Robotics4EU

Boosting Wider Adoption of Robotics in Europe

Deliverable 4.2

Validating Robotics Business Ideas

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1 Executive Summary

This deliverable presents the results of a European wide citizen consultation on concrete robotics business ideas[1]. A total of 11 online survey style consultations were carried out from May to December of 2022 in which citizens were invited to provide feedback on concrete robotic solutions. A total of 1045 respondents from over 35 different countries participated.

The assessment of each robotic solution from the 11 participating companies was done in an online, informed survey style consultation via the EngageSuite platform.[2] Respondents were guided through the surveys via the platform which provided them with informative text, pictures, video material and questions about a specific robotic solution. The platform then collected the answers from each of the individual respondents such that they were able to be exported and subsequently analysed. The surveys were created in a collaborative process between the participating companies and DBT to ensure that the results would be beneficial for the participating companies.

Depending on the kind of questions that were asked, the surveys either produced qualitative data, quantitative data, or a combination of both. As a result, this report presents 11 different reports – one per company. The reports can be read as a standalone paper.

The report builds on the idea that involving citizens in the development process can help ensure that solutions align with society's expectations and needs, prevent costly mistakes, and increase acceptance of the technology.

The reports conclusion reveals common themes and concerns, including the importance of the appearance and design of the robot for acceptance, concerns about privacy and security in regards to data collection, recognition of the potential for robots to relieve humans of unwanted and repetitive jobs, the importance of clear and comprehensive information on safety measures, mistrust in robots' responsiveness towards human movement, the expectation for strict safety procedures, regulations, and legislation, the need for further testing in real-life contexts, the need for robots to indicate their intentions through multiple modes of communication, and the perception of robots as tools rather than alternatives to humans.

[1] All companies and respondents that participated in this activity did so freely and did not receive compensation.

[2] EngageSuite is a participation platform developed and run by the DBT. It is a multi-purpose platform used to engage citizens, stakeholders, researchers etc. It can be used to create surveys, informative and interactive learning sites and more.

2 Introduction

This report presents the results of a European wide citizen consultation on validating robotics business ideas. A total of 11 robotics business ideas from 11 different companies participated in the activity and received feedback from citizens all over Europe. The objective of the report is to collect concrete feedback from citizens on current robotics solutions that are under development to showcase how citizens can contribute to the validation of robotics business ideas and development plans. In addition to help validate business ideas the learnings from the report will also give inputs to the development of a maturity assessment model in the Robitcs4EU project.

The report first introduces the Robotics4EU project and background knowledge to the importance of engaging citizens in the development of robotics.

The introduction is followed by an elaborative chapter describing the methodology and approach to how the citizen engagement activity has been planned, executed, and studied. This chapter present both how the companies and citizens have been recruited. Additionally, it gives an overview of the demographics of the citizens participating and highlights the challenges that was faced in a subchapter on the methodological considerations.

The report then goes onto presenting the results of the citizen's feedback which is collected in 11 individual mini reports – one per company. Each mini report will follow the same structure of firstly presenting the robot and the company participating, then secondly presenting the demographics of those giving feedback and thirdly presenting the results of the citizen feedback. As each report should be able to standalone you will as a reader of the full deliverable experience repetitions of some chapters and sections.

Lastly the report will present how the Robotics4EU project can use the results moving forward and go into the conclusion.

2.1 About Robotics4EU

The citizen consultation presented in this report is a part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of (AI-based) robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, focus will be on the implementation of the responsible robotics principles among the robotics community that result in societal acceptance of the robotics solutions in the four application areas.

Robotics4EU will empower the EU-wide responsible robotics community representing robotics innovators from companies and academia in the four application areas, as well as citizens/ users and policy/ decision makers by:

- Raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.
- Advocating for the responsible use of robotics among all stakeholders' groups.
- Developing a responsible robotics maturity assessment model and bringing the project results to the standardization bodies.

To accomplish the above, the project will implement the following set of activities:

1) Assessing the needs and developing a responsible robotics maturity assessment model that is a practical tool for the robotics developers and helps them to strategically plan how to address the legal, societal and ethical aspects of robotics;
2) Empowering the robotics community by organizing capacity building events in healthcare, agri-food, agile production and infrastructure;
3) Ensuring citizen acceptance of robotics and assessing robotics ideas and applications provided by the industry with citizens and end-users (via online consultation and co-creation workshops);
4) Reaching out to the policy makers by compiling a responsible robotics advocacy report, organizing a high-level policy debate, and transferring the results to the standardization bodies.

2.2 The Importance of Engaging Citizens in the Development of Robots

Robot technologies are undergoing rapid development and its implementation can cause major change and disruptions to society. These changes are already impacting much of the world around us. Areas such as production, transportation, agriculture, healthcare, and others are becoming increasingly reliant on automation and robotic technology. Therefore, it is also essential to explore how these societal changes are perceived and received by "regular citizens", namely individuals who are not directly involved in the development of—or consulted for— when it comes to the design of robots. This also includes citizens who are not considered to be the main target customers and users of these devices by robot designers and developers.

The case for involving citizens rests on the core democratic notion that technology with the potential to have a significant impact and thereby change the lives of most citizens, should not only be discussed by key stakeholders, policy makers, experts, or businesses. Rather, it is important that the opinions of those most likely to be directly impacted by these changes are considered and that a broad public debate is engaged. This will help contribute to new technology being developed in a more responsible manner and with attention to the societal needs, concerns, and risks that may otherwise be overlooked or de-prioritized by the robot community or policy makers. Thus, involvement can ensure not only to make robots ready for society, but also to make society ready for robots, through increased awareness and readiness by the average citizen. The rationale is not merely based on moral obligations in the name of democracy or solidarity, but just as much on the fact that citizens *want* to be involved in decision making regarding robot technology. Indeed, one of the most important findings from the GlobalSay citizen

engagement task – described in report D4.1*: GlobalSay on Robotics – Citizen Consultations on Wishes and Concerns* – was that 85% of the participants think it's important to include citizens in the development and regulation of robotic solutions.[3]

Additionally, there are several ways in which robot manufacturers could benefit from engaging citizens in their development processes. Instead of simply relying on user research inviting citizens 'behind the stage' to leverage their situated knowledge and unique positions can help make sure that the robot manufacturers' solutions are aligned with society's expectations and needs. This is a significant advantage because it can help gauge and verify the product's viability and decrease the risk of large economic losses due to robotic solutions that fail to deliver value to users and society. Also, the 'outsider' perspective that citizen engagement provides can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. For instance, issues pertaining to ethics or usability, are very important to consider but may be overlooked, or their significance may be underestimated because the potential impact is difficult to assess without situated knowledge. While citizens may not possess the technical knowledge required to build or control a robot, they are experts of the social worlds they inhabit that new technologies are put into. This type of expertise is an important addition to professional expertise because it is what ultimately decides whether society will accept a new technology. A solution that fails to account adequately for – sometimes implicit – societal values and attitudes risks being perceived as redundant, unethical, and perhaps even threatening, even if its intended purpose is not. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

[3] Access the full report here: *GlobalSay on Robotics – Citizen Consultations on Wishes and Concerns*

3 Methodology and approach

The following section describes the methodology used in the activity as well as methodological considerations such as general and technical challenges. It also presents the considerations and actions taken with regards to the recruitment of companies and citizen respondents for the activity. Furthermore, it describes demographic considerations and findings as well as an in-depth description of how the data collected throughout the activity was handled and analysed is also included in this section.

3.1 Methodology for online citizen consultation

The methodological approach used for the activity was an online informed consultation which was done using an online platform called EngageSuite. It allows participants (over the age of 18) to participate on their own terms and on their own time through an online link to give feedback on specific robotic solutions within the areas of healthcare, agri-food, agile production and inspection & maintenance.

To give an overview of the methodology the process can roughly be summarised into a 10-step process visualised below:

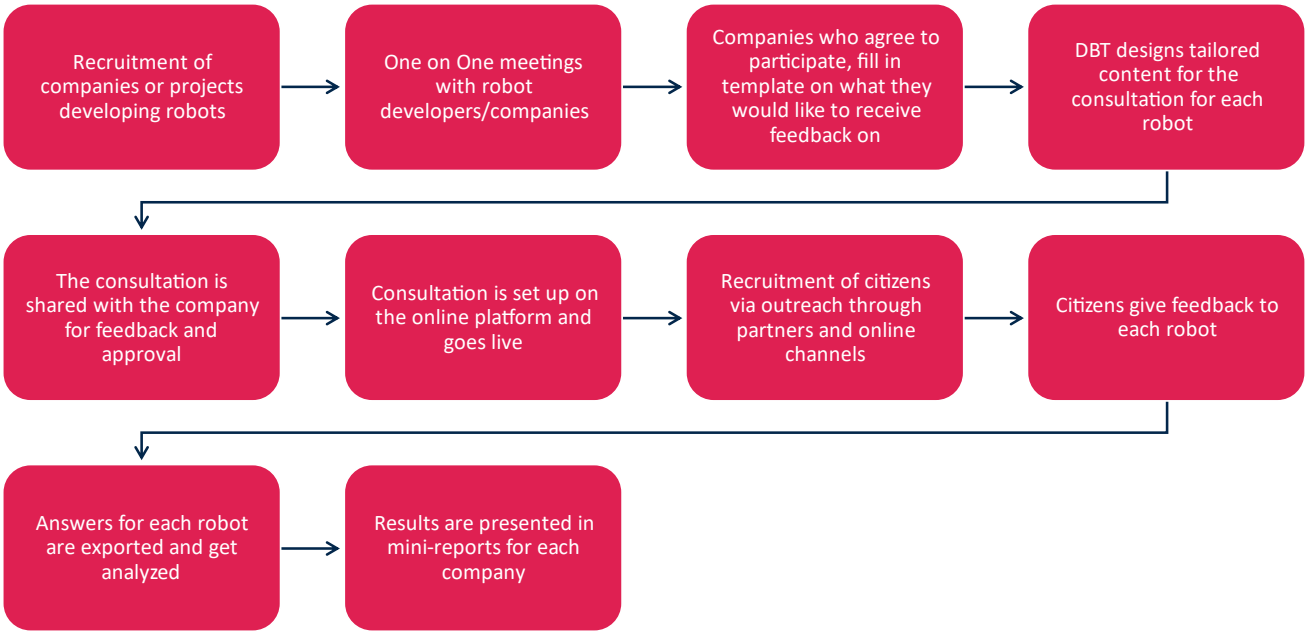


Figure 1 Process overview

The methodology employed sought to get concrete feedback from citizens on current robotics solutions that are under development. The objective of this is to showcase how citizens can contribute to the validation of robotics business ideas and development plans by including diverse and new perspectives to the developing stages of a robot. The results can help examine citizens' attitudes towards the robots and potentially identify concerns that can hinder an adoption of the usage of the robot. Thereby the citizen consultation is an opportunity to bring citizens and robotics developers together and bring the citizens' perspective into the technology development process.

The consultations were created in collaboration with eleven different robotics companies/projects that agreed to participate and present their robotic solutions. Each company had their own consultation created in collaboration with the Danish Board of Technology (DBT). Each consultation used a survey-style approach asking a mix of questions the company wished citizens to answer, and questions created by DBT.

In addition to giving the individual companies feedback on their robotics applications the consultations can also give a picture of the European population's opinions on current robotic ideas and development. This overall picture can be very useful for getting an idea of what citizens think about the current development of robotics and how citizens think that development of these technologies should be steered in the future. However, it is important to note that the methodology does not claim statistical representativeness, and the results should therefore only be seen as indications of what opinions citizens have concerning different aspects of current robotics development.

A more detailed description of the different steps in the methodology will follow in the upcoming subsections of the report.

3.1.1 Company Recruiting – Finding the Appropriate Robots

At the beginning of the activity, an extensive mapping of robotic companies and developers was performed. The initial mapping was mainly done via desk research within the four priority-areas of the project: healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. The mapping was done in order to find relevant information on the current developments within the robotics community and to find relevant robotic solutions that fit the scope of the activity, while at the same time being at the approximate level of societal readiness level (SRL) for which the activity was mapping.

Beyond the desk research, mapping of relevant companies was also done by attending robotic forums and events such as R-22, ROBOTBRAG 2022 and The European Robotics Forum (ERF) 2022. At these events DBT talked to designers, engineers and developers about current development and trends within the robotics community to get a better understanding of which robotic solutions to approach to be involved in the activity. Meetings involving gatekeepers of the robotics industry held by partners of the consortium or externals partners of the project gave access to relevant robotics businesses and projects involving the robotic industry. A greater focus to work across EU projects has also been an important element in the recruitment strategy by reaching out to ICT-46-2020 projects interested in participating. Further, the Robotics4EU consortium contributed to the mapping of robotic solutions by doing desk research and reaching out to their own contacts and by engaging their networks.

All relevant information was gathered in spreadsheets, where it was organised according to the relevant priority-areas (Healthcare, agri-food, inspection and maintenance of infrastructure and agile production). Relevant information about the companies such as: contact details, country, link to websites and short descriptions were added to this spreadsheet as well. This provided the consortium partners involved in the process with

an easy to access overview of the progress along with the possibility of adding information themselves.

In total approximately 95 robotics companies or projects were mapped and considered for the activity. Out of the 95 companies the consortium reached out to approximately 45 companies or projects either through mail, phone or personal contact (Example of outreach via email can be seen in appendix 1. Some companies were excluded because they were assessed to not fit the scope or because of a lack of contact details.

In the selection of robot's emphasis was put on:

1. **Priority areas**
   Up to three robots in each priority area: Healthcare, Inspection and Maintenance, Agri-food and Agile production.
2. **Fit the scope -** Companies willingness to use results - Location within Europe.
   In the selection of robot's emphasis was put on finding companies that were still in the developing stages of a robotic solution as the objective of the consultation was to help companies validate their business ideas. However, there was also the possibility of having robots in the later stages of development or robots that were already on the market as long as the companies were willing to consider the citizens' feedback for further development of the robot or in new business ideas.
3. **Approximate level of Society Readiness Level (SRL)**[4]
   The initial plan was to recruit companies within SRL 1-3, but as it proved to be quite difficult to engage companies who fit the scope and in the appropriate priority areas, less focus was put on this parameter. In addition to this, it was also challenging to assess the SRL without involving the companies in the assessment. And as the companies were already struggling setting time aside it was decided to not ask for additional time to assess their current SRL. Instead DBT made approximate evaluations of the robots based on public information, common for all companies were that none had previously worked within the SRL framework. Here it quickly became clear that pinpointing the level for each robot would not be possible as some companies might have done some stages without doing the prior stages e.g., many companies would agree to have done SRL 3 "initial testing of the proposed solution together with relevant stakeholder" but not agree to SRL 1 which says they should have identified the societal readiness of the solution.
   Therefore, the levels of society readiness for this activity should only be taken with a grain of salt which shows that Societal Readiness Level is still work in progress, especially for companies which have had much experience with TRL, but less so with a structured way of thinking about SRL. This in itself can be seen as an activity of making these companies aware of the SRL framework.

[4] To read more about the Society Readiness Levels please look at the Robotics4EU projects deliverable 1.1 "Societal Readniess Plan" Mark W. Kharas | Roger A. Søraa | Sofia Moratti

Out of the 45 contact points, 14 companies/projects showed interest in participating and were invited to one-on-one online meetings with DBT where they were introduced to the Robotics4EU project and the activity. A walkthrough of the process for the citizen engagement activity was presented including the company's role within the activity (The presentation material for the company meetings can be seen in appendix 3 & 4). Out of the 14 meetings, 12 companies/projects were interested and agreed to further participate in the citizen engagement. Unfortunately, one company decided to withdraw at the last minute due to other priorities.

In total 11 companies participated in the consultation: 3 within healthcare, 3 within inspection and maintenance, 2 within agri-food and 3 within agile production. A majority of the companies were from Denmark due to DBT being from Denmark and doing most of its networking in the country. Below is an overview of the companies and projects participating. A short presentation of their robotics solution is described later in the results chapter.

Table 1 - List of companies participating in the citizen engagement activity

Name	Country	Focus area
Lifeline Robotics	Denmark	Healthcare
Capra Robotics	Denmark	Inspection and Maintenance
NAUST Robotics	Denmark	Agri-food
Graspian	Denmark	Agile production
Halodi Robotics	Norway	Healthcare
IDmind	Portugal	Healthcare
RobStruct	Denmark	Agile production
Panza Robotics	Slovakia	Inspection and Maintenance
X-Drive Robots	Denmark	Inspection and Maintenance and potentially agri-food
DARKO	European Research Project	Agile production
STING Pollinator	Italy (Project developed under the framework of the European Initiative on Pollinators)	Agri-food

3.1.2 Setting up the consultations

Once companies had agreed to participate, the next step was to set up the content and questions for the online consultation. Three factors influenced the design of the consultations:

1. The results should be relevant for the companies. Companies should be able to influence the content to ensure that relevant questions are asked which can help them in their current development,
2. To ensure engaged citizens the consultation must be short, easy and accessible. It was estimated that to keep the attention of the citizens the online consultation for each company should not take more than 15 minutes. This put special demands on the amount of information and number of questions that could be included.
3. A mixture of qualitative and quantitative questions should be asked.

To ensure the first factor each company received a template they should fill out with: 1) An introduction of the robot and its purpose including how it benefits citizens and the society and 2) Topics, themes or questions they wished to get feedback on regarding their robot. To help the companies, the template delivered inspirational questions to assist them when creating their own questions. Lastly the companies were also asked to submit pictures and videos of the robot in the template. (See the template in Appendix 4).

DBT used the input from the templates as inspiration to finalise the questions and content and implement them in the online consultation platform EngageSuite. Here DBT made sure to use their experience with citizen engagement to frame the questions with the citizens in mind and to ask questions within the Robotics4EU interest. Some companies had many ideas for questions and others had only a few ideas. Therefore, it largely varied to which degree DBT influenced the questions and content.

All eleven consultations followed a survey style structure with an introduction to the robot through a short presentation in text accompanied with pictures and videos of the current version of the robot or illustrations/computer renderings of the conceptualised robot. To keep the survey condensed between 6-12 questions were framed for each robot.

Below is an example of how one of the consultations looked like: All consultations can be seen in full size in the appendix 5.

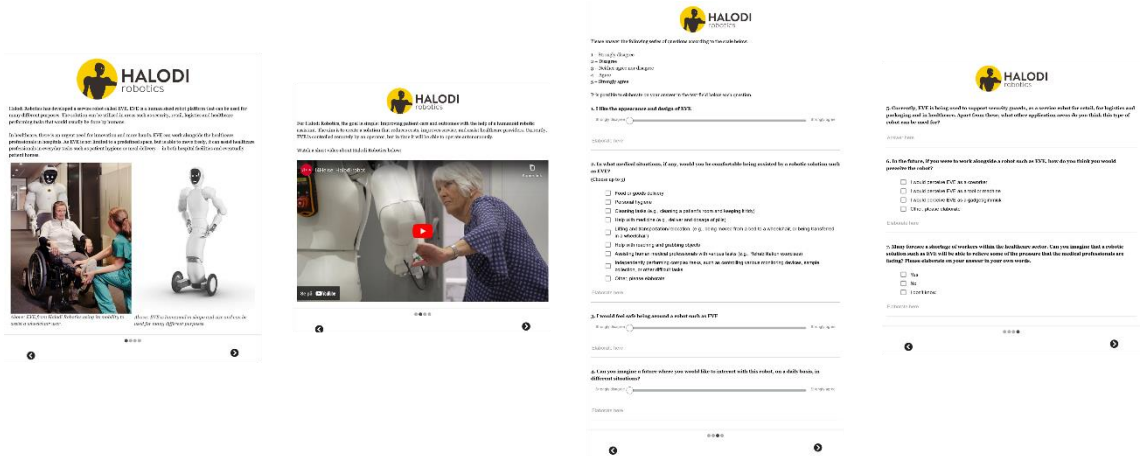


Figure 2 - Example of the design and look of one of the eleven consultations

3.1.3 Citizen Recruiting Strategies and Outreach

The Danish Board of Technology (DBT) developed and organized the strategy for the recruitment of citizens to answer the eleven different surveys. The task aimed at engaging at least 500 responses from citizens who had previously participated in a citizen engagement activity organised by the Robotics4EU project in 2021[5].

