler |

| | |
|---|---|
| | **Name:** Iso Robot plut planting<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Automatic planting of small plant plugs from out seedling tray into ground<br>**Link:** www.iso-group.nl/en/machines/iso-robot-plug-planting-machine |
| | **Name**: ISO Vision<br>**Company:** ISO-Group (The netherlands)<br>**Application:** Plant care; Transplant and fixation<br>**Link:** www.iso-group.nl/en/machines/iso-visionplanter |
| | **Name:** Itraldon Titan 4HSE<br>**Company:** Italdron (Italy)<br>**Application:** Drone for spraying and monitoring to precision farmning<br>**Link:** www.italdron.com/professional-drones-application/precision-farming |
| | **Name:** Itraldon Titan 4HSE EVO<br>**Company:** Italdron (Italy)<br>**Application:** Drone for spraying and monitoring to precision farmning<br>**Link:** www.italdron.com/professional-drones-application/precision-farming |

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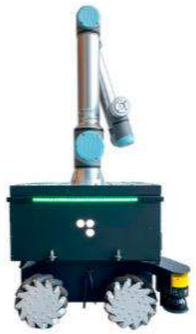
| | **Name:** Itraldon Bigone 4HSE<br>**Company:** Italdron (Italy)<br>**Application:** Drone for spraying and monitoring to precision farmning<br>**Link:** www.italdron.com/professional-drones-application/precision-farming |
| | **Name:** Juno<br>**Company:** Lely (The Netherlands<br>**Application:** Livestock welfare: Feed pusher<br>**Link:** www.lely.com/solutions/feeding/juno/ |
|  | **Name:** Kairos<br>**Company:** Robotnik (Spain)<br>**Application:** Internal Logistics (potential for food production or stable automation)<br>**Link:** robotnik.eu/products/mobile-manipulators/rb-kairos/ |
| | **Name:** Mariner<br>**Company:** Maritime Robotics (Sweden)<br>**Application:** Automatic boat USV (fish monitoring)<br>**Link:** www.maritimerobotics.com/mariner |

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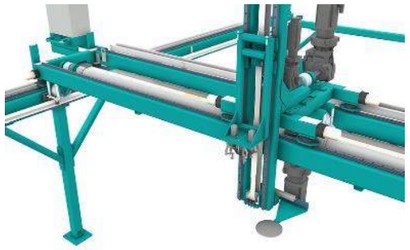
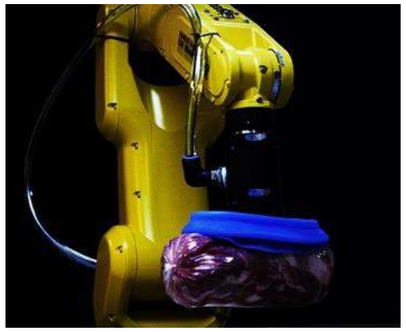
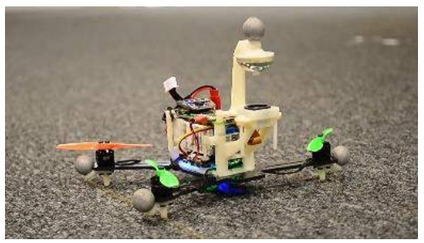
| | **Name:** MATE-XT<br>**Company:** Comau (Italy)<br>**Application:** Exoskeleton for upper limb support (Harvesting/ stable work support)<br>**Link:** mate.comau.com |
|  | **Name:**<br>**Company:** Robot gantry (Denmark)<br>**Application:** Three axis gantry robot for production<br>**Link:** robotgantry.com/gantry-robot-3-axis/ |
|  | **Name: Meat mover**<br>**Company:** Danish crown/DMRI (Denmark)<br>**Application:** Moving/packing of meat products<br>**Link:** dti.dk/specialists/generic-meat-moving-robot/39317 |
|  | **Name:** MiniBee VI<br>**Company:** BrainOnbroad (UK)<br>**Application:** Artificial bee for pollination of crops<br>**Link:** brainsonboard.co.uk/2018/10/26/introducing-the-minibee-v1/ |