However, it quickly became clear that it would not be possible to engage a sufficient number of people solely by reaching out to the citizens who participated in the previous citizens engagement activity therefore additional outreach was done to supplement the number of respondents. The outreach strategy can be summarised into three different approaches:

1) Reach out to the citizens who participated in the project's previous citizen engagement activity, Global Say from 2021, and ask them to participate again. At the end of the GlobalSay activity conducted in 2021, participants were asked to enter their email addresses if they wanted to be contacted for future citizen engagement activities. A contact list of 276 citizens was gathered for further outreach.
2) Do additional recruitment through outreach via the partners of the project in the partnering countries (Denmark, Norway, France, Lithuania, Estonia, and Portugal, Malta & Italy).
3) Do additional recruitment through SoMe outreach strategies.

The initial plan for the citizen engagement was to have each respondent give feedback to four robots in one consultation. Therefore, the eleven surveys were divided into three rounds/compilations of surveys, with three-four companies in each round.

In the first round the four companies Lifeline robotics, Naust robotics, Capra robotics and Graspian were included in a shared consultation. DBT invited the one 3rd of the GlobalSay contact list with the former participants via email. In addition to this all partners of the consortium were invited to share the survey with their network and through their social media channels. When the survey had been live for one month the second round started with four new companies to have their robotic business ideas validated. The second round included Halodi robots, RobStruct, IDmind and Panza robotics in a shared consultation. The two rounds of consultations were live simultaneously during several months in the summer 2022 but unfortunately, they did not receive enough attention to reach a sufficient number of responses for the citizen engagement activity.

DBT consulted with the project communication partner LOBA to localize what the problem might be, and what could be done to improve the consultation and increase the motivation for participation among citizens. It was concluded that the main reason why it was difficult to recruit citizens was because of the exhaustive length in the set-up of having the citizens give feedback to four robots grouped together in one round. **Therefore, it was decided to divide the consultations, so each robot/company got**

[5] D.4.1 – GlobalSay on Robotics: Citizen Consultations on Wishes and Concerns.

their own individual consultation instead of grouping four companies together. Doing this would drastically lower the amount of time it would take to participate, and it would be possible to do more focused advertisement of each survey both on social media and when reaching out directly to citizens. In addition to this a new page at the Robotics4EU website was also developed to showcase each robot.

Figure 3 - Screenshot of the webpage designed to showcase the robots and reach more citizens

All partners in the consortium were informed of the changes and their part in the recruitment process for the new surveys. To increase the number of respondents each partner got the responsibility to recruit a minimum of 8 responses to each of the 11 surveys. DBT facilitated and updated the consortium partners with their progress with the recruitment process. DBT also provided partners with material and methods to use in their recruitment for the surveys. The material for the partners included suggestions of different recruitment strategies, such as the snowball method, social media recruitment, data-based invitations and creative approaches targeting forums with a social, debate or knowledge sharing focus. DBT and LOBA collaborated closely to provide both promotional material and information to enhance the recruitment process on social media and through other outreach channels.

All the partners in the consortium were encouraged to plan their recruitment strategies fitted to their own activities within the Robotics4EU project. DBT assisted partners with information on which companies needed attention, and which demographics needed to be targeted in the further recruitment in a shared document once a week during the entire recruitment process. The transparency of the process and progress for the activity was visible to all in consortium. This gave the partners a better chance of adapting their recruitment to their own activities within the project.

DBT invited once again all former participants from the contact list created during the GlobalSay in 2021 to participate in the citizen engagement activity by entering as many

surveys as they wanted. DBT contacted all former hosts from Denmark and asked for help to share the surveys with their group from the GlobalSay activity, while the consortium partners were asked to contact the former hosts from their own countries.

3.1.4 Overall Demographic Data and Considerations

In total the 11 surveys received 1045 answers from over 35 different countries. Attention was directed towards engaging citizens from a wide range of different genders, educational levels, areas of residence and ages. In this section the overall demographics of answers will be presented. Demographics of each individual survey will be presented later.

The surveys managed to collect answers from every age group. However, most prevalent throughout the surveys were respondents between ages 25-34. This group made up a total of 24% of the answers given throughout. Ages 45-44 were the second most represented group accounting for 18% of the answers given. The third most represented group were respondents ages 45-54 years old. For a full overview of the age distribution of the respondents, see the figure below:

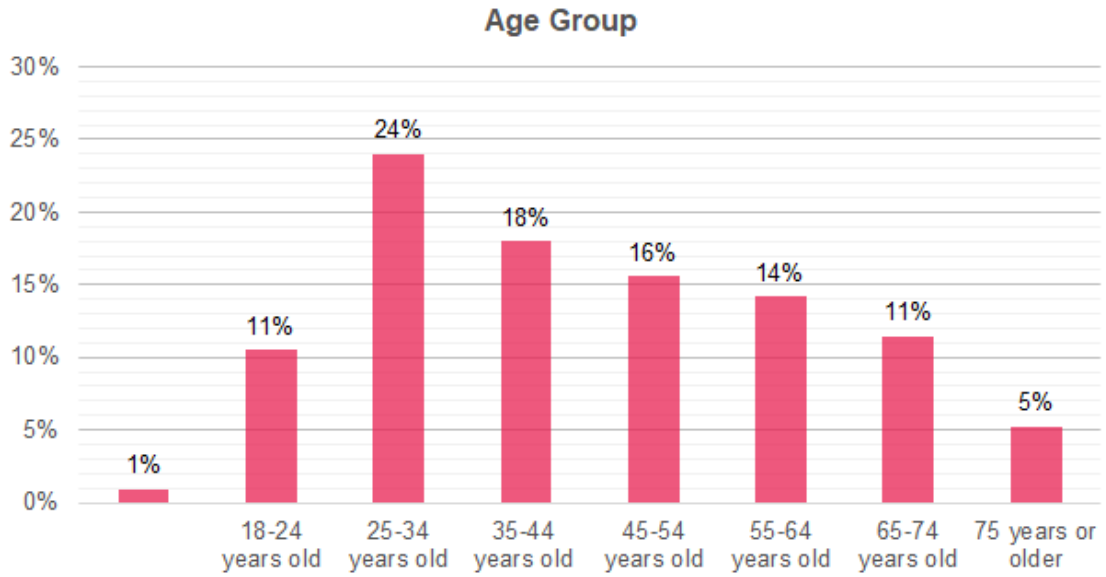


Figure 4 - Distribution of age

As is evident from the overview, the most difficult demographics to reach and engage in the activity were people between ages 18-24 and 75 years or older. These groups only made up 10% and 5% respectively. All partners responsible for recruiting respondents were aware of the difficulties of recruiting people from these categories and utilised their own strategies to do so. For example, the French partner LNE did targeted recruiting of older people at a Science Festival and Portuguese partner LOBA did targeted campaigning on social media.

The gender distribution of respondents was reasonable with 52% male and 45% female. The remaining respondents were divided between ‘Prefer not to answer’ with 1,1% and ‘Other’ with 0,5% while 0,6% chose not to disclose their gender. The full overview of gender distribution can be seen in the figure below:

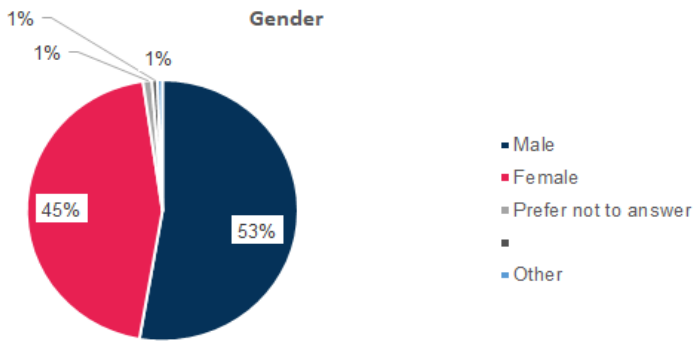


Figure 5 - Distribution of gender

The surveys engaged people from a total of at least 34 different countries. As expected, the countries of the Robotics4EU project partners were those able to recruit the most respondents. Denmark was the country with the most respondents accounting for a total of 21% of the answers given in the surveys. Following this, many respondents unfortunately did not disclose from which country they came. A total of 18% of the respondents did not enter this information.[6]

France accounted for a total of 13%, followed by Norway with 10%, Lithuania with 9%, Portugal with 8% and Estonia with 6%. Thus, the surveys received respondents from western, eastern, northern and southern European countries. Countries such as the United Kingdom, Italy, Malta and Croatia were also represented. The survey also reached several countries outside Europe such as the United States and Asian countries such as Malaysia, China and Singapore were also represented.

The distribution of where respondents lived was somewhat uneven as the surveys saw a large percentage of respondents from large cities. Nearly half of all respondents that participated chose this option, accounting for a total of 47% of the total answers. The second most chosen area was small town, with 24%. Suburban was chosen by 17%, while rural was chosen by 9%. For a full overview of the distribution, see the figure below:

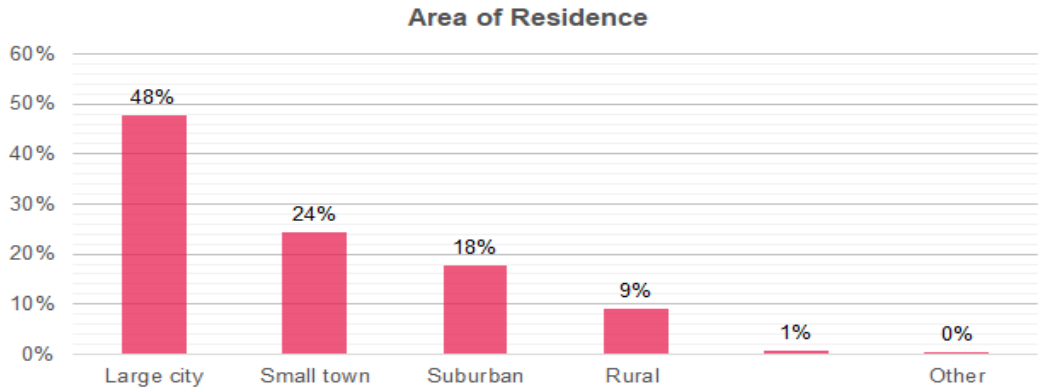


Figure 6 - Distribution of area of residence

[6] The potential reasons for this are described in section 3.2

Respondents engaged in the surveys were generally highly educated. Most respondents answered that they held a master's degree or equivalent with this answer accounting for 35% of the total responses. The second most chosen answer was bachelor's degree or equivalent amounting to 24% of the answers, while 18% answered that they held a doctoral degree or higher. For a complete overview of the distribution of educational distribution, see the figure below:

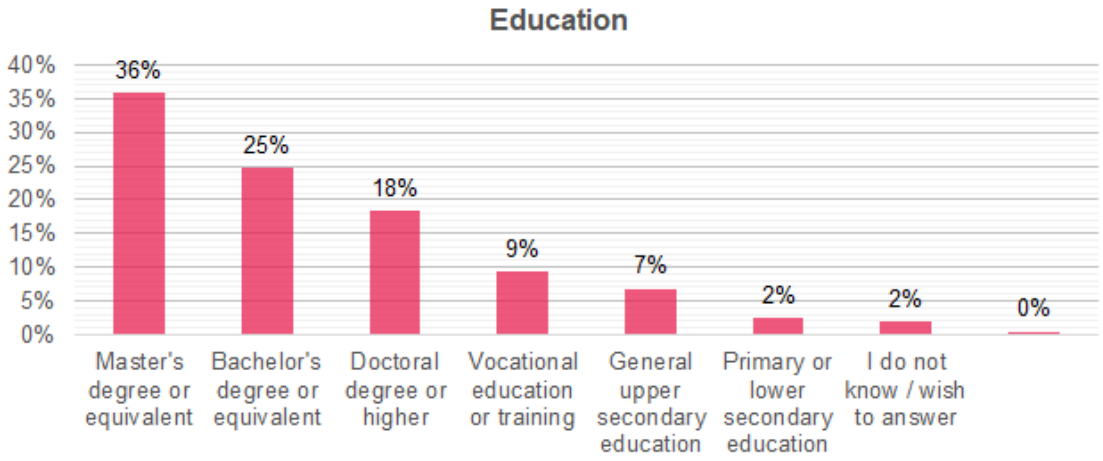


Figure 7 - Distribution of educational background

3.1.5 Data management and Analysis

All data from the surveys was collected via the EngageSuite platform. The platform collects the responses to each question during the survey making the answers available to be exported at any time – even while the surveys are still ongoing and gathering data from respondents. This feature was used to keep track of the number of answers to each individual survey throughout the activity and give updates to the project partners, letting them know which surveys needed more attention. Surveys that needed more answers could then be pushed on social platforms by the DBT and the relevant project partners.

At the end of each survey, the data collected was exported out of EngageSuite and into an Excel Spreadsheet where the data was sorted, and unusable answers were removed. All the quantitative data was handled directly in the spreadsheet and visualised using the various graph functions found in Excel.

The qualitative data such as elaborative open text answers, were copied from the Excel spreadsheet into an online Google Sheet document where it was automatically translated using the Google translate function that can automatically detect a target language and translate it into a desired language – in this case English. Translations were occasionally lacking in quality, however, for the most part translations were of sufficient quality and able to be used in the analysis without problems. Any translations that lacked in quality were examined and translated via the online translation tool DeepL.

To analyse the qualitative data the analytical approach of 'Affinity Mapping'[7] was used. Affinity mapping is a method to organize and give structure to many pieces of information for example from interviews, surveys, brainstorming sessions etc. The approach is to visually cluster information in topics and thematic that have resemblance to each other. The affinity mapping was mainly done in Mural – an online whiteboard collaborative space that allows users to employ a myriad of tools for online co-operation and creation. Here the translated qualitative data for each survey was sorted according to the corresponding question and organised by theme. Colour coding was widely used to sort the answers into different categories such as, positive, negative, indifferent and others. Below is an example of how answers were sorted for analysis in Mural.

Figure 8 - Qualitative data analysis on the Mural platform

3.2 Methodology for physical face-to-face citizen consultations

In addition to the online consultations a number of physical consultations were held as three focus group interviews with citizens participating at the *Robotex International 2022* festival. Here randomly selected citizens who visited the festival were asked to participate in a focus group interview program during the festival. The focus groups involved eleven citizens ages 18 to 45, who were asked to give feedback and ratings on the same 11 robots participating in the online consultations. At the focus groups the citizens were presented to the robots through photo material along with a short introduction that was used in the form of a presentation. In the focus group interviews, a semi-structured interview approach was used to collect information from the participants. The objective of hosting face to face consultation via focus group interviews was to support the results from the online citizen consultation. This was done to explore if any different topics, themes or concerns would appear in a physical consultation where citizens more freely could ask follow-up questions or go in depth with answers that wouldn't be possible in an online format. Throughout the mini reports small sections from the focus group interview will be used as additional input to the companies. These will be indicated by small red squares, when relevant, throughout the mini-reports.

[7] The term affinity diagram/mapping was devised by Jiro Kawakita in the 1960s - Improving Performance Through Statistical Thinking by Galen C. Britz

3.3 Methodological considerations

Throughout the citizen engagement activity, the project faced several challenges which affected the methodological approach and should be taken under consideration when reading the results and taken into consideration for future learnings when doing similar activities.

3.3.1 General Challenges

Online engagement through surveys

Engaging citizens through online survey-style consultations can be challenging. As opposed to physical engagement, online engagement demands that the citizens keep their engagement on their own throughout the duration of the survey – without a facilitator to help or guide them and instead, citizens must rely on the online platform to be their guide throughout the entire process. This means that if there are any problems, difficulties or questions during the survey, there is a risk that the respondent might give up on completing the survey before finishing. From the data collected it is possible to see that some participants did indeed exit the survey before finishing. However, whether this was because of technical problems or due to other circumstances is not known. One main challenge when conducting citizen engagement via survey style consultations is that it can be difficult to maintain the interest of respondents, and some might leave the survey before finishing.

Recruitment of companies

Despite several efforts to reach companies all over Europe it very quickly became clear that the most efficient way of recruiting companies was through personalised direct contact either through multiple mails, phone calls or physical networking. As a result of this many Danish companies were more interested in participating as the Danish Board of Technology was the main partner performing the recruitment. From this we can conclude that despite many professional companies having English as their work language, companies seem to be more approachable when they are contacted either in their native language or from an organisation or person they already know.

Difficulties in recruiting enough citizens and engaging them

The citizen recruitment proved to be quite challenging and multiple strategies and approaches were in play to increase the engagement and reach a sufficient number of responses on each survey. Halfway through the process considerable changes in the format of the consultations were made to improve the user experience of the surveys from a citizen's perspective. To summarize, the improvement consisted of lowering the time it takes to participate and giving the citizens the opportunity to choose themselves which robot they would like to give feedback on. The improvements had a positive effect and more participants engaged in the surveys however it is important to be aware of the relatively small sample for the individual surveys when going through the results.

Difficulties in recruiting lower educated and the younger and older generations

Efforts were made by all partners to recruit respondents as broadly and diverse as possible. However, there is a lack in the number of lower educated and the younger and older generations. As is evident from the above, the lack in specific demographics of the surveys may influence the answers and tendencies described in the report. When reading through the responses it is important to be aware that these results do not intend to be statistically representative, but rather indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

The physical face-to-face consultations did not have the intended effect

From a methodology perspective, the triangulation of results during the Robotex International 2022 event did not appear to add much value to the final outcome. The results of the focus group were necessary; however, they can also give distorted results because the event at which the focus group was being conducted was attended by citizens who have a greater ease with technology. But still, the similar results of the focus group interview also confirmed that the previously collected data is valid and has met its primary purpose. In the future, using a similar methodology, it is not essential that the focus group is carried out during certain events.

3.3.2 Technical Challenges

There were some unforeseen technical challenges that arose during the activity. One of the noticeable problems was that, in a substantial number of cases, respondents did not disclose from which country they came. It is difficult to tell exactly why so many chose not to disclose this information. However, one possible explanation for this might be related to the UI (user interface) of the EngageSuite platform, i.e., the accessibility and user friendliness. The platform is composed of individual modules, each able to perform a specific function, such as presenting text, images, video or for designing a variety of questions used for engagement. The modules are all different and certain modules have less intuitive layouts. The module used for selection countries is a drop-down menu where the respondents must click on a small arrow to make the menu appear. It is plausible that this might for some be a hindrance that in turn causes them to skip this part of the demographics page.

Another related challenge was that some respondents did not answer all the questions in the surveys – a challenge that might once again be explained by the limits of the EngageSuite platform. The platform has an option to make the next page of the survey inaccessible until all, or a defined selection of answers, have been answered or filled out. However, the platform does not visually represent it very well, and a decision was made to not make any questions mandatory to minimise respondent dropout during the survey; we feared that if met with a 'greyed out' next button and no explanation as to why they were unable to proceed, they might quit the survey before finishing. The number of respondents that skipped certain questions is however rather low and not something that is considered to have significant influence on the survey results.

4 Results presented as mini-reports

In the following chapter the results of the responses to the eleven surveys will be presented. The results and analysis will be presented as **eleven mini-reports,** one for each robot, that can be read separately from each other and the entire deliverable. Each report will be sent to the developers/company/organisations of the robots to give them a concrete product from their participation in the project. By doing this we will have eleven standalone reports which are tailored to the robot developers, which they can use both internally in the organisation but also externally if wanted.

Each report will follow the same structure with variation depending on the focus of the questions asked:

1. Introduction to the Robotics4eu project and the citizen engagement activity the company/project has participated in
2. Presentation of the robot
3. Presentation of the demography of the respondents
4. Presentation of survey results and analysis

As each mini-report should be able to standalone you will as a reader of the full deliverable experience repetitions of some chapters and sections. The main repetitive chapter will be the first page introducing the Robotics4eu project and the citizen engagement activity the company/project has participated in. When you have read this once you can easily skip it when reading the other robots.

The robots will be presented in the following order:

Name	Country	Focus area
Lifeline Robotics	Denmark	Healthcare
Capra Robotics	Denmark	Inspection and Maintenance
NAUST Robotics	Denmark	Agri-food
Graspian	Denmark	Agile production
Halodi Robotics	Norway	Healthcare
IDmind	Portugal	Healthcare
RobStruct	Denmark	Agile production
Panza Robotics	Slovakia	Inspection and Maintenance

X-Drive Robots	Denmark	Inspection and Maintenance
DARKO	European Research Project	Agile production
STING Pollinator	Italy	Agri-food

Once the companies receive the mini-reports it will be up to the individual company how they choose to use the results. The Robotics4EU project hope to motivate the companies to use the citizen input as a first step towards including citizens throughout their development stages and to initiate processes that can help improve the societal readiness of the robots they are developing. For the companies interested, they will also be invited to participate in a set of co-creation workshops hosted by the Robotics4Eu project in 2023.

4.1 Lifeline Robotics

This report presents the results of a collaboration between Lifeline Robotics (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.1.1 Presentation of Lifeline Robotics

Covid-19 came as a shock to many. Everything was turned upside down and everyone had to adjust to a new life filled with restrictions while trying their best to stay safe and healthy. A robotic solution like the Lifeline swab robot will enable organisations, companies and even nation states to be better prepared for the spread of future pathogens.

The purpose of the Lifeline swab robot is to conduct safe and gentle throat swabs with a high-quality to the sample collected. For example, in conducting a Covid-19 test. The solution works by combining artificial intelligence (AI), machine vision and sensitive robotics into a medical device.

The machine vision provides images to the AI which detects several human features ranging from a head to the back of the throat. The AI delivers specific swab target points to collect the best possible swab for that exact throat structure. Then, those points are transferred into gentle robotics movements.

The solution will be fully automatic, meaning that human personnel is not required to collect a sample from a citizen. This frees healthcare personnel to do more valuable human-centric work, as compared to a repetitive and monotonous swab sampling. It also shields workers from the danger of infection and minimizes the variety in quality between the samples.

Being a medical device means that the product must comply to strict regulations and are of the highest human safety standard.

Lifeline Robotics will not be able to stop a viral pathogen from forming. However, Lifeline Robotics will provide technology that can help nation states and organizations with being prepared to detect a viral threat before it evolves into a full blown, out of control pandemic – essentially, contributing to a so called early-warning system. Ultimately, the solution will improve health and save lives while securing the economy and minimizing the worry.

4.1.2 Demographics

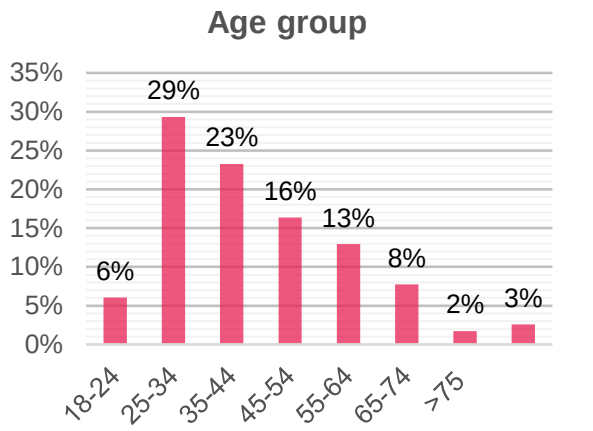
Overall, a total of 116 respondents participated in this survey.

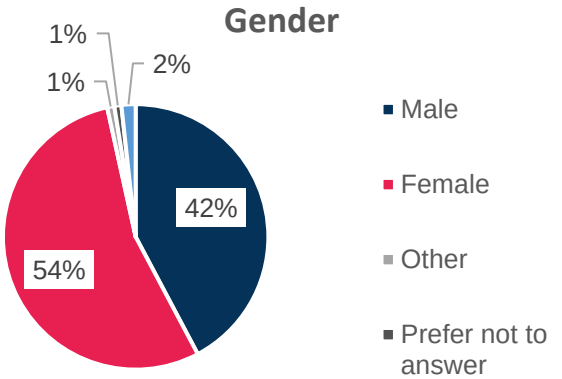
Responses consisted of high representation of citizens in the age group 25-34, accounting for 29% and ages 35-44 accounting for 23%. the age groups 45-54 and 55-64 were also adequately represented whereas the younger generation (18-24) and older generations from 64 years and up were not as well represented.

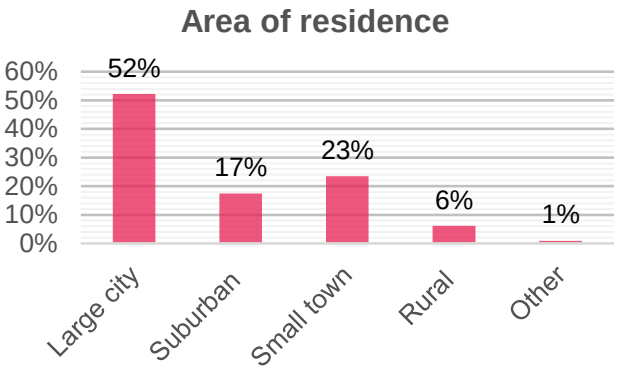
The gender distribution of citizens was relatively equal, with male participants accounting for 42% and female participants accounting for 54%. The remaining either answered 'other' or did not specify their gender.

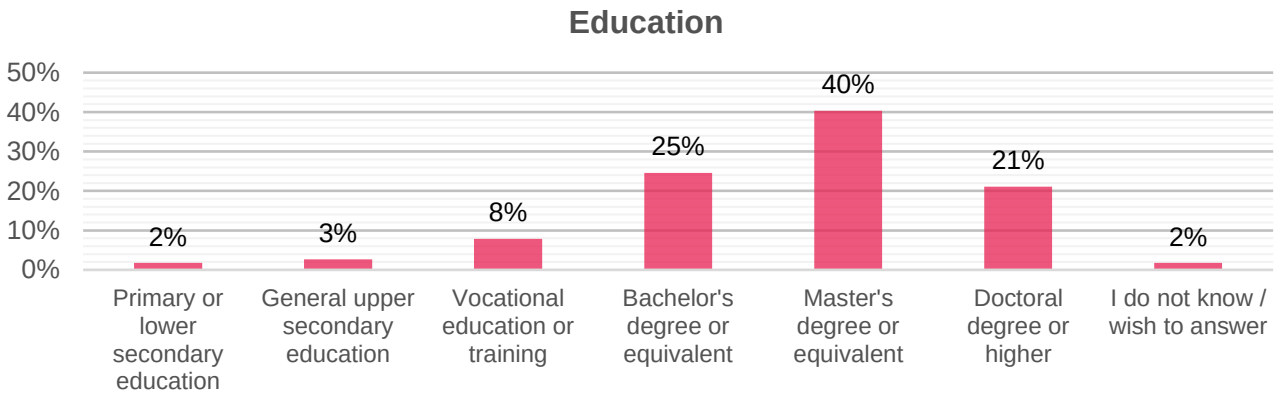
Looking at distribution of areas of residence, a total of 52% of the respondents answered that they lived in a large city. The second most chosen option was small town with a total of 23%, these were followed by suburban with 17% and rural with 6%.

Respondents were generally highly educated with 86% answering that they held either a bachelor, master's or higher degree, whereas only 12% held secondary education or vocational education.









The survey received answers from participants from at least 17 different countries in total. Citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe. Additionally, citizens from outside of Europe such as China and the USA have also been engaged. Especially people from Portugal and Denmark have been engaged, taking the top spots with the former accounting for 19% and the latter for 17% of the total answers.

As is evident from the above, most participants answering the survey were young and middle-aged people holding degrees and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.1.3 Survey Results

Citizens were asked eight questions regarding their perception of the robot and what barriers and opportunities they could imagine there might be if they were to use the robot.

First, respondents were presented with the following scenario and then asked four questions on how they imagined they would feel in the situation.

> *Imagine that you were about to be tested for COVID-19 as you have had a sore throat and been coughing for a while. You have chosen to go to your nearest testing centre as it is most convenient for you. At the testing centre, they have implemented swab robots and it will therefore be your first time being swabbed in your throat by a robot.*

Question 1: How would you feel about the situation?

The respondents had divergent feelings towards having a robot swab them for Covid-19, which can be divided into positive and negative attitudes towards the robot.

Positive feelings towards the robot:

Approximately half of the respondents indicated positive feelings towards the robot. Around half of the positive respondents said they would feel fine or okay with the situation, some highlighting that it would perhaps be even more exciting or interesting than the normal procedure. Among these a good number of respondents also said that they would feel comfortable or safe in the situation without any major concerns or fear of risks holding them back to try it. Among this group there is a sense of trust towards the robot and an assumption that any implemented version of the robot would have gone through extensive testing to ensure safety. One respondent said, *"Being a new mechanism and trying it out for the first time, I would feel a little anxious but at the same time confident that it is a fast process that takes a few seconds and has been designed and tested by professionals"*. Furthermore, efficiency and hygiene were highlighted as some of the positive feelings towards the situation. A few mentioned that the robot would be more effective and protective towards both the citizen and medical staff as there

would be no risk of infecting another person with the virus. One respondent said: *"I am glad to have that, quite often robots perform better in terms of precision in operations, and I am also happy then I won't be exposing the medical workers there in danger, well, robots won't be infected by my virus"*. Some also saw it as a solution to overcome the lack of medical staff.

The focus group interviews conducted during the Robotex festival also confirm that it would feel safer knowing that someone has already tried it beforehand. A participant said: "I might not really want to be the first, but if another person has already had it, I could try it."

Negative feelings towards the robot:

Contradictory to the responses above, many of the other respondents highlighted feelings linked to them being doubtful about the situation. "Uncomfortable", "terrifying", "worried" "stressful" and "anxious" were some of the words used to describe their feelings among a large group of the citizens. One respondent said: *"[I would feel] Nervous. New technology for sticking something down my throat is not an appealing prospect"*. Safety and fear of pain or harm was also mentioned by a large group. There was a general fear towards the robot not being able to perform its task safely and precisely enough to avoid harming the patient. A considerable concern was centred around the force and sensitivity of the robot and a lack of trust that the robot would not go too far down the throat causing pain and discomfort. Respondents were also afraid of their own reactions causing the robot to make a more inaccurate and painful swap. Respondents questioned whether the robot would be able to respond accordingly to people accidentally coughing, moving their tongue/mouth or doing sudden head movements: *"[I would feel] A little insecure as the robot is not able to respond if I get the urge to cough, or vomit"* and *"[I would feel] Fascinated and curious but also nervous to keep still and not react too much in case my reaction would make the swab more painful"*. One person even said that: *"It would be important to me that I was stronger than the robotic arm so I could move it physically if I got scared."*

Another considerable barrier towards the robot was the lack of professional human medical workers. Some would simply rather be tested by a human where others are open to the idea if human assistance such as a nurse or a doctor were present. One of the respondents that would rather be tested by human said: *"I would like to hear warmer voices from human beings rather than cold machines. If there are only machines placed, I would feel helpless"*. Among those who would like medical staff to be present, the reasons were to supervise the robot, ensure safety, make the patient feel more comfortable and to give explanations on how the machine works and what to do.

Question 2: What information would you like before being swabbed by a robot?

Communication on **Procedure** and **safety** are the two most important types of information the respondents would like to receive before being swapped by the robot. Respondents would like clear information on how the robot operates and a step-by-step instruction on what the patient should do, what the robot will do during the swab, what will happen after the swab, how the patient will receive their results and how their data

will be handled. Many would like to receive this information beforehand on their cell phone or while waiting to be fully prepared for the test. Others also indicate that the information could be given by the robot just before the swab or during the procedure.

In addition to information on the procedure it was also important that information on safety is given to the users of the robot. Respondents would especially like more information on the sensors in the robot and the safety measures to towards ensuring that the swab will go too far down the throat or push too hard causing injury: *"I would feel safer if the device made safety indications with a recorded voice. Like: There is no risk of touching any zone of the mouth, causing pain".* Respondents also asked for information about emergency stop or procedures in case of a malfunction or if the patient wanted to stop the swab in case something was uncomfortable or hurt. In connection to this, information on certification, test protocol, success rate, and maintenance is mentioned as ways to show that the robot is safe. The respondents want to be assured that the robot is tested and follows EU liability regulations and is verified by a recognized organisation. Concerns regarding maintenance and hygiene were also mentioned. A few respondents would like information on how often the robot is sanitized and the safety measure towards not infecting the next person with potential virus through surface areas people might touch with their hands or head.

Many respondents mention videos or brochures as the best channel of communication. Some also mention that it would be nice to see examples of others being swabbed before trying it themselves: *"That would make me more comfortable and trust the robot more".* This is proposed to either be though a live demonstration on a test person or though video testimonials: *"Ideally, I would like to see it 'live', but a video would be ok too."* Some also asked to receive the information by a human rather than a video.

A significant group also asked for information regarding human medical staff. This varies from information on when a human last has checked the machine, how a human can be contacted if needed to information on *"Where I can get swabbed by a person instead?".*

Question 3: What would be your biggest concern regarding being tested by a swab robot?

Many of the same barriers as previously described occurred again when asked what the respondents' biggest concern would be. The biggest concern is the fear of being hurt by the robot due to poor design and programming or technical errors in the system. This concern also relates to another big concern which is the mistrust in responsiveness towards human movement or human feedback. Many respondents once again highlight that they are concerned about their own reactions when being swabbed and therefore would need reassurance that the robot can react to discomfort, pain or unexpected movements. A specific suggestion to help this barrier was to design a function where the user can give feedback when feeling pain or discomfort and that the robot can communicate with the user throughout the swab to ensure that everything is going as planned. A couple of respondents also suggested to have a visible stop button: *"I think a visible stop-button would provide a sense of control and safety ".*

Lack of human support was also mentioned once again as one of the dominant concerns. Many suggested to have a human assistant on site to ensure trust both with the procedure but also to help assist if something goes wrong. It was mentioned that discomfort and nervousness cannot be dealt with by a robot and that especially for young children and older people human assistance would be necessary.

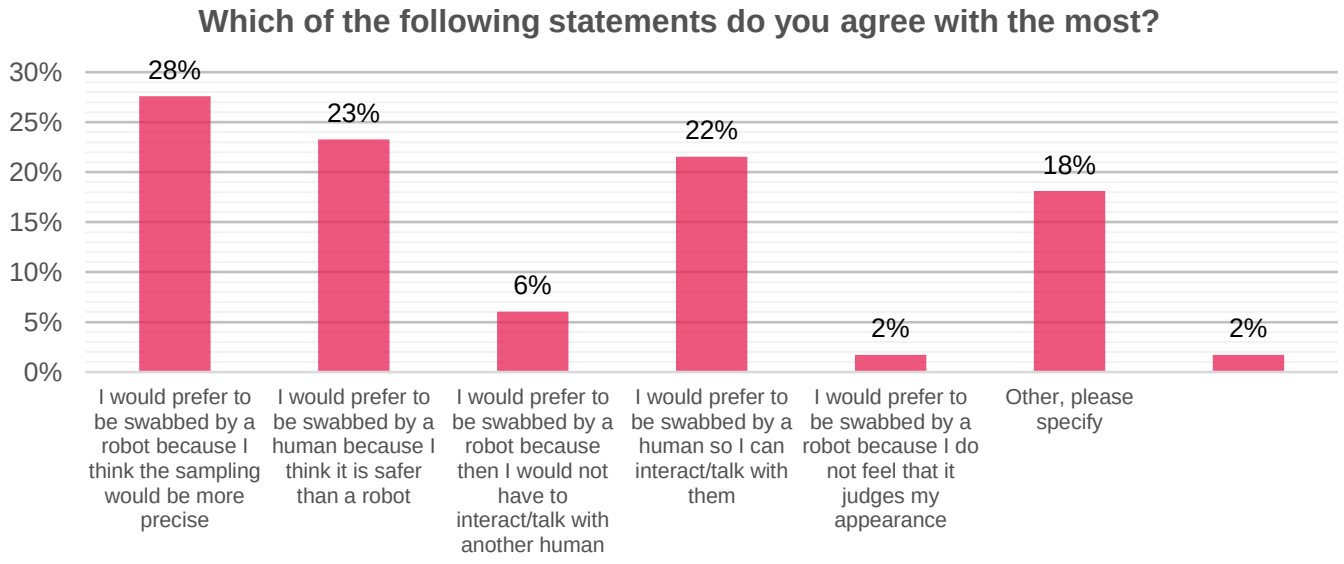
- Lastly accuracy, reliability in the sample collected and efficiency in it taking longer time than if performed by a human were also mentioned as concerns by a few respondents.

Only four respondents had no concerns towards the robot indicating that this type of robot has many barriers and challenges which should be designed for to ensure trust in the robot.

The focus group interviews conducted during the Robotex festival confirmed that the fear related to this robot is moderate, as there is a small fear of mistakes made by robots. The interviewee points out that "If a person took a sample, it would still be safer."

Question 4: Which of the following statements do you agree with the most?

In the fourth question the respondents were presented with several statements that could be incentives for being tested by a robot or by a human. The respondents could only choose one option. About half (49%) of the respondents answered that they would prefer to be tested by a human, with 23% reasoning that they think it would be safer than a robot, 22% saying that they prefer a human so they can interact/talk with them and 4% had other reasons to why they preferred a human. 42% answered they would prefer to be tested by a robot with 28% saying they would prefer it because they think the sampling will be more precise, 6% preferring it because then they would not have to interact/talk with another human, 2% preferred it to not be judged on their appearance and 4% had other reasons for preferring a human. The remaining 9% were indifferent, did not know what they preferred or wanted to do the test themselves.



Question 5: When would it be a good idea to use a swab robot?

To get an idea of the business potential and where it would make sense to implement the robot the respondents were asked in which situations or places, they could imagine a swab robot being placed.

A large group responded that they could see potential in using the robot in pandemics/epidemics where infection rates are high and mass testing would be needed to test a concentrated group of people. Several mention that they see a benefit if it can free up medical workers for other tasks or when there's simply not enough medical staff to test many people in short periods of time. Among the places a robot like this would be useful many mention public institutions such as hospitals, test centres, pharmacies, retirement homes, universities, prisons, and other type of health centres.

In addition to the public institutions a large group of people could also imagine being tested at more public spaces or private institutions such as the workplace, shops, caffes, restaurant shopping malls, train stations, large events, and airports. Especially the airport was mentioned by many of the respondents: *"It can also be used at airports, to get out of the airport you must show a receipt for testing ".*

Question 6: When would it not be a good idea to use a swab robot?

As a follow up the previous question respondents were also asked when it would *not* be a good idea to use a swab robot and whether they could imagine the robot being misused or misplaced in certain situations.