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| | **Name:** Moley Kitchen<br>**Company:** Moley (UK)<br>**Application:** Autonomous food preperation<br>**Link:** moley.com/ |
| | **Name:** Moov 2.0<br>**Company:** Joz (The Netherlands)<br>**Application:** Livestock welfare: Feed pusher<br>**Link:** joz.nl/en_uk/solutions/feed-pusher-robot-moov/ |
| | **Name:** Mouse line<br>**Company:** Asti Mobile Robotics (Germany)<br>**Application:** Internal logistics (Potential for Food production)<br>**Link:** |
| | **Name:** Neo 2<br>**Company:** Avidbots<br>**Application:** Indoor production; Floor cleaner<br>**Link:** avidbots.com |

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| | **Name:** OPS XO<br>**Company:** Octopus Robots (France)<br>**Application:** Livestock welfare; poultry littering sanitation<br>**Link:** octopusbiosafety.com/en/animal-welfare/xo/ |
| | **Name:** Optimum<br>**Company:** Pellenc (France)<br>**Application:** Semi-automatic tractor for vinyards<br>**Link:** pellenc.com/agri/produits/optimum-new-generation/?lang=en |
| | **Name:** Palletzing system<br>**Company:** Smart Robotics (The Netherlands)<br>**Application:** Packaging in production in food productions<br>**Link:** smart-robotics.nl/en/palletizing/ |
| | **Name:** Pig Feeder Robot<br>**Company:** Pellon (Finland)<br>**Application:** Livestock welfare; Autonomous feeding pig unit<br>**Link:** pellon.fi/en/pig_husbandry/feeding/pig_robot/ |

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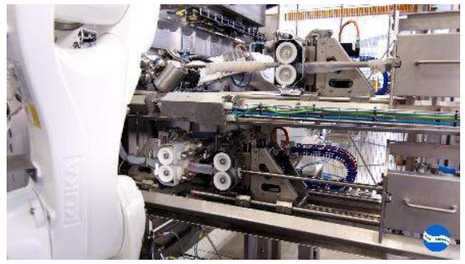
| | **Name:**<br>**Company:** PotchaFacilie (Italy)<br>**Application:** Plant care; cutting and collecting young plants in indoor production<br>**Link:** potarefacile.com |
|  | **Name:** P1 SelectiCa Sorter<br>**Company:** Proxmia (Denmark)<br>**Application:** Production system for pork casings<br>**Link:** http://proxima-centauri.dk/selectica-sorter-p1/ |
| | **Name:** Rabbit tractors Robot<br>**Company:** Rabbit Tractors (Ireland)<br>**Application:** Field monitoring and mapping<br>**Link:** |
| | **Name:** RoboCrop<br>**Company:** Garford (UK)<br>**Application:** Mechanical Weeding and soil maintenance<br>**Link:** garford.com/products/robocrop-inrow-weeder/ |

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| | **Name:**<br>**Company:** IGS (Intelligent Growth Solutions) (UK)<br>**Application:** Autonomous Vertical farmning systems<br>**Link:** intelligentgrowthsolutions.com |
| | **Name:**<br>**Company:** Ferrari Costruzioni Meccaniche (Italy)<br>**Application:** Automated transplanter<br>**Link:** ferraricostruzioni.com/en/tray-transplanters/41-futura-twin-automated-transplanter.html |
| | **Name:** RoboEVO<br>**Company:** Energreen (Italy)<br>**Application:**<br>**Link:** energreen.it/prodotti-manutenzione-verde-energreen/robo-porta-attrezzi-radiocomandati/roboevo-trinciatrice-cingolata-radiocomandata/ |
| | **Name:** RoboMAX<br>**Company:** Energreen (Italy)<br>**Link:** energreen.it/prodotti-manutenzione-verde-energreen/robo-porta-attrezzi-radiocomandati/robomax-trinciatrice-forestale-porta-attrezzi/ |