The most recurring answer here was to not use this type of robot on certain groups of people such as children, elderly people, people that don't feel comfortable with the robot and in certain health treatment situations where the human factor is important. One respondent explained: *"I don't feel like a robot would fit as well if the work is around interaction with children, like a kindergarten or a primary school. As I feel It would be harder for the robot to understand the kids feelings".*

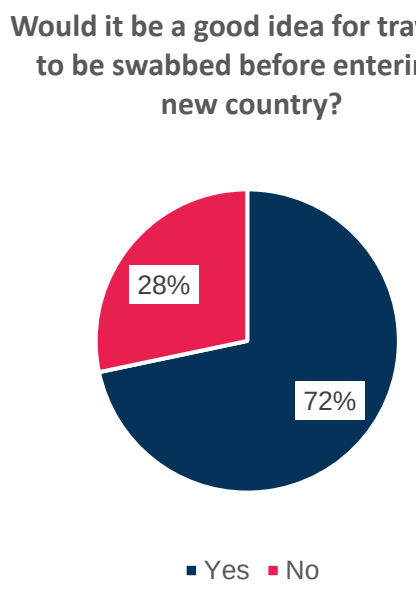
Contradictory to some of the response in the previous question some do not think public spaces and places with crowds are a good place to implement the robot. Barriers and concerns towards public spaces include not being private enough, vandalism and risk of misuse, lack of hygiene, and lack of specialized assistance/supervision. There's also a concern that the robot will be less efficient than a human tester and thereby produce queues and crowds with high risks of getting contaminated by other people waiting.

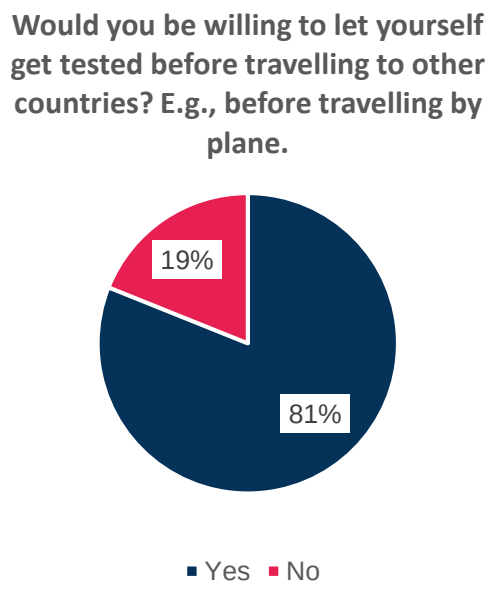
Another issue raised by multiple respondents is the concern of how the data is handled and stored after being swabbed. *"The robot should be implemented and operated by public health care institutions, not a private company outside regular healthcare. I would be nervous about others' use of the collected data (GDPR and commercial misuse)."* One respondent is also worried that this kind of robot will create an unwanted testing culture in the society.

There was also a group of seventeen respondents who couldn't think of any situations where the robot could be misused or misplaced indicating trust towards the robot.

Question 7: Would it be a good idea for travellers to be swabbed before entering a new country? And would you be willing to let yourself get tested before travelling to other countries? E.g., before travelling by plane.

To test the business potential of testing people before entering a new country the respondents were asked directly what they thought of this idea. 72% thought it was a good idea to have testing procedures for people entering a country and 81% would be willing to let themselves get tested before travelling to another country. This indicates that there is a group of people who don't think testing is a good idea but who would be willing to take a test if necessary. Looking at the elaborations of to the answers it is important to note that many respondents indicate that it depends on the situation of the country and the stage of the given epidemic/pandemic. Many mention that they do not think it is necessary with the current stage of Covid-19 (fall 2022). Some also mention that they think it is good idea but that they would prefer to not have to wait in additional lines at the airport and would rather do the test beforehand.





Question 8: Imagine that you are the designer of a swab robot, what would the robot look like?

Lastly respondents had the chance to freely give any suggestions for the appearance of the robot. Here there were about as many different opinions and suggestions as respondents. The respondents were engaged in the robot and would like to give their suggestions for improvement.

Overall, the recurring responses can be divided into different themes. First, several respondents did not think the design is important or would rather focus on **function over design**. A robot that expresses safety and hygiene is important for them. Then there were two large groups with diverging opinions. One group thought it is important that the robot is **small, minimalistic,** and has a **simple design**. One respondent explains: *"I wanted to design it so that it was as minimalist as possible, as it may seem violent to*

have to interact with a machine full of buttons, wires, arms, etc". On the other hand, a large group would rather like to see a more **human like design** as we see in anthropomorphic robots. Some mention that this could reduce concern and feel less intimidating. Some also responded that they were happy with the current design of the robot and one highlighted that human-like design would not help with acceptance in their point of view.

Lastly a few also mentioned that if they were to design the robot, they would include users in co-constructing the robot: *"I would include users from different backgrounds and ages to test and provide feedback to achieve a comforting environment and ensure a good user experience."*

4.2 Capra Robotics

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The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

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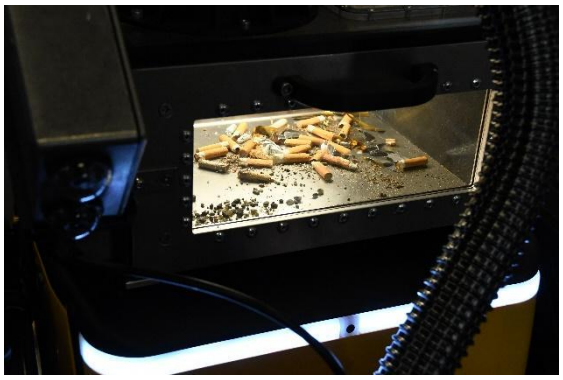
4.2.1 Presentation of Capra Robotics

Capra Robotics have created a mobile robot for collecting cigarette butts, primarily for urban areas. Keeping our cities clean is a needed but costly affair. Therefore, municipalities are looking for solutions that are neither too time-consuming, labour-intensive, expensive nor environmentally damaging.

Fundamentally, robots have the benefit that they tirelessly continue to solve routine tasks. As the world looks today, it also becomes increasingly difficult to get the needed staff for monotonous jobs. Robots could be the next-generation tool for relieving and upgrading the skills of municipal service employees to foremen of robots, while still giving them the ability to solve creative and complex tasks.



The robot is equipped with a camera to find the cigarettes and a vacuum cleaner to remove them. The robot is controlled by an operator, who gives it commands from a provided app. It is estimated that the operator can oversee about 5 robots at any given time. The main goal of this solution is to minimise the amount of microplastics and toxins in urban areas by removing discarded cigarettes from the ground.

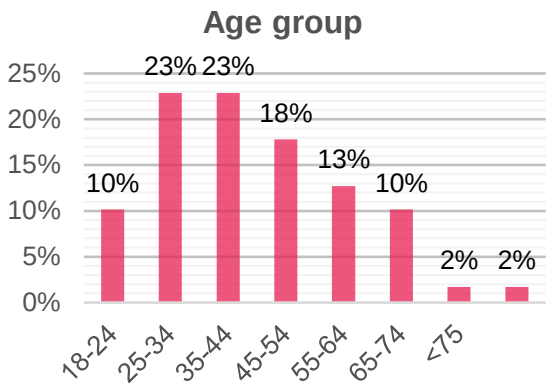
4.2.2 Demographics

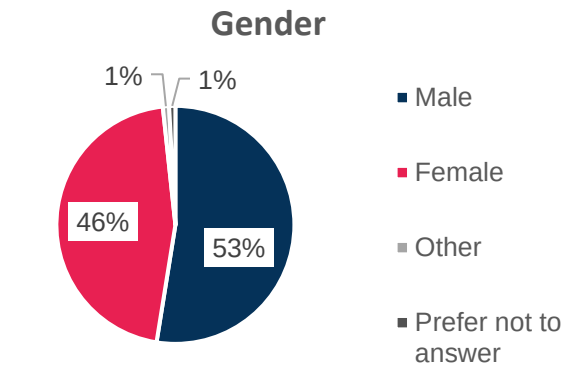
The survey received a total of 118 responses. The respondents were mainly citizens in the age groups 25-34 and 35-44, each group representing 23% of the total responses. These were followed by the age group of 45-54, accounting for 18% of the total responses, and age groups 18-24 and 65-74, each accounting for 10%. Less than 2% of the respondents were aged 75 years or above.

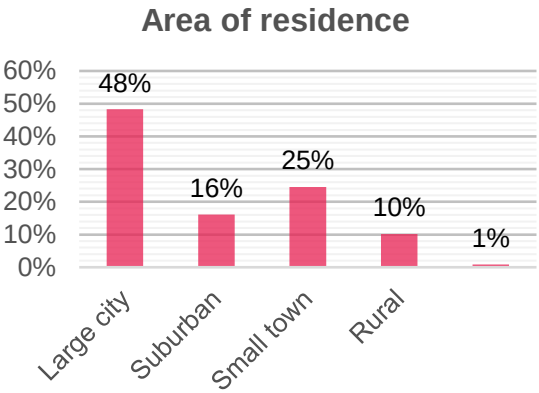
Gender distribution was relatively even, with 53% of the respondents being male and 46% being female – the remaining 1% being unspecified.

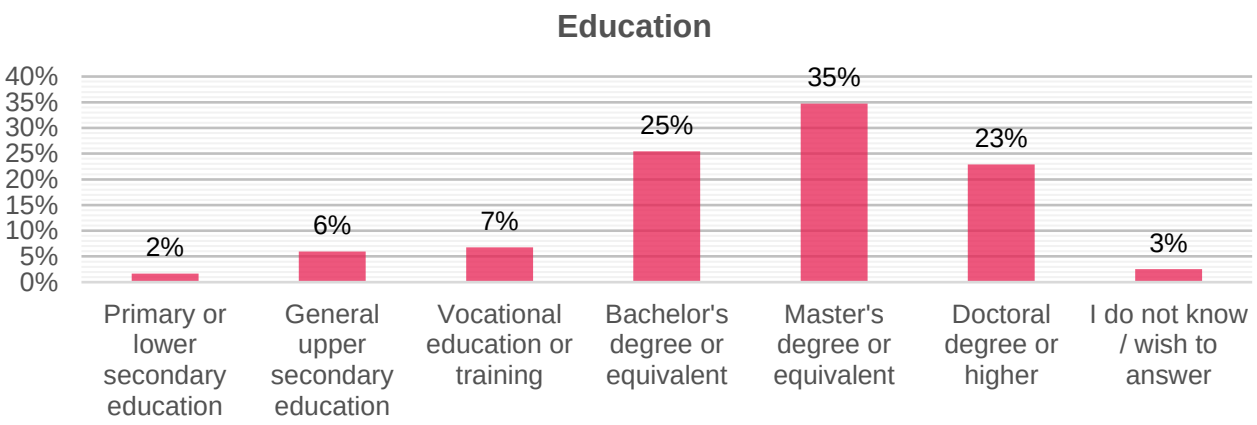
Almost half of the respondents said they live in a large city, followed by 25% who said they live in a small town. 16% of the respondents live in a suburban area, while 10% answered that they live in a rural area.

Respondents were generally highly educated. As many as 23% said they hold a doctoral degree, 35% a master's degree or equivalent, and 25% a bachelor's degree or equivalent. This distribution may partly reflect the age distribution, although obviously age does not directly correspond to educational level. In any case, there is a clear predominance of respondents holding degrees.









The survey responses were distributed across 16 countries, of which 15 were European, accounting for 79% of the total responses. The remaining country was the United States, which however accounted for just below 2% of the total responses. The remaining 19% of the responses were of unknown origin. Citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe. A particularly large number of responses came from France and Denmark, each accounting for 14% of the total responses, followed by Portugal with 13% and Norway with 11%.

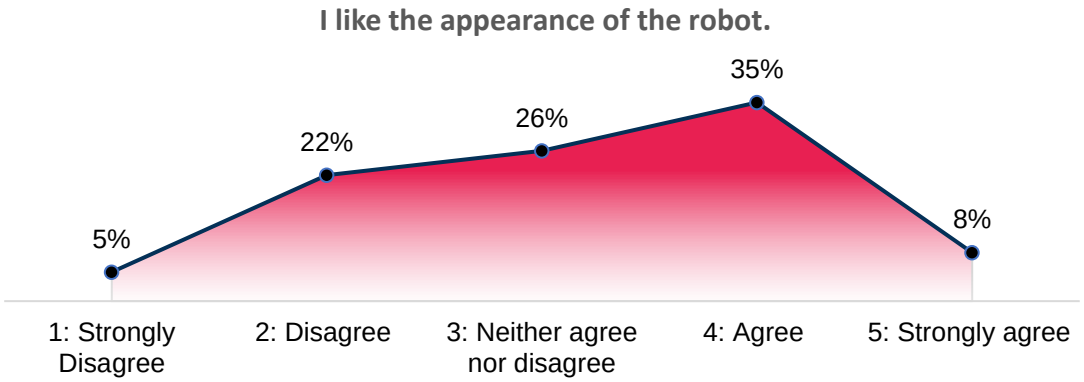
To briefly sum up, most of the respondents for this online consultation were younger or middle-aged, highly educated and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses on the following pages, it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.2.3 Survey results

The online consultation consisted of 8 questions and the respondents were asked about the robot's appearance, functionality, and safety. The results will not be presented in a chronological order to how they were asked but by compiling questions relating to the same topic.

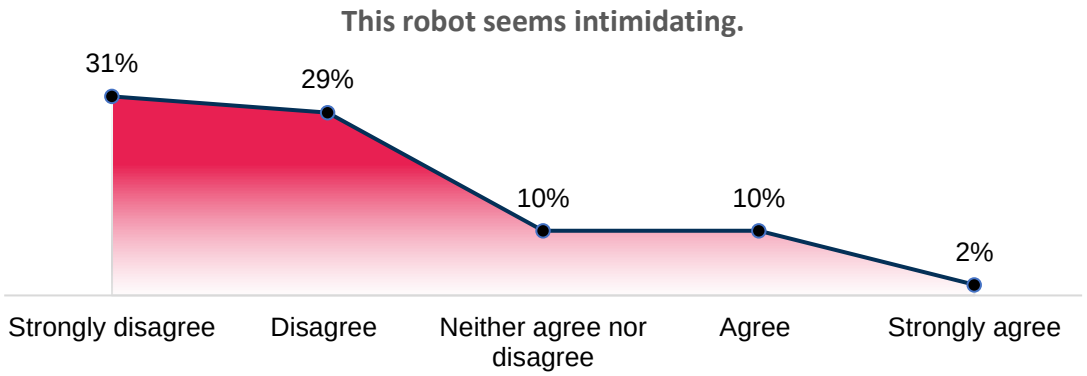
Question 1: I like the appearance of the robot &
Question 3: This robot seems intimidating

The following results are a combination of questions addressing the robot's appearance. Several answers from the survey circled around the appearance of the robot. When asked about the robot's appearance more than a third of the respondents either agreed or strongly agreed to liking the appearance of the robot. On the opposite side a little less than 30% answered they did not like the appearance of the robot. Most of the comments on the robot's appearance focused on the aesthetic and functionality of the robot. Different comments suggested a change of colours, so the robot would look more: *"(…) eye-catching"*. Other suggestions were to make the robot seem more familiar and have a friendlier look. These types of comments can reflect how changes in our environment might be easier adapting to when the changes replicate some sort of familiarity. One respondent suggested that it could look like the noo noo vacuum from Teletubbies, a friendly looking vacuum from a children's television program. These statements were supported by comments about having the robot look more like a vacuum than it already does, as this would also help accentuate the functionality of the robot. So, when introducing a robot to an environment where it will engage with people, an appearance that both displays the functionality of the robot and has a familiar look can help increase the acceptance of its presence.



Whether the respondents perceived the robot as intimidating is also part of the perception of the robot's appearance. Question 1 focusing on the robot's appearance didn't receive a lot of elaborated answers to why people liked the appearance of the robot. But with question 3, when the respondents were asked if they found the robot intimidating several elaborations on why respondents do not find the robot intimidating were received. These comments can support why respondents might like the appearance of the robot. More than half of the answers to whether respondents found the robot intimidating answered they disagreed or strongly disagreed and did not find the robot intimidating. Respondents have used these adjectives to describe the robot: **'harmless', 'small', and 'not dangerous'**. These attributes can be supported by another comment: *"The robot has a noble purpose, and when you see its content, you can understand what kind of work it is doing*". This comment helps understand why the appearance of the robot might seem appealing to the respondent, when the physical appearance of a robot clearly displays its functionality. Some of the comments on why respondents are not attracted to the look of the robot are more connected to subjective opinions towards the look of the robot, while they do not find the robot intimidating.

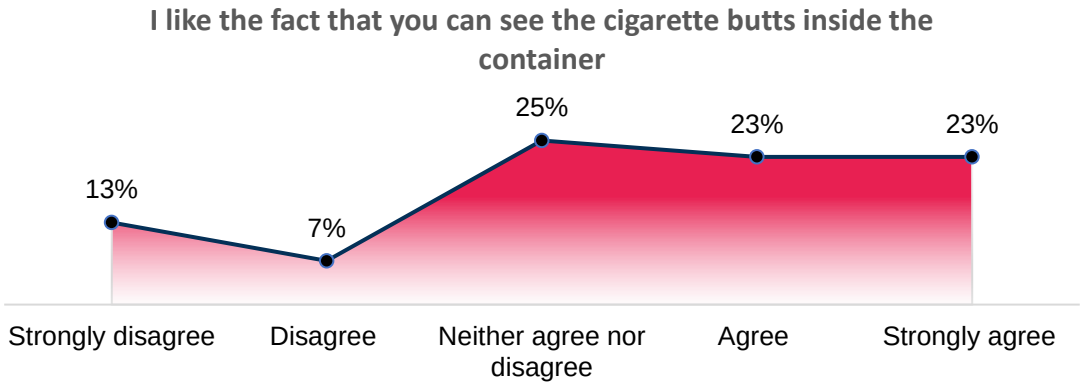
Some of the respondents found the robot intimidating. These concerns were mostly explained with a connection towards the maturity of the robot's functionality rather than the look and appearance of it. One respondent experienced the robot as scary, but at the same time the look of it was familiar: *"looks like wall-E"* (, a friendly robot from a children's movie). The comment emphasises why the appearance and look of a robot is important for the societal acceptance of the robot. Several comments focus on the aesthetics and how it's important for the approval of a robot.



During the focus group interviews conducted at the Robotex Festival in Tallinn, the participants discussed the robot's appearance for a long time. In the case of robots moving around streets, the importance of appearance was pointed out. One participant mentioned: *"Such a nice little cute robot. In my opinion, this cute look could be emphasised somehow. Right now, he looks like a doer of dirty work and could be a little nicer."* The participants pointed out that in the case of robots operating in urban spaces, more attention should be paid to what emotions the robots evoke in people. One of the participants said: *"If we think that it is something that is on the street and in the urban space and is always active there, then it can also create a positive mood for people. For example, if you are smiled at, you smile back. It could do several jobs at the same time. "*

Question 6: I like the fact that you can see the cigarette butts inside the container

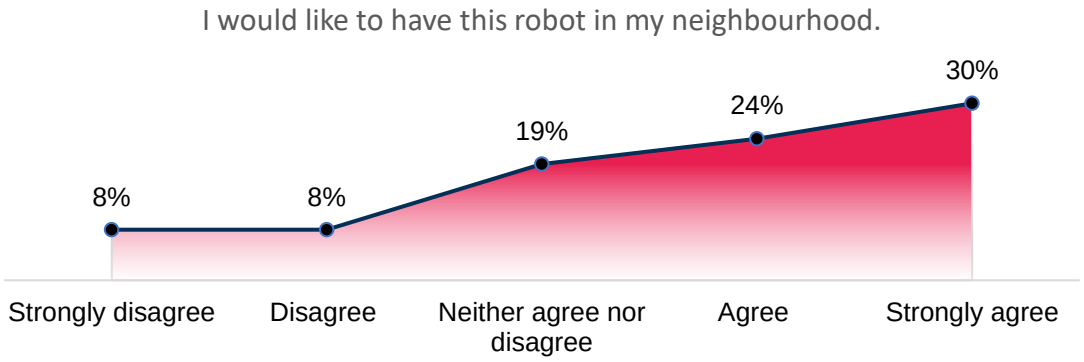
When asked if respondents liked seeing the collected cigarette butts inside of the robot a little less than half of the respondents agreed or strongly agreed to the statement, but several elaborated their answers with comments such as: *"…it is good to see how much the robot has picked up, the cigarette waste is an unpleasant sight"* and: *"(…) not necessary, the proof of work is that streets are clean"*. While most of the respondents liked seeing the robot's function displayed, some of the respondents do not wish to see the cigarette waste. One respondent suggested: *"Use an LED panel instead. You can show number of cigarette butts and friendly emoji icons. Cigarette butts inside a transparent box isn't visually appealing"*. There are many ways to display the functionality of the robot which are more discreet than a clear look at the actual waste being collected. To this question more than a fourth of the respondents neither agree nor disagree with the statement of like seeing the cigarette waste. The answers support how the perception of the robot's appearance is very subjective and that many respondents do not have a strong opinion of it. Some respondents suggest enhancing the aesthetics and appearance of the robot by making it look more familiar and by aiming for a look supporting the functionality of the robot, when using a display that showcases the effectiveness of the robot is welcomed by respondents.



7: I would like to have this robot in my neighbourhood

Respondents were generally very positive toward the robot's functional purpose and welcomed the aid it would be able to provide. Most respondents agreed or strongly agreed that the robot seems helpful, and those who elaborated on their answer emphasised the benefit of relieving humans of a generally unwanted and repetitive job: *"People don't want to walk around cleaning cigarette butts. This thing does. Therefore, it is useful"*. For some respondents, the robot also appeals to the concern of available labour force. One respondent elaborated by noting: *"with an aging population and lack in human workforce for monotonous jobs, this robot is just what we need in cities, as pollution have increased dramatically the last 100 years."*

Only 3% of the respondents strongly disagreed that the robot seems helpful, while 11% disagreed and 13% neither agreed nor disagreed. These responses may be due to doubts about the robot's effectiveness in practice since this hasn't been demonstrated to the respondents, or respondents can't identify an immediate need for it in a personal context. For instance, when asked to consider the statement: "*I would like to have this robot in my neighbourhood*", several respondents pointed out that they don't notice a lot of cigarette butts in their neighbourhood and that this particular type of litter isn't much of a problem. This, of course, points to the fact that there are many different types of neighbourhoods, and the prevalence of cigarette butts (and litter in general) may depend on the country and whether the neighbourhood is in a rural or metropolitan area, its socioeconomic status, and so on. However, most respondents still either agreed or strongly agreed that they would like to have the robot in their neighbourhood, while 19% neither agree nor disagree – the latter of which might be explained by the same reasons as above.

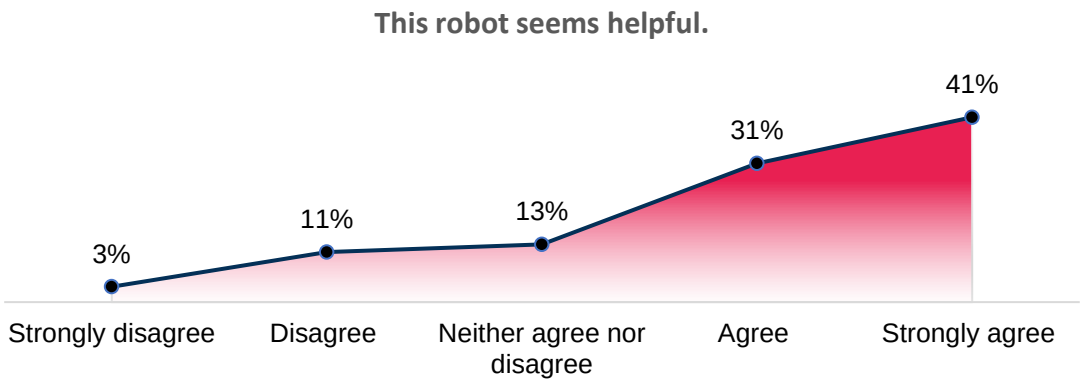


Although the majority of the respondents seemed to like the idea of a robot that picks up cigarette butts, there were also a significant number of respondents who felt its scope is somewhat limited. As mentioned above, the robot might be perceived as being redundant in areas that are less plagued by cigarette butts, and some respondents even pointed to the fact that they experience: *"smoking is on the way out"*, which of course alludes to a declining need for technology specialising in picking up cigarette butts in their opinion. As several respondents suggested, this presents an opportunity to better leverage the robot's potential by making it capable of picking up other types of litter in addition to cigarette butts. One respondent noted that, *"A human being would probably collect all*

garbage and not just cigarette butts." This comment brings up the classic distinction between robotic efficiency and human judgment and emphasizes the fact that if the latter is superior in order to perform a task adequately, then it is difficult to justify the employment of a robot. However, if the robot is capable of recognizing and picking up several types of litter, it will likely be perceived as more useful by society. For instance, one respondent said that they live in the countryside and while cigarette butts are not much of a problem in their neighbourhood, other trash such as fast-food wrappers and empty cans are. Another respondent found other types of litter related to their specific neighbourhood to be bothersome and expressed a need for a robot that could take care of that: *"I never see cigarette butts in my neighbourhood. I live in front of an elementary school. Kids lose homework, articles of clothing, and discard snack wrappers and containers in front of my house. I could use a robot for picking up after them."* Others requested a robot that can pick up dog poop, and some suggested the possibility of using a robot to remove hazardous litter such as syringes or glass shards.

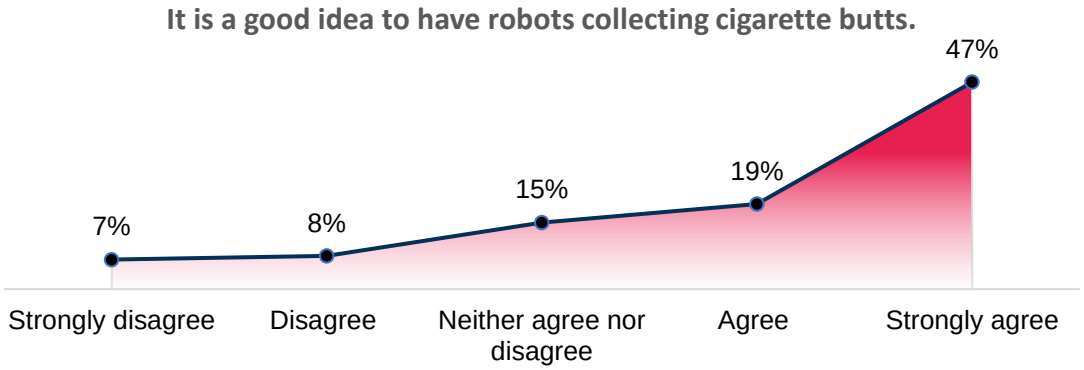
Question 2: This robot seems helpful & Question

When asked if the robot seems helpful almost two thirds of the respondents replied they agree or strongly agree. A respondent emphasises why the robot could be perceived as helpful: *"It is helpful, given the trends of cigarettes does not decline".* Even though many of the respondents see the robot as helpful, there are still some reservations within the elaborated answers in the survey. These reservations are expressed as the responsibility of littering is moved from people themselves to the robot instead. One respondent expressed: "*it [the robot] could make people not care where they drop their cigarette butts"*. Many of the respondents who were hesitant towards the robot and its function prefer to either educate people not to throw cigarette butts or limit the spaces to smoke. Respondents' elaborated answers indicated a wish for preventive actions towards smoking and cigarette waste and demonstrated a challenge for the acceptance of the robot, even though most of the respondents supported the statement of the robot being helpful. The perception of how helpful the robot is are limited by which other behaviours are being accentuated according to both littering and smoking. The effectiveness of the robot could be supported by a nudging functionality informing people to use the trash can for their cigarette butts. At the same time the robot's function is limited to the extent a robot can affect human behaviours according to smoking and littering.



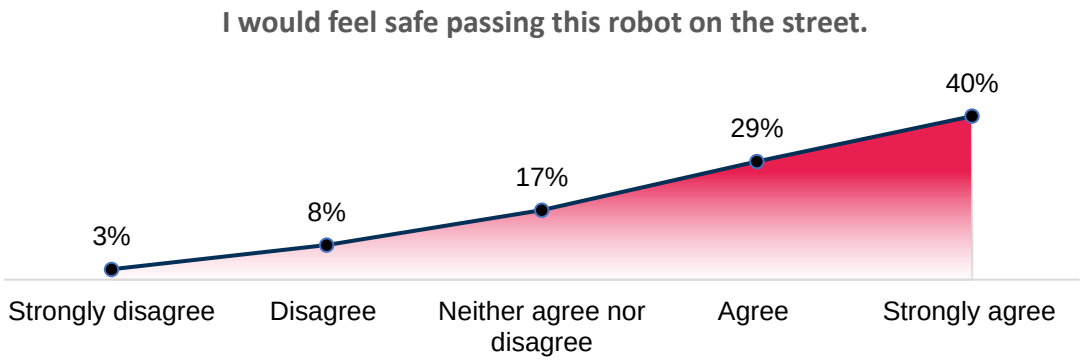
Question 5: It's a good idea to have robots collecting cigarette butts

Another question in the online consultation asked if the function of collecting cigarette butts is a good idea, a large percentage of the respondents agreed or strongly agreed. In the consultation some of the answers are supporting how the robot's functionality of collecting cigarette butts is helpful. These respondents have a special focus on how the robot can help fight pollution: *"One thing is that strong winds will bring cigarette butts to the sea, causing more ocean pollution. A different matter is that both pets and small kids are not careful about what they eat, so it is important to collect"*. Other respondents focus on how the task the robot is performing can be more suited for a robot since the task isn't very appealing for humans. This is being supported by comments like: *"Most people would not want to do such a thing"* and *"(…) lack in human workforce for monotonous jobs, this robot is just what we need in cities, as pollution have increased (…)"*.



Question 4: I would feel safe passing this robot on the street and

As previously mentioned, respondents seem to generally be in favour of this type of robot, especially if it was capable of handling other types of trash besides cigarette butts. Also, despite the potential to increase acceptance by targeting familiarity in the robot's appearance, it generally seems like people would feel comfortable around it: 40% of the respondents strongly agreed that they would feel safe passing the robot on the street, while 29% agreed to the statement. 17% answered that they neither agree nor disagree, for which there could be many reasons; however, it's important to keep in mind that the questions and statements presented in the survey are hypothetical in nature, since they ask respondents to *imagine* scenarios in which they encounter the robot. Since they have no actual experience to base their answers on, it may be difficult to provide an answer with enough confidence, and so some respondents might prefer to 'play safe' by remaining neutral or at least undetermined in their response. This might be the case even more so for respondents who are particularly opinionated about this type of robot, or robots in general, because they may feel like they need more information in order to give a qualified answer.



Nevertheless, the responses reflect a generally positive attitude, which also resonates with the overall impression that the robot seems harmless. Most respondents either disagreed or strongly disagreed that the robot seems intimidating, indicating that although people might prefer a robot with more familiar-looking features, its appearance and behaviour as people imagine them from the information available in the consultation do not appear to be threatening on an individual level. As is evident from the elaborations, this partly has to do with the robot's size, since it is small enough for humans to maintain a feeling of superiority over it. As one respondent put it*, "If it attacks me, I am able to kick it over and throw it into a canal. So yes, I feel safe".* However, a few respondents felt that it might depend on the situation and recipient whether the robot feels intimidating. One respondent noted that*, "On narrow sidewalks it could be intimidating,"* while another respondent pointed out that *"It might appear intimidating to small children, senior citizens or pets".*

In general, the willingness to trust the robot and its intentions seems to rely on the extent to which people feel like they have more power than the robot does, and whether the robot is capable of adequately communicating its presence and intentions. In commenting on whether they would feel safe passing the robot, one respondent said: *"No problem. If I move, I would avoid it. If I was standing or sitting, then I would expect the robot to show that it has seen me, and make me feel certain that it will not run over my feet*". Rather than displaying suspicion or scepticism, this respondent simply expects the robot to be built and programmed in such a way that it puts human needs and safety before anything else. Indeed, while few respondents find the robot to be intimidating, some did raise concerns about safety risks. These concerns were mostly related to whether the robot is heavy and could drive into people, or whether you might risk falling over it. Because of this, several respondents stressed the importance of building safety measures into the robot that would mitigate these types of risks, including visual and auditory indicators. One respondent said that: *"with enough sensors the robot should be safe,"* and, in a similar vein, another respondent suggested that *"It would need a tall flag so that it can be seen from automobile drivers, persons in electric wheel chairs, bicyclists, others"*. Thus, even if the robot is relatively small and slow, it is still important to design it in such a way that it will be able to reliably make people in its vicinity aware of its presence.

Besides concerns about safety, some respondents were slightly sceptical about the viability of the robot in terms of logistics and flexibility. Doubt was raised about whether the robot would be useful in large cities and crowded areas. To the statement "*This robot seems helpful*", one respondent commented, *"I am not convinced of his ability to move in real urban areas,"* and this sentiment was echoed by another respondent who thought that the robot was *"[n]ot very helpful. Try to use that in Rome city center"*. Still others even expressed concern for the robot's safety, pointing out the risk of vandalism that could end up destroying it. One respondent expressed these points as a question, asking, *"Would it survive operating in a tough neighbourhood? Can it operate on around cars parked on sidewalks?"*

While these insights are more doubts based on assumptions about the robot's capabilities and ability to be integrated into various environments than they are concerns about impact, they are important for understanding the expectations the respondents have toward robots and what it takes for them to be accepted as meaningful additions to society. Additionally, a final but important concern raised by a handful of respondents was related to a well-known topic within the robot and automation debate: namely, replacing humans with robots. This concern did not only regard robots' limited perception of reality and context in terms of what counts as litter – as we discussed earlier – but just as much the social implications. To the statement "*I would feel safe passing this robot on the street*", one respondent commented, *"Yes, but it does not provoke a positive feeling, subjectively. If a human were out cleaning, they'd probably give a friendly nod."* Another respondent said that they *"would rather pass a human being"*, alluding to the value of the subtle social interactions of everyday life.

If a robot takes over a job that is normally performed by a human, it will be at the cost of any potential social interaction between that human and whomever they might meet while working, even if the interaction is merely a nod or a smile. And, as these consultation responses suggest, it is a shift in everyday structures that will likely not go unnoticed. The robot may, of course, simply be intended as an addition to existing efforts at reducing pollution locally and not as a replacement for human labour. In this case, it is possible that respondents worried about social disruption would be more inclined to accept the employment of the robot.

Participants in the focus group interviews conducted during the Robotex festival pointed out that in the case of robots operating in urban spaces, more attention should be paid to whether they also stand out in traffic. *"He could be brighter. That if he is moving in traffic, he should of course catch the eye."*

4.3 NAUST Robotics

This report presents the results of a collaboration between NAUST (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.3.1 Presentation of NAUST Robotics

NAUST Robotics are developing an autonomous drone (i.e., a drone able to fly and move around on its own) equipped with speakers to protect the agricultural fields from birds and wild animals' attacks. The drone will fly over the fields playing deterring noises with the purpose of moving the animals back to natural areas and keep the crops safe.

A landing platform for the drone (drone-in-a-box), that will be initially set in the field, will shelter, and recharge the drone itself. It will also detect the presence of animals either by sound or images, triggering the deployment of the drone to the area affected. The whole system will work autonomously.

The solution aims to increase the agricultural yield in agriculture, while avoiding the use of more harming techniques for scaring the fauna and the human-time used to check the status of the fields. The robot is limited to playing bird sounds, and in no way aims to harm the animals. Research shows that bird sounds are the most effective, but least stressful method to lead them back to natural areas. Current techniques include hunting, poisoning or using disturbing noises, whereas NAUST Robotics wants to offer a more humane solution for bird control. The robot also reduces food lost while bringing increased revenue for the farmer and it will result in a lower CO2 footprint and chemical input usage per unit of food.

4.3.2 Demographics

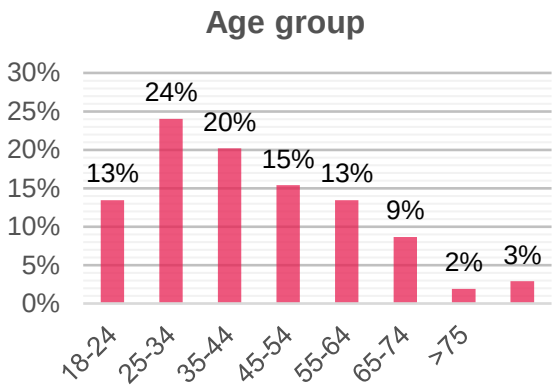
A total of 105 respondents were engaged in the activity answering questions about the robot.

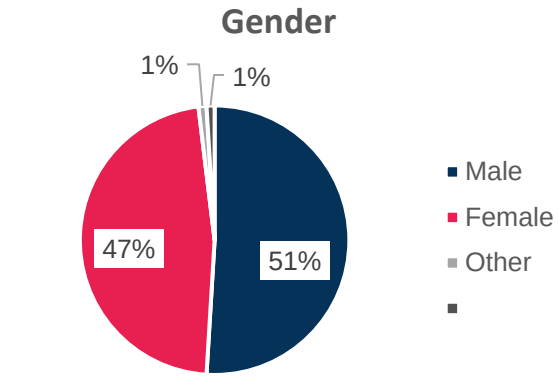
Respondents for this survey consisted mainly of citizens in the age group 25-34, accounting for 24% and ages 35-44 accounting for 20%. Following these ages 45-54 accounted for 15%. These were followed by ages 18-24 and 55-64 with both groups accounting for 13% each.

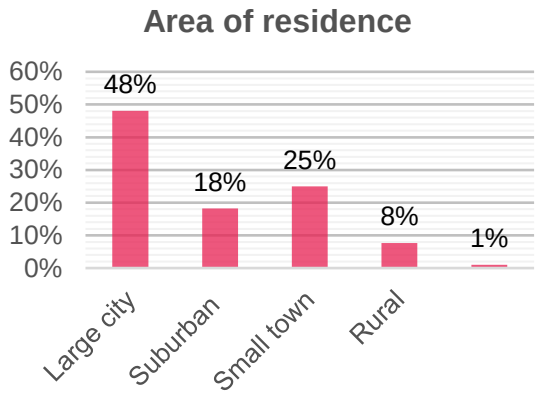
The gender distribution of respondents was adequately equal, with male participants accounting for 51% and female participants accounting for 47%. The remaining either answered 'other' or did not specify their gender.