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| | **Name:** RoBoPlant<br>**Company:** ISO-Group (The Netherlands)<br>**Application:** Autonomous planting<br>**Link:** iso-group.nl/en/machines/roboplant |
| | **Name:** Robout<br>**Company:** Robotnik (Spain)<br>**Application:** Internal logistics (potential for food production)<br>**Link:** robotnik.eu/products/customization/rb-robout/ |
| | **Name:** Roestelmash agrotonics<br>**Company:** Roestelmash<br>**Application:** Smart farming<br>**Link:** en.rostselmash.com/agrotronic/ |
| | **Name:** Rubion<br>**Company:** Octinion (Belgium)<br>**Application:** Strawberry harvesting<br>**Link:** octinion.com/products/agricultural-robotics/rubion |

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| | **Name:** Salmon production system<br>**Company:** Marel/DTI (Iceland)<br>**Application:** Preperation of salmon<br>**Link:** teknologisk.dk/ydelser/3d-printet-laksegriber/39452 |
| | **Name:** Spoutnic NAV<br>**Company:** Tibot (France)<br>**Application:** Livestock welfare; Stimulate the movement of the birds and to aerate the litter<br>**Link:** tibot.fr/technical-data-spoutnic-nav-333.php |
| | **Name:**<br>**Company:** Ecorobotics<br>**Application:** Autonomous weeding<br>**Link:** |
| | **Name:** Stan<br>**Company:** Stanley Robotics (UK)<br>**Application:** Other domain<br>**Link:** stanley-robotics.com/tech-new/ |

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| | **Name:** TED<br>**Company:** Naio Technologies (France)<br>**Application:** Autonomous weeding in vinyards<br>**Link:** www.naio-technologies.com/en/agricultural-equipment/vineyard-weeding-robot/ |
| | **Name:** Titanion<br>**Company:** Octinion (Belgium)<br>**Application:** AGV for outdoor transport/monitoring<br>**Link:** octinion.com/products/agricultural-robotics/titanion |
| | **Name:** Tractor Line<br>**Company:** Asti mobile robotics (Germany)<br>**Application:** Internal Logistics<br>**Link:** astimobilerobotics.com/tractor |
| | **Name:** Vector<br>**Company:** Lely (The Netherlands)<br>**Application:** Livestock welfare; Mixing and feeding robot<br>**Link:** lely.com/solutions/feeding/vector/ |

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| | **Name:** Vertical farming<br>**Company:** Codema (The Netherlands)<br>**Application:** Vertical system including robotic arms and high-tech monitoring<br>**Link:** codema.nl/products/vertical-farming/ |
| | **Name:** Volcano_Pro<br>**Company:** Robotnik (Spain)<br>**Application:**<br>**Link:** robotnik.eu/products/customization/rb-vulcano-pro/ |
| | **Name:** Weed Whacker<br>**Company:** Odd.bot (The Netherlands)<br>**Application:** Mechanical weeding<br>**Link:** www.odd.bot |
| | **Name:** Xaver<br>**Company:** Fendt (now AGCO (US))<br>**Application:** swarm seeding<br>**Link:** fendt.com/int/fendt-xaver |

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| | **Name:** Xenion/Fluxion<br>**Company:** Octinion (Belgium)<br>**Application:** indoor AGV for transport of harvested crops<br>**Link:** octinion.com/products/agricultural-robotics/ |
| | **Name:** Ztove<br>**Company:** Ztove (UK)<br>**Application:** Food preperation; automated frypan<br>**Link:** ztove.com/en/front-page/ |
| | **Name:**<br>**Company:** Christiaenagro (The Netherlands)<br>**Application:** Visiongrading of harvested asparagus<br>**Link:** christiaensagro.com/en/products/asparagus#product-video-6 |
| | **Name:**<br>**Company:** Christiaenagro (The Netherlands)<br>**Application:** Automatic peelling of asparagus<br>**Link:** christiaensagro.com/en/products/asparagus#product-video-6 |