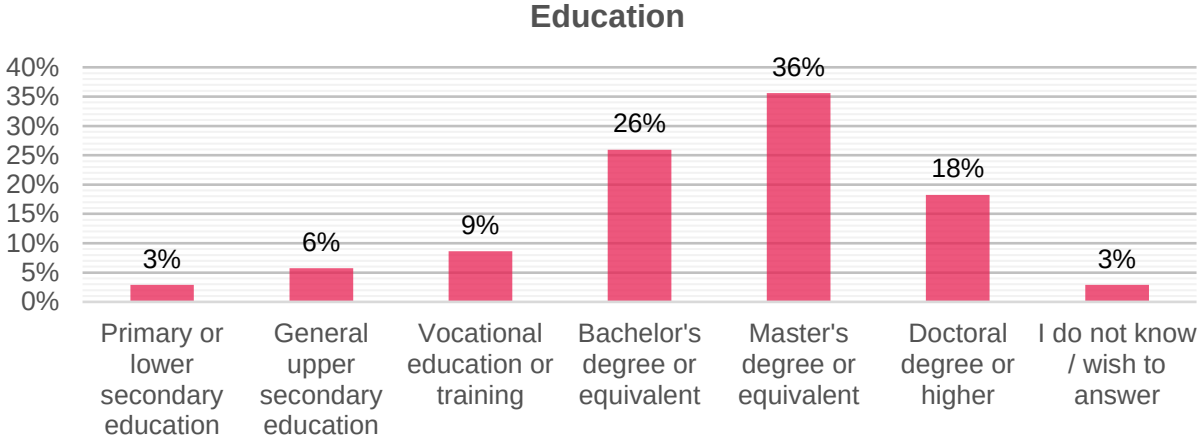
Looking at distribution of areas of residence, a total of 48% of the respondents answered that they lived in a large city. The second most chosen option was small town with a total of 25%, followed by suburban with 18% and rural with 8%.

Respondents were generally highly educated with 35% answering that they held either a master's degree or equivalent and 26% answering that they held a bachelor's degree or equivalent. Following this the third most chosen option was doctoral degree or higher with 18%.









The survey received answers from respondents from 17 different countries in total. 18% chose not to disclose their country of origin. Apart from this, Denmark and France took the top spots with the former accounting for 17% and the latter for 15% of the total answers. Following this Portugal was with 9%, Lithuania and Estonia with 8% each and Norway with 7%.

As is evident from the above, most respondents answering the survey were younger people holding degrees and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses on the following pages, it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.3.3 Survey Results

The online consultation consisted of 7 questions focusing on citizens general view on drone technology.

Question 1: What is your perception of drones and what uses are you aware of?

Firstly, respondents were asked to write briefly about their perception of drone technology and what uses they knew of. Here, respondents generally mentioned a few clusters of categories with quite a few overlaps between them. Respondents highlighted drones used for video and photography in a variety of different situations, and one citizen mentioned how:

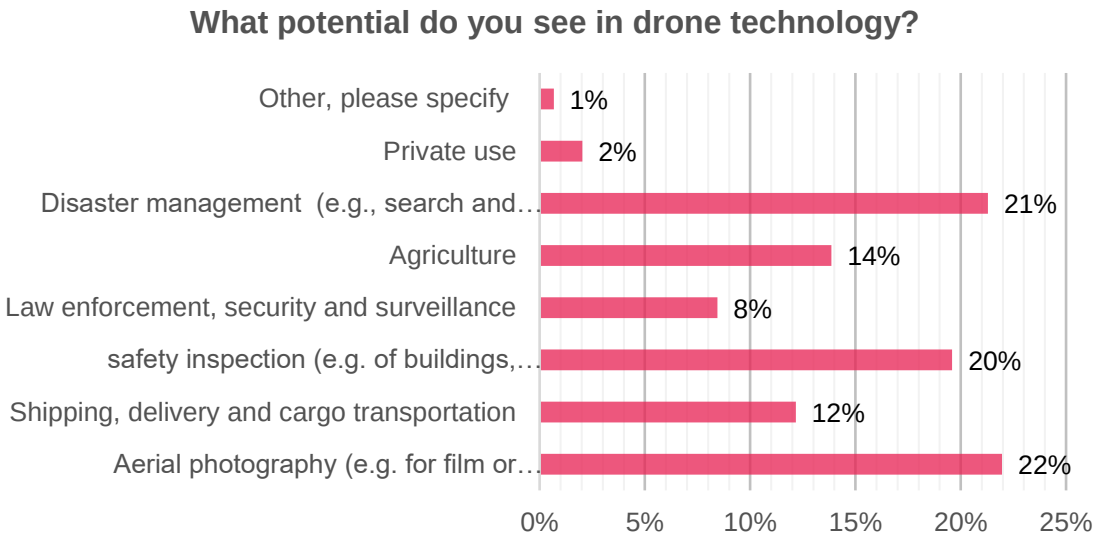
"Drones can do surveillance; search and rescue; traffic monitoring; weather monitoring; personal use; videography and photography; agriculture; delivery services"

This answer encompasses many of the topics highlighted by the respondents throughout the activity. Furthermore, drones used for aerial photo and videography were also mentioned by participants at this point of the survey. Another important area that attracted a lot of attention was the potential use of drones for military operations and considerations about drones being used for military purposes made up a substantial portion of the answers.

Respondents were also quite positive towards drone technology and mentioned several uses of drones that are greatly beneficial as a technology and a tool that can be used for multiple purposes.

The participants in the focus group interviews conducted during the Robotex Festival did not feel intimidated by this robot. Rather, it was pointed out that since drone technology is already quite well known, it has become a safe technology that is destined to fulfil its role and do the job. *"I can't say either bad or good. It's like simple worker, I would say."*

Question 2: What potential do you see in drone technology (choose up to 3)?

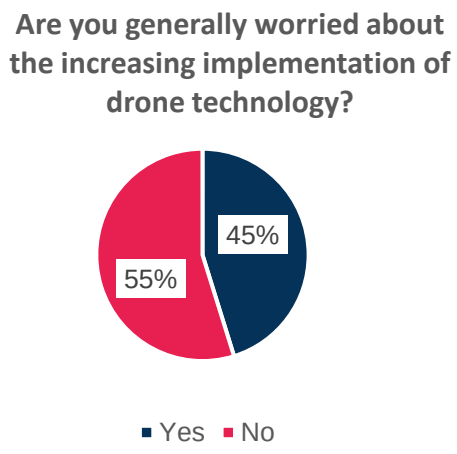


**Data is showed as a percentage of total answers in this question, not total of respondents*

When asked about the potential of drone technology the respondents engaged in the activity mostly favoured 3 areas, namely *'Aerial photography (e.g., for film or journalism)'* with 22%, *'Disaster management (e.g., search and rescue, weather monitoring etc.)'* with 21% and *'safety inspection (e.g., of buildings, infrastructure, industrial areas etc.)'* with 20% of the answers. Interestingly, agriculture was not among the top choices indicating that despite drones being fairly well known among citizens it is not for agricultural purposes they relate the technology or see most potential. This does of course not mean that drones shouldn't be used for agricultural purposes but is rather an indication that when having to choose among three options agriculture is not the prioritized area from a citizen perspective. In fact multiple citizens elaborated that they would like to choose all the options.

Question 3: Are you generally worried about the increasing implementation of drone technology? Please elaborate on your answer in your own words.

When asked whether participants were worried about the increasing implementation of drone technology 55% answered 'No', while 45% answered 'Yes'. Even though more than half answered that they were not worried about increasing implementation of drone technology, several concerns were raised in the elaborative section of the question.



Here respondents highlighted the need for regulatory measures to create a society in which drones are accepted. Several of the

answers concerned the fear of drones being used to increase surveillance in society at the cost of privacy. Answers such as:

"Mainly worried that they will be used for surveillance on civilians"

Along with statements such as:

"I'm a little worried - but not much. I am worried about whether they are safe enough - and whether they are used for dystopian control surveillance"

Were quite prominent as elaborative answers to the question. Furthermore, respondents mention how legal concerns can be a considerable cause for worry. They highlight the need for regulation and legislation to ensure that drones are beneficial and helpful to society and not just as tools that might be misused and abused. A consensus was that with the proper regulation and legislation, drones will be a beneficial technological addition to society – and one capable of bringing about a large positive outcome.

While answers relating to legislative and regulatory action were by far the most common, worries relating to military use were also highlighted at this part of the survey. Here participants highlighted how drones are capable tools for performing bombing assaults or other military operations but also the fear that they might be used in terrorist acts. Interestingly, several mentions highlight the noise made by drones as being a problem and a cause for worry, a general sentiment being that their noise will be a nuisance and affect both wildlife and people and that increasing use of drones might make cities even more noisy.

Many also highlighted the positive aspects of drones and the potential of the technology, mentioning:

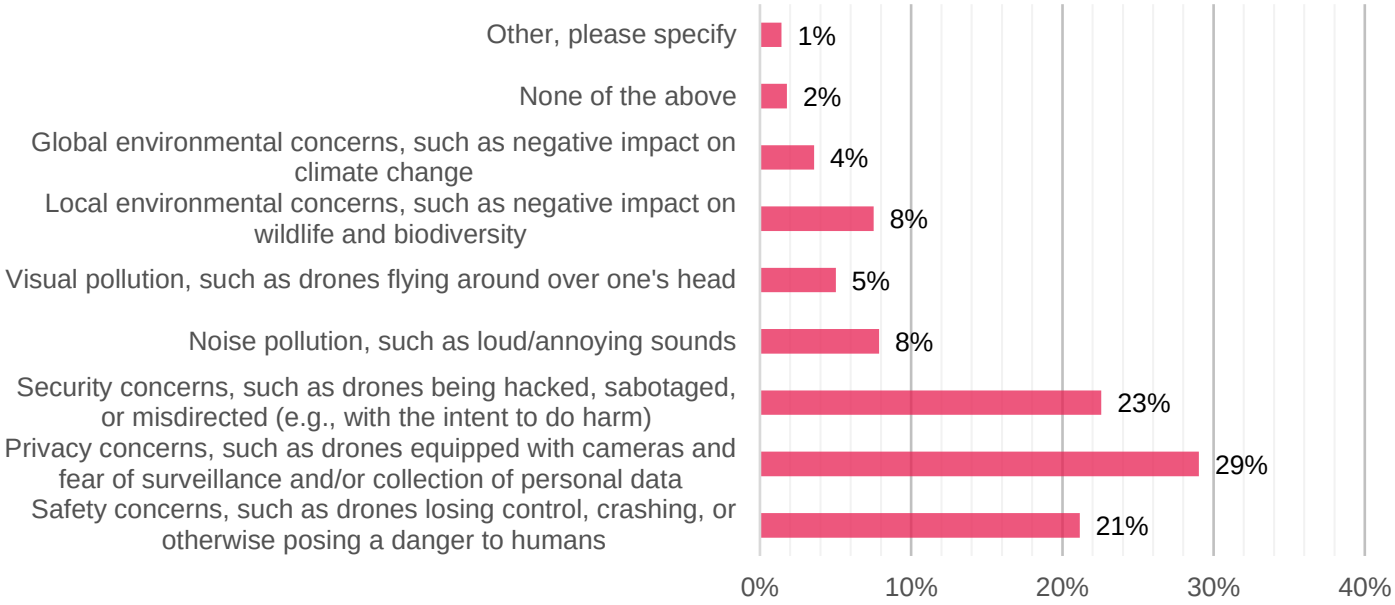
"[…] the value outweighing the big brother or voyeuristic negatives."

And if respect for privacy is upheld and regulation and legislation are implemented, usage of drones is seen as being highly beneficial.

Question 4: Which of the following areas are you most concerned about regarding the future uses of drone technology?

As responses to this question were limited to participants choosing only 3 of the answers it is to be expected that, had participants been able to choose more than 3, they would have highlighted the other areas as being important as well. Limiting the number of options to 3 was done with the intention of getting participants to be more critical with their answers.

Which of the following areas are you most concerned about regarding the future uses of drone technology? (choose up to 3)



**Data is showed as a percentage of total answers in this question, not total of respondents*

However, when asked to pick out the 3 areas that respondents felt most worried about, some tendencies reveal themselves. When asked about the areas that worried the participants the most, it was evident that *'Privacy concerns, such as drones equipped with cameras and fear of surveillance and/or collection of personal data'* was the most concerning option answer. This answer received 29% of the total votes. The second most chosen answer was *'Security concerns, such as drones being hacked, sabotaged, or misdirected (e.g., with the intent to do harm)'* with 23% of the total votes. Following closely was the answer *'Safety concerns, such as drones losing control, crashing, or otherwise posing a danger to humans'* with 21% of the total votes. As is evident from the distribution of answers to this question, the areas causing the most concern for participants are privacy, security, and safety, with privacy ranking just higher than the other two areas.

Looking at the answers to this question, it was also evident that environmental concerns did not rank high among the participants, neither locally nor globally. The answer *'Local environmental concerns, such as negative impact on wildlife and biodiversity'* received 8% of the answers, while *'Global environmental concerns, such as negative impact on climate change'* received 4% of the answers. A similar tendency can be seen when looking at the areas regarding the participants' attitudes towards drones and the way they occupy the spaces around us. Here, neither visual nor noise pollution were ranked particularly high with *'Visual pollution, such as drones flying around over one's head'* accounting for 5% of the total votes and *'Noise pollution, such as loud/annoying sounds'* for 8%. Once again, this distribution of answers shows that when obligated to choose only 3 options there are some areas that respondents saw as being more pressing that others, for example in terms of environmental concerns being less worrying that privacy and safety concerns.

Question 5: What can designers and developers do to make drones look safer and more reliable?

Here, several respondents mentioned that equipping drones with redundancy features and failsafe mechanisms could help create a better attitude towards drones. Mentions of adding elements such as parachutes preventing the drone from crashing into people, animals, or property in case of a crash or an accident. Another respondent noted that it might be useful to:

"*Provide designated drone spaces and safe areas, implement fail-safes for automatic drone landing in case of damage or other problems.*"

Other suggestions include ensuring that the software has been developed with focus on safeguarding it against cyber threats and hacking. Considering the design itself, many argued that safeguarding the helices of the drone would make them look considerably safer.

Perhaps not surprisingly, this was one of the questions that received the highest number of answers claiming that they did not know or had no opinion.

Q6: Soon drones may operate completely autonomous. What, in your opinion, should be done to ensure that society will accept and trust autonomous drones?

When asked about the increasing autonomy of drones and how the future of drones might look, the worry about legislation once again came up as one of the most pressing matters. Here, calls for very strict safety procedures, legislation and regulation were central for the participants of the survey. Respondents mentioned permits, authorization, and security approval by aviation authorities or other third parties along with restrictions on private use as some of the main pathways towards a more widespread societal acceptance of drone technology.

However, there were also a substantial number of respondents that were completely against the use of automated drones, one participant stating that:

"[…] There will always be a risk of breakdown, malicious hacking. Any absence of human control of an autonomous machine in a free field environment leads to a significant and unacceptable risk"

Further, respondents note that they would simply not trust them to operate automatically and that there should be a person controlling the drone in case of malfunctions and that:

"[…] Total autonomy is much harder to achieve than partial and so this will need a lot of work!"

Those who did not oppose a shift towards increasing autonomy highlighted the need for communication, information, and transparency. Here, raising awareness was seen as a way towards achieving acceptance and trust and multiple participants mentioned that communicating and involving citizens could be beneficial as a means towards broader acceptance for example by involving citizens in the development process.

As with many AI-driven applications, there is often a call for transparency towards the systems utilised, and the case for drones is no different. One respondent mentioned that making the software used open-source and showcasing code audits could be a way of gaining trust, while others argued that more transparent development of drones and their software could improve public trust.

Question 7: Drones are increasingly performing activities that involve the use of cameras. How can developers ensure that citizens do not feel that they are being watched or that their personal data is being collected and/or misused?

Concerning the use of drones equipped with cameras, respondents were generally somewhat more negative. Several answers here entertained the notion that it would be extremely difficult or simply not be possible to change the perspective of citizens when it comes to the way they feel about their data. Several respondents argue that this is one of the biggest issues to tackle when it comes to creating and ensuring trustworthy drone technology while maintaining that they do not know or have suggestions as to what could be done, and as one respondent mentions:

"People still have the fear that their personal information is collected and abused, it is in our nature and does not think it can be so easily changed"

For this question respondents also focused heavily on data and how to make sure that citizens can know how data is being processed and stored.

Several respondents mention that equipping drones with software that blurs or obscures could help trustworthiness, such an approach would need to be combined with information and communication to citizens about what data is being processed or stored by the drones. Once again, transparency is mentioned as a key component of societal acceptance and one way towards this could be to:

"Clarify what the cameras are used for. Have routines in place, like safe storage of data, and deletion of said data"

Another suggestion mentioned by respondents was to limit the movement space of drones to selected areas, for example by prohibiting the use of drones in public areas, near private properties and areas with people. Furthermore, they should only be allowed to operate with proper authorization. However, they once again highlight communication and information as a way forward.

The participants in the focus group interviews conducted during the Robotex Festival also pointed out that since this drone makes a sound, it is difficult to assess how disturbing or scary the drone could be, because it is difficult to tell from the picture whether the sound it makes could be somehow scary or unpleasant. "When it's coming towards a person, it can be maybe kind of startling."

4.4 Graspian

This report presents the results of a collaboration between Graspian (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

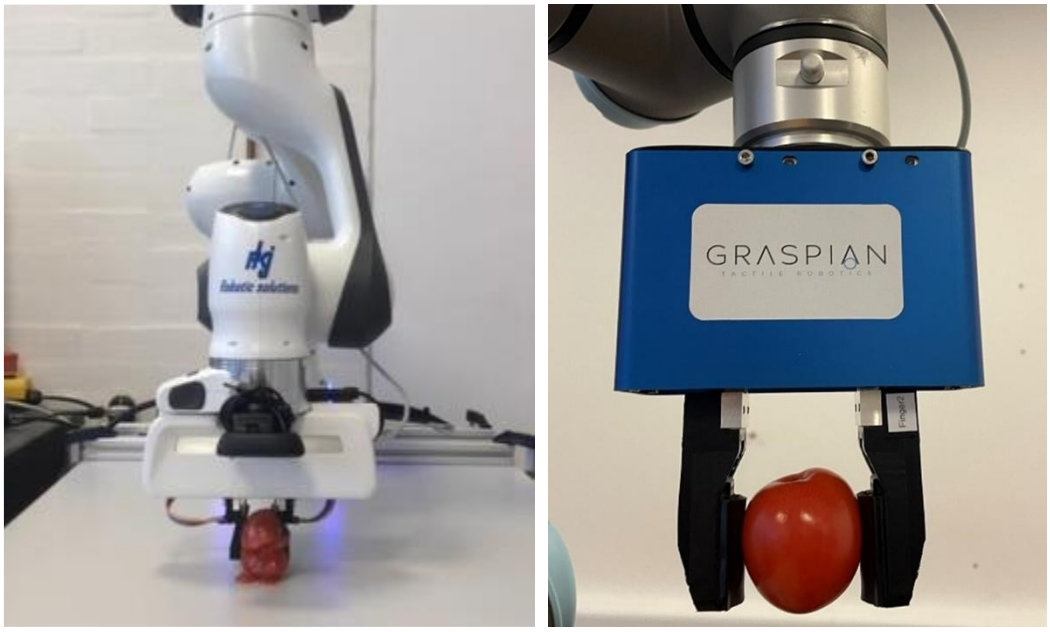
There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.4.1 Presentation of GRASPIAN

Graspian is a robotics company adding the sense of touch to robots when grabbing objects. Just like humans combine visual and tactile sensing, Graspian make robot tools with the sense of touch, so that they are able to handle objects that are otherwise challenging to robots. A challenging object can be either:

1. Being of a fragile material,
2. Having a slippery surface,
3. Having an irregular shape, or
4. Working in a changing environment

5. By combining input from a camera and touch sensors, Graspian gives the robot much improved capability for navigating its surroundings using both visual and tactile sensing. Using this technology, the robot can avoid dropping, damaging or bruising of objects. One example of such objects is fruits and berries that require delicate handling.



Robot picking up a tomato with and without the Graspian technology

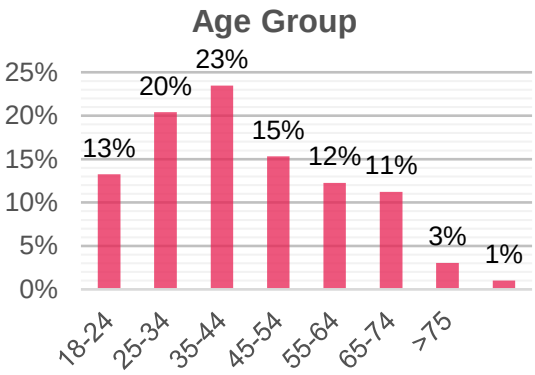
4.4.2 Demographics

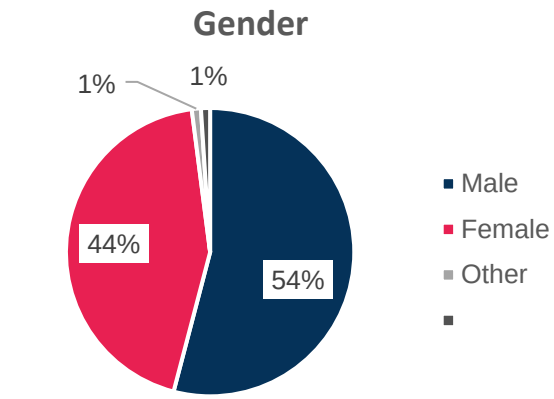
The survey received a total of 98 responses. The survey received a well distributed number of respondents from most age groups. Citizens in the age groups 25-34 and 35-44, were best represented accounting for 20% and 23% of the total responses. These were followed by the age groups 18-25, 45-54. 55-64 and 65-74 each accounting for 10% to 15%. The only age group not represented very well was the 75 and older with 3%.

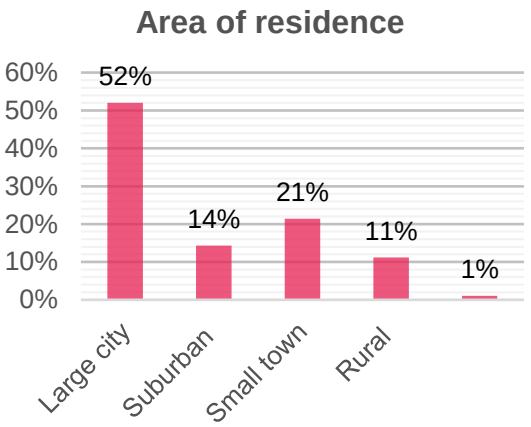
The gender distribution of citizens was relatively equal, with male participants accounting for 44% and female participants accounting for 54%. The remaining either answered 'other' or did not specify their gender.

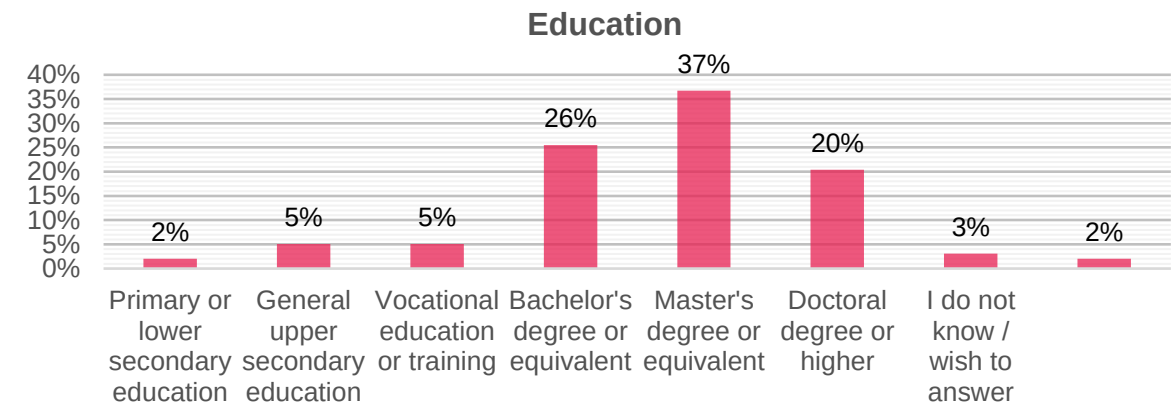
Looking at distribution of areas of residence, a total of 52% of the participants answered that they lived in a large city. The second most chosen option was small town with a total of 21%, followed by suburban with 14% and rural with 11%.

Participants were generally highly educated with 83% answering that they held either a bachelor, master's degree or higher, whereas only 12% held secondary education or vocational education.









The survey received answers from participants from 16 different countries. However, 19% chose not to disclose their country of origin making it difficult to give exact information on where respondents participated from. But citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe.

As is evident from the above, most participants answering the survey were young and middle-aged people holding degrees and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.4.3 Survey results

Citizens were asked eight questions regarding their perceptions of the robot, exploring what opportunities there might be for a robot like Graspian and the company, but also evaluating the trustworthiness of the robot in different situations.

Question 1: Could you think of some situations where a robot with the ability to gently touch an item could do something that is not possible today?

To explore the potential business opportunities for Graspian the citizens were asked to think of situations where the use of such a robot could be beneficial. The most frequent ideas for usage can be categorized to be within healthcare and fruit/vegetable picking.

Several respondents thought of using the robot as a medical tool for situations that would need tactile interactions with humans. A few mentioned high precision surgeries, as robots can be more calculated and accurate than humans. A couple of respondents also imagined that Graspians technology could be useful when helping the elderly or disabled people. For instance, help people going to the toilet, bathing, or lifting. Some also mentioned that it could be used as a prosthesis for persons missing one or more limbs.

Many thought that the robot's capabilities would be ideal in agriculture especially for picking fruit, berries, sprouts and to handle objects in food-production such as putting cucumbers in jars for pickling.

"Handling objects with different density, fruits being a good example. Some are not fully grown and hard, some are very soft"

A few mentioned that the technology could be useful for managing tasks that either involves touching hazardous materials/chemicals or operating in hazardous environments or too confined spaces for humans.

Other ideas for usage included: working in fields with fragile materials such as glass production or archaeology, production of sensors and springs, packaging or parcel handling, collecting chicken eggs, changing a lightbulb, snail collection and a few even indicated it could be used in the sex industry.

Question 2: Could you think of a better – or more descriptive – name than Tactile robotics?

The company would like to receive feedback on using the name Tactile robotics. Most respondents thought the name was good or did not have any other suggestions for a better alternative. Among those who came with concrete suggestions several made use of the word sense/sensory and touch wanting to put emphasis on this special capability. Some mentioned that people do not understand the word tactile, and others found it very fitting. Below a selection of suggestions are highlighted:

Sensitive Robotics	Tactile Robotics	Sensory Robotics	Haptic Robotics	GentleBot
Haptronics	Sensory	TouchRobots	SoftTouch Robotics	Light-Touch Robotics
RobotTactile	SensoBot	Soft Roboitcs	Tactilobotics	Sensible Robotics

Question 3: If a robot arm acts as your extended limb, how would you like to receive feedback from the robot when it touches an object?

To explore the potential of using Graspians technology as a co-bot the participants were asked how they imagine receiving feedback from the robot if the robot acted as their extended limb. The responses can be categorized into four different kinds of feedback: ***visual indication, audio indication, haptic feedback*** **and** ***though the nerve system*****.** When analyzing the answers to this question it became clear that the respondents interpreted this question in two different ways. Some understood the questions as if the robot was a prosthetics to a missing limb and others understood it as teleoperation where they see themselves as the operator from either a nearby or distant location.

Haptic Feedback

Many respondents wanted to experience the feedback through touch or tactility by applying forces, vibrations, heat/cool transfer, or motions to the user. For the respondents it was important that the sensation is as comparable to how they would feel the object themselves and that they somehow also can feel how soft and heavy the object is through return of resistance: *"I would say a return from force to resistance, probably also a subtle change in surface texture if the technology exists"* and *"I would like to know the size, texture, and weight"*. Some imagined this to be through a wearable like a glove and/or VR/AR.

Visual and Audio Indication

Feedback through visuals such as lights or screens were also highlighted. Two respondents suggest using LEDs that softly changes colors to indicate how hard the user is pressing. Many also said that audio signals such as beeping noises or speech would be a good way to receive feedback. One respondent mentioned a function similar to the beeping sensors new cars use to communicate distances to objects when parking.

Through the nerve system

Some respondents even imagined that the robot can be linked to the human neurological system so they both can control it and feel it via the brain's impulses. One respondent said: *"I want it directly to go into the brain, but that is not really possible yet. For now, gentle taps or weak electric signals on the limb end could work."* And another commented that: *"In my wildest imagination: via a chip in my head or something similar that is not so intrusive"*

Question 4: How can a robot such as this be designed to tell a person in its vicinity that the robot knows what it is doing?

To explore how the robot can give reassurance to the humans in its environment the respondents were asked to give information on how they think a robot can signal a person that it knows what it is doing.

Just as in the previous question many respondents thought that the best way is through audio and visual cues. Some suggest that the robot could make the people around it aware of its doing by either saying it out loud before or as it is doing it. Others suggest showing it through a screen or with light indicators e.g., *"with a panel/screen showing the tasks as it is in the process of".* A few also suggested exploring how the robot can mimic body language we know from humans such as mimicking eye movements so that it is visible what it is looking for.

"The robot's 'arms' should be equipped with small camera devices, so each time it grabs an object it would observe it before handling it. Then it can describe what objects it is touching or seeing"

Others also made suggestions for the design and look of the robot beyond audio and visual feedback features. For them, the robot can reassure people around it by making sure that the robot looks lightweight, does not move too fast, integrate a good flow between movements (to look less like robot movements), and either have repetitive actions that are easy to foresee, or it could also be the opposite and should be more flexible.

A few also indicated that the robot should be so well designed and trained that it is clear instantly that the robot knows what it is doing and that it would only need to communicate when it detects a system error.

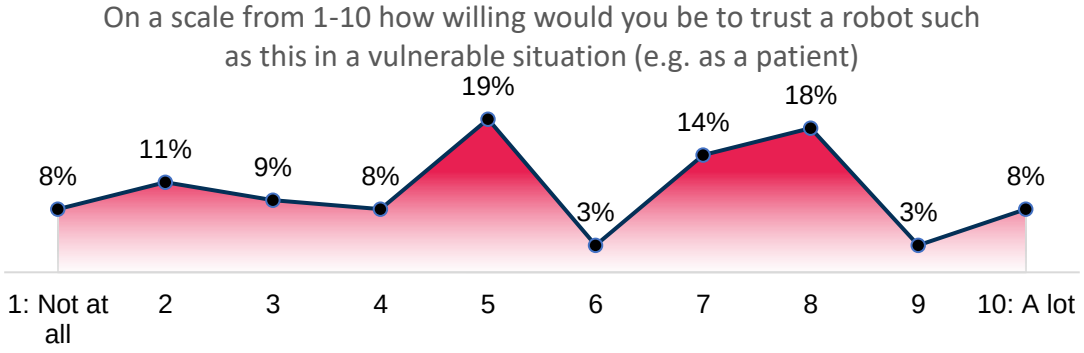
The participants in the focus group interviews conducted during the Robotex festival also pointed out that as an industrial robot and in an industrial environment, the attitude towards it is significantly milder because you get the feeling that it is doing it in its usual environment. "It is important that you understand what it is for and what it does. If you don't know what it is, it makes you feel uncomfortable."

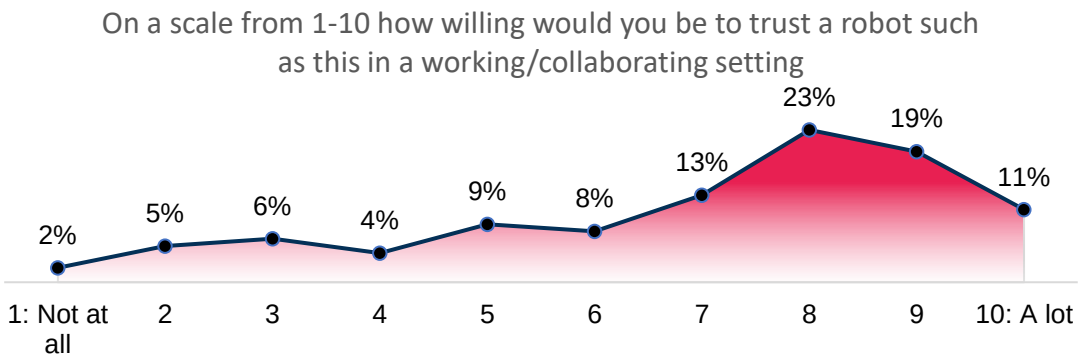
Question 5, 6 & 7: Evaluating trust in different situations

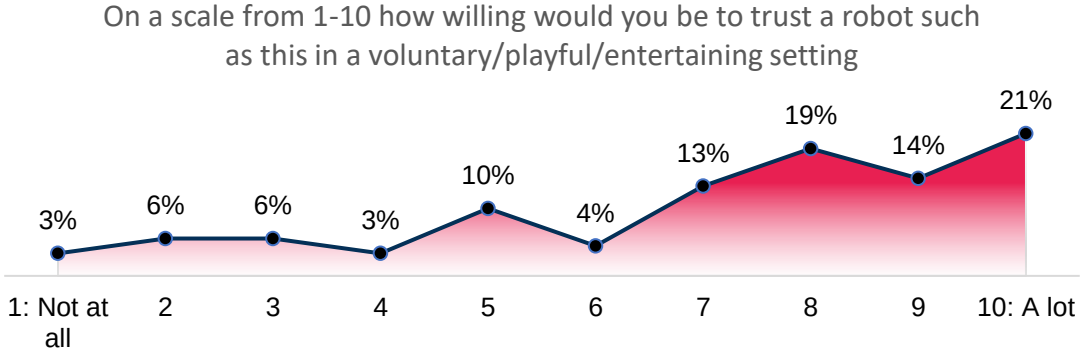
To explore the acceptance and trust of a robot like Graspian the citizens were asked on a scale from 1-10 how willing they would be to trust the robot in three different situations:

6. How willing would you be to trust a robot such as this **in a vulnerable situation (e.g. as a patient)**
7. How willing would you be to trust a robot such as this **in a working/collaborating setting**
8. How willing would you be to trust a robot such as this **in a voluntary/playful/ entertaining setting**

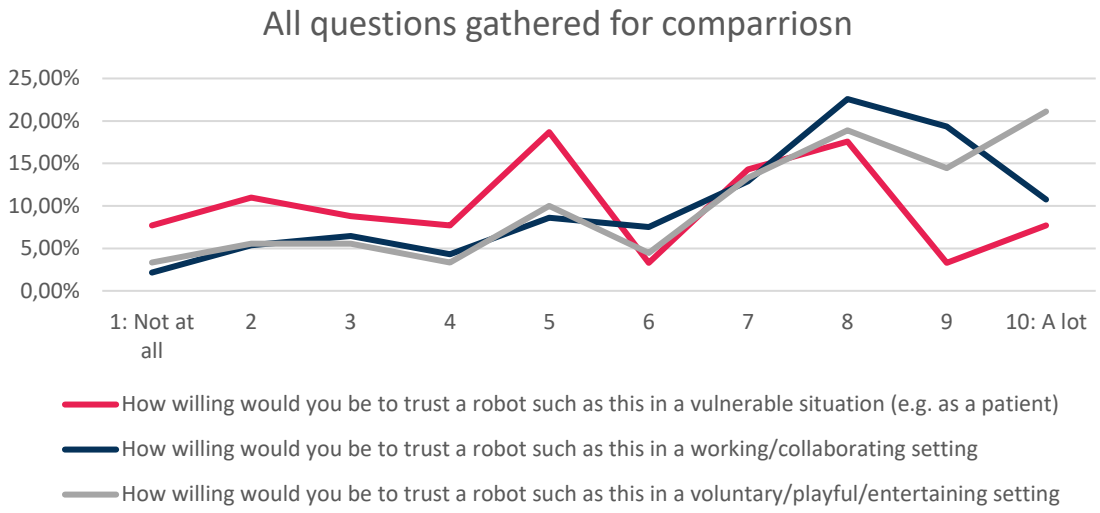
The questions were asked to explore whether level of trust is dependent on the use of the robot. This was done to give the company indications on potential barriers for different use-cases, they should consider exploring further if the robot is to operate in such situations.







Comparing the responses from all three situations, it is clear that there is a higher degree of trust to working/collaborating with a robot like this and to engage with it in a voluntary/playful/entertaining setting over engaging with the robot in a vulnerable situation for example for healthcare purposes as a patient.



Looking at the elaborative answers it appears that people are less confident in a robot in a vulnerable situation due to a general mistrust and skepsis in robots being in contact with patients, *"I don't feel confident that a robot can be as gentle as a human."* Some explain that they would be okay with the situation if a medical professional or human was present or supervising the robot *"Upon surgery, I would trust the doctor who assured me of the robot".* Several also indicate that it is difficult to imagine a situation like this and that they would have to see it in action to get a feel for its reliability. Some also saw great potential in the robot technology highlighting that perhaps the robot could do better precision work than humans and not be affected by tiredness and long working hours.

The participants in the focus group interviews conducted during the Robotex festival also pointed out that the attitude towards robots in industry is better. They seem safe. "It would be interesting to see how it works, but this robot doesn't make me worry".

Regarding willingness to trust the robot in a working/collaborating environment the respondents had a high degree of trustworthiness but multiple pointed out that it very much depended on the situation and that it would take some time to get used to. When it came to the voluntary/playful/entertaining setting people did not see any big issues of mistrust other than some highlighting that it depended on what kind of entertainment it could be used for and emphasised as long as it doesn't propose any risks to its environment or humans *"No problem, as long as it is clear that it is not harmful in a predictable way".*

Despite the clear difference of level of trust in the situations it is still interesting to note that the level of trust towards the first situation actually scores rather high, having more

people choosing the higher numbers on the scale compared to the lower numbers. 46% of the respondents are leaning towards the positive side of the scale choosing 6 or above and 35% are leaning towards having less trust choosing below 5 on the scale. The high number of respondents choosing the middle of the scale can either indicate that they are in between, but it can also indicate that they were unsure how to answer the question and therefore deliberately choose the middle of the scale.

Question 8: What is your opinion on collaborative robots in general? E.g. are you concerned about your job being made redundant? Are you concerned about robots taking control?

The majority of the respondents had positive attitudes towards collaborative robots and did not have major concerns towards the technology. Many saw a great potential in robots as a tool to tackle labour shortages and freeing up people from manual and repetitive work tasks *"If we get more robots in the community, there will probably be more room for fun and creativity. We get rid of the dangerous, repetitive and boring work. And that's good".* Many see this as an inevitable and necessary future to which we will adapt just as we have done previously with new technology like computers and smartphones. The majority do not fear a future where robots take control over work-places or society as they believe robots only to some extent will be more effective than humans and jobs will instead be redefined, one even mentions: *"A robot can never take over the control, you can just turn it off."*

Few had concerns regarding a future with robots replacing human jobs and mentioned that they fear a society with less interaction between humans and a future in favour of the rich. *"I worry about my job being more boring and mechanical because I have to interact with an object instead of a fellow human being."* A few also mentioned that it was not so much robots they feared but more the development of AI.

The results of the focus group conducted among the participants of the Robotex International festival show that the attitude towards industrial robots is milder and friendlier than towards robots used in the city or at home. "Such machines can be seen in factories. You might not want to have one at home, but I have nothing to do with it there either. In the case of industrial robots, a lot of attention has been paid to safety already in its nature."

We can conclude that in general the respondents seem to be optimistic towards collaborative robots as long as the human factor remains a priority, and that the robot is sufficiently tested and developed under ethical and security regulations.

4.5 Halodi Robotics

This report presents the results of a collaboration between Halodi Robotics (NO) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

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What is the Robotics4EU project?

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Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.5.1 Presentation of Halodi Robotics

Halodi Robotics has developed a service robot called EVE. EVE is a human sized robot platform that can be used for many different purposes. The solution can be utilised in areas such as security, retail, logistics and healthcare performing tasks that would usually be done by humans.