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| | **Name:**<br>**Company:** Christiaenagro (The Netherlands)<br>**Application:** Automatic grading (and packing) of mini cucumbers<br>**Link:** christiaensagro.com/en/products/mini-cucumbers#product-video-11 |
| | **Name:**<br>**Company:** Hepro (Germany)<br>**Application:** Peeling of fruit ang vegetable<br>**Link:** **hepro-gmbh.de/en** |

To be continuedly updated....

agRO
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food

# Additional robotic technologies

agRO BO food

# Universal robots (UR)

"The UR10e is an extraordinarily versatile collaborative industrial robot, delivering both high payload (12.5 kg) lift and long reach (1300mm) which makes it well suited for a wide range of applications in machine tending, palletizing, and packaging" - Universal Robots (2021)

## Key words

Completely autonomous robotic arm. Robots that are fixed when in use. Includes manipulators Controlled by Buttons or screen permanently attached to the robot. Parallel gribber as primary actuator. Other tools includes; Vacuum, electric grippers, cameras connected by Ethernet up, modbus, profinet, I/O. Opeaters in swarm teams. Operated on pre-set programs. Customizable.

Learn more at: www.universal-robots.com/es/productos/robot-ur10/

## Information

Company: Universal Robots (Odense, Denmark)
Launch year: 2018
Application area: Packaging, data and labelling
Price: 35.000 euro
EMC certification: Yes
Organic farming certification: Not yet
Energy source: Electrical (220v)
Sensor input: Program
Communication interfaces: Internet ip, modbus rtu, profinet, I/O
Carrying capacity: 12.5 kg
Transport capacity: N/A
Fleet management compatibility: Yes
Maintance: Less than once a month
Safety measures: The robot has safety certification for collaborative working

# STÄUBLI HE Hygienic & Humid Environment

## Information

Company: Stäubli (Madrid, Sabadell, Bilbao - Spain)
Launch year: 1984
Application area: Food and drink preparation
Price: N/A
EMC certification: Yes
Organic farming certification: Not yet
Sensor input: Visual
Carrying capacity: N/A
Transport capacity: 150 kg
Fleet management compatibility: no
Communication Interfaces: EtherCat, Ethernet/IP, Profinet, Devicenet, Sercos III, Powerlink...
Maintance: More than once a month
Safety measure: The robot has safety certification for collaborative working

## Key words

Completely autonomous Collaborative industrial robot, washable and without covers for Food and drink preparation, Quality control of packaging, dairy processing, meat, vegetables and cleaning. Fixture is permament, nonetheless possibility of mobility, placement on ceiling and walls in addition to the floor. Possibility of remote management from PC, mobile or similar. Also portable independent control. Own software, internal solenoid valves, safety PLC in the controller, touch control. low energy consumption, precision and reliability. product specialized in the food sector Can be customized on demand. AEF ISOBUS certified (TIM) communication

Learn more at: www.staubli.com/es-es/robotics/

# FANUC CRX

## Key words

Autonomous selection, handling, boxing, palletizing robot. Fixed when in use. Controlled by separate computer or tablet. Equiped with suction, parallel and 3 fingers Grippers as primary actuators. Operates in swarm teams. open software via Fieldbus. On-site programming by the operator. Completely autonomous when operating. Customizable. High flexibility

Learn more at: www.fanuc.eu

## Information

Company: FANUC (Barcelona, Spain)
Launch year: 2018
Application area: Harvesting
Price: 30,000 euro
EMC certification: Yes
Organic farming certification: Yes
Energy source: Electrical (200 VAC)
Sensor input: Visual
Communication interfaces: Ethernet IP
Carrying capacity: 15 kg
Transport capacity: N/A
Fleet management compatibility:
Maintance: Less than once a month
Safety measures: The robot has safety certification for collaborative working

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This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 825395