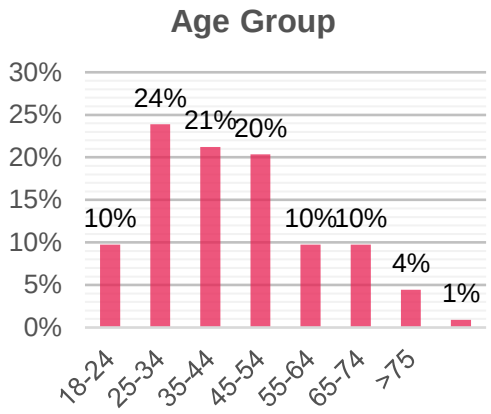
In healthcare, there is an urgent need for innovation and more hands. EVE can work alongside the healthcare professionals in hospitals. As EVE is not limited to a predefined space, but is able to move freely, it can assist healthcare professionals in everyday tasks such as patient hygiene or meal delivery — in both hospital facilities and eventually patient homes. For Halodi Robotics, the goal is simple: Improving patient care and outcomes with the help of a humanoid robotic assistant. The aim is to create a solution that reduces costs, improves service, and assists healthcare providers. Currently, EVE is controlled remotely by an operator, but in time it will be able to operate autonomously.

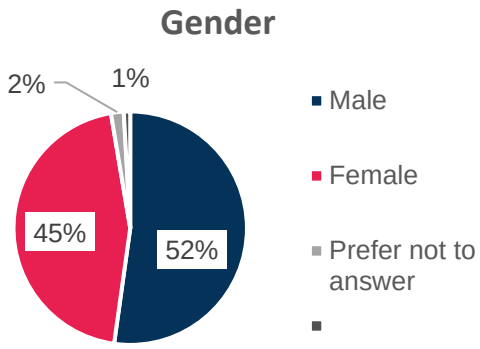
4.5.2 Demographics

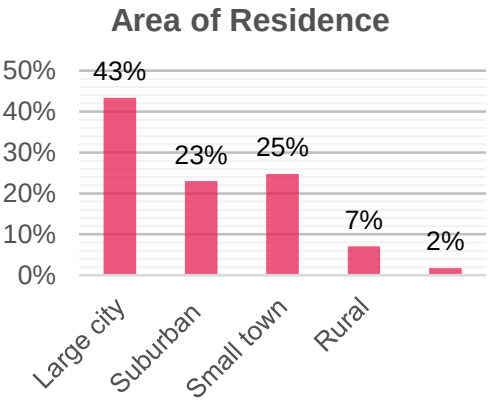
The survey received a total of 113 responses. Respondents were mostly citizens between the age of 25-34 and made up 24% of the total answers. The second largest age group was the age group from 35-44 with 21%. Closely followed by the citizens of the age between 45-54 with 20%. The age groups of 18-24, 55-64 and 65-74 all had 10% each of the total amount. A little less than 5% of the respondents were older than 75 years. The gender distribution was close to being evenly divided with 52% male respondents and 43% female respondents entering the survey. A little less than 2% did not wish to answer.

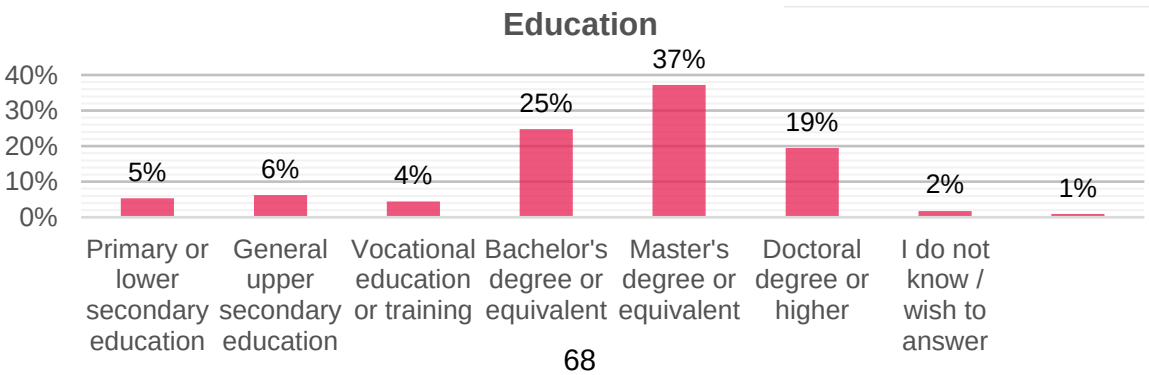
The distributions of the residence of the respondents were primarily from a large city with 43%, secondly with 25% of the respondents were resident in a small town. Closely followed by respondents living in suburban areas with 23% of the total amount. 7% of the respondents live in rural areas and form the lowest residential representation of the survey. See the figure below for an overview of residential distribution. The survey attracted mostly respondents with a high degree, the largest number being respondents with a master's degree representing 37% of the total amount, followed by 24% with a bachelor's degree. 6% had a general upper secondary education, while 5% had a primary or lower secondary education. Lastly 4% of the total had a vocational education or training.

These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.









4.5.3 Survey Results

Question1: I like the appearance and design of EVE

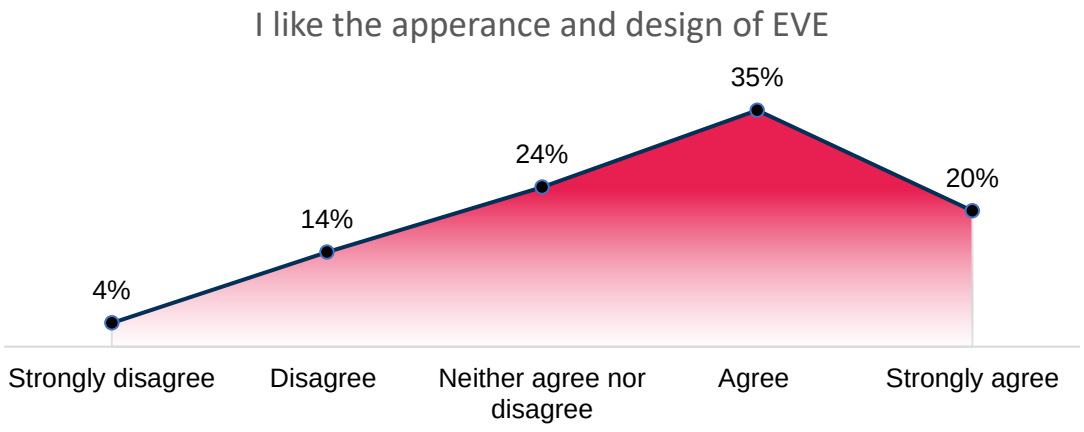
When asked about the robot's appearance many respondents were positive. More than half of the respondents answered that liked the appearance of the EVE (35% 'Agree' and 20% 'Strongly agree'), whereas only 4% 'Strongly disagree' and 14% 'Disagree'. A little less than a quarter of the respondents chose 'Neither agree nor disagree' as response to the question asked. Respondents were able to elaborate on their answer to the question and the reasoning behind it. Here, some of the respondents expressed how the look and appearance of EVE makes them feel comfortable, whereas others like the practical look, as one respondent states:

"*EVE's design is both human-like and practical. It doesn't take up much space, and the human-like appearance makes it feel more human."*

Another respondent thinks EVE looks both *'warm'* and *'receptive'*. The anthropomorphic look of the robot is mentioned by one of the respondents who argues that:

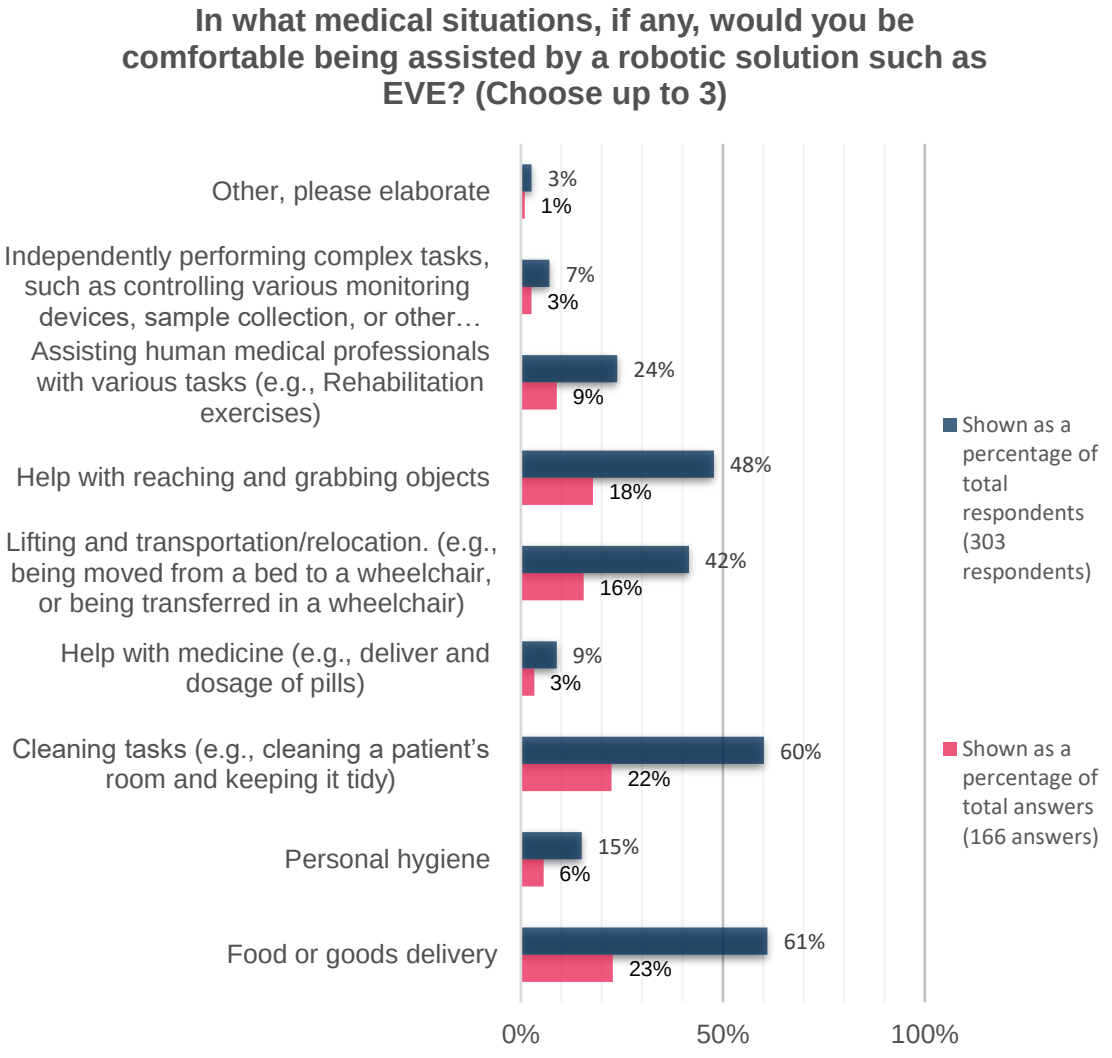
"*The anthropomorphic appearance is important, interaction is more comfortable. At the same time, it keeps the robotic appearance, it's very clear that it's just a machine."*

However, there were also some respondents that expressed a dislike towards the design and appearance of EVE. Some of these more negative comments were partly due to the humanoid aspects of the design. Here, words like '*alienating'*, '*scary'* and '*daunting'* were used by a few of the respondents to describe their feelings towards EVE. In line with these comments were also comments that were concerned with distrust towards the robot and its functionality. It is difficult to say whether these comments represent a fear towards the robot or a more general fear towards robots within healthcare. One respondent expresses concerns connected to the robot's stability*: "not confidence in its stability given the size and little fan of external cables at the level of the arms".* Based on the elaborative answers there is a good indication that the look and appearance of the robot are important factors to consider for the broader societal acceptance of the robot.



Question 2: In what medical situations, if any, would you be comfortable being assisted by a robotic solution such as EVE?

Here, respondents were able to choose up to 3 answers. Among the most popular answers that respondents chose were using the robot to perform various deliveries (with 23% of the total answers) and using the robot for cleaning tasks (with 22% of the total answers). There were also many that thought the robot could be helpful as an extended limb able to assist in reaching for objects and grabbing them (18% of the total answers). Additionally, more than every tenth would be comfortable being lifted or transported by the robot (16% of the total answers). Some were also comfortable with letting the robot assist medical professionals with various tasks (9%) and a little less were comfortable with EVE assisting with personal hygiene (6%). Less than 5% are comfortable with letting EVE assist with medicine, such as delivery and dosages of drugs. The same goes for the robot to independently perform complex tasks e.g., controlling devices and sample collections.

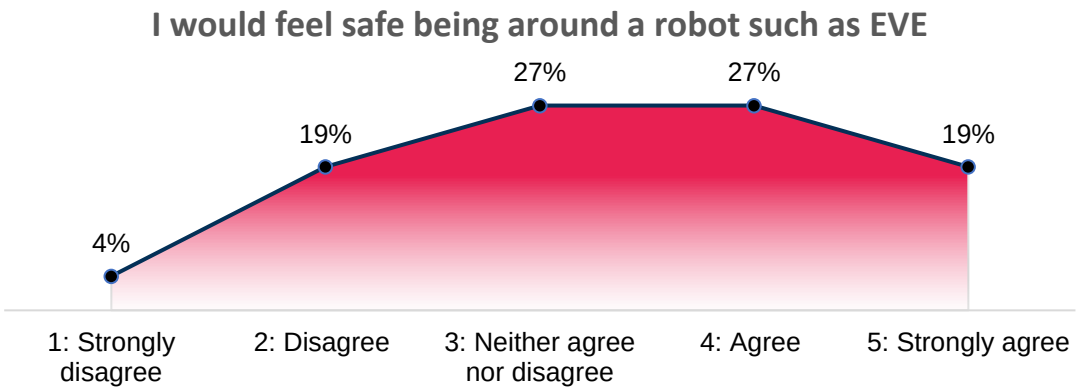


Some respondents mention other areas within healthcare where they consider EVE to be of assistance. One respondent suggests using EVE in relation to communication or even alertness in an alert situation and another respondent suggests using the robot to help disabled or people with weaknesses. A few respondents express how EVE can be useful with: *"[…] relieve nurses and care assistants of the demands of patient comfort […]"* and *"[…] extension of staff's efforts and presence […]"*. There are however also several comments that places focus on how human contact is important for recovery. While robots such as EVE can assist with a broad range of tasks, the presence of human healthcare professionals is being accentuated by the respondents. This might be why most of the respondents can see the robot being of assistance to healthcare professionals and as a tool for an increasing requirement for help to the healthcare system.

Question 3: I would feel safe being around a robot such as EVE

Almost a quarter of the respondents answered that either 'Agree' (27%) or 'Strongly agree' (19%) when asked whether they thought they would feel safe being around a robot such as EVE. Only 4% did chose 'Strongly disagree' and 19% chose 'Disagree'. Many respondents also opted for 'Neither agree nor disagree' with 27%.

Considering the elaborative responses, it is possible to get a more in-depth look at the reasoning behind the distribution of the answers to the question. One respondent argues that: *"It would be at first very uncomfortable but would be easier over time"*. Such an argument might draw on the reasoning that adjustment towards new and emerging technologies can take a certain amount of time. Many of the respondents that placed their answers on the lower end of the scale also elaborated on their answers. Some of these comments focus on the size of the robot and have them question the stability of the robot, whereas others focus on the lack of human presence makes them feel less safe. When having to interact with a robot, respondents are wary about the maturity of the robot on whether it can communicate its intentions and understand what a patient wants. Another respondent mention that: *"I don't think I feel safe. I rather think that if I need help it is available to help me"*, the comment shows how the respondent can see how the robot can be of assistance to the healthcare professionals but still is not ready to consider the robot as a primary caregiver. Other respondents have also voiced how they would feel safer if a human/healthcare professional were close by when using the robot. In addition, a respondent is asking for safeguards such as a "stop" signal or emergency button for them to feel safer around EVE and another respondent notes that if they were able to quickly get in touch with a human being, they would feel safer.

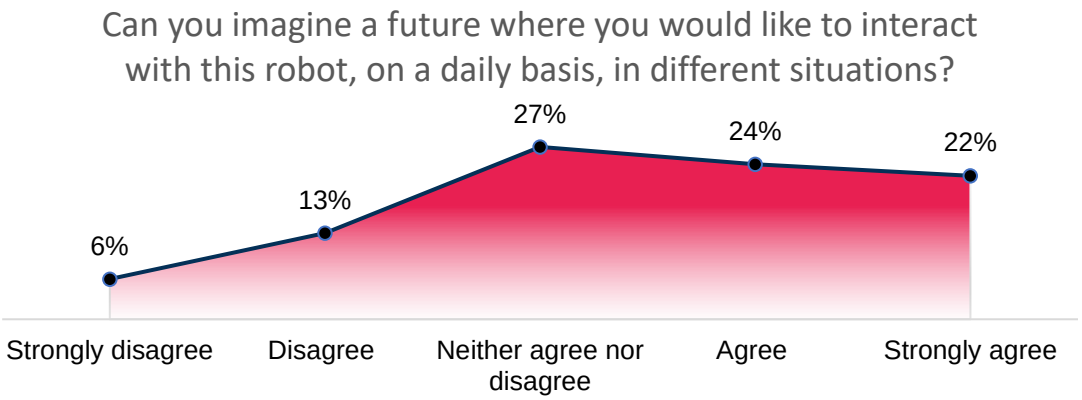


More than a quarter of the respondents neither agree nor disagree with feeling safe around EVE. Yet, one respondent remarks how: *"Feeling safe is proportional to friendliness. Smaller robots are better"*. The size of EVE might be one of the reasons why some respondents articulate worries towards the robot. However, there are also others who consider the size of the robot as an advantage for its functionality. Such doubts towards the robots could be considered when introducing a robot of this type into society with the aim of assisting healthcare professionals.

In the focus group interviews conducted during the Robotex Festival, the participants also pointed out that the robot looks scary and is associated with sci-fi movies that have been seen too much. *"I'm afraid his eyes will turn red and then it will be dangerous."*

Question 4: Can you imagine a future where you would like to interact with this robot, on a daily basis, in different situations?

A little less than half of the respondents would like to interact with the robot. While almost every fifth answered they 'Disagree' (13%) or 'Strongly disagree' (6%) to a future where they would like to interact with EVE daily. Nearly every third respondent answered that they 'Neither agrees nor disagree' (27%). The distributions of answers indicate that there isn't a complete answer to how likely it is that the respondents wish to interact with the robot. It is also important to keep in mind that the question and statement presented in here is hypothetical in nature, since respondents are asked to *imagine* a scenario in which they encounter the robot. Since they might not have an actual experience to base their answer on, it may be difficult to provide an answer with enough confidence, and so some respondents might prefer to remain neutral or at least undetermined in their response.



Looking at the elaborative answers given, many of the responses were linked to activities that respondents did not wish to perform themselves. For example, respondents thought that the robot could be useful as an aid in cleaning tasks and some respondents answered that they would like to use the robot to help them with their mobility if this had been impaired.

There were also several comments where respondents expressed that they would prefer a human over a robot. Some mentioned that this is because they perceive this kind of interaction as important to mental health and fighting loneliness. One of the respondents stated that: *"Loneliness is a real mental health issue if we delegate care to robots. Just seems like neglecting vulnerable people to me."*

However, there are also many that applaud the idea and are fine with interacting with a robot – some arguing that this would only be the case if a human is nearby or can assist if needed. Still, many see the growing potential of robots such as EVE and their ability to perform a wide range of tasks that can help humans in their day to day lives.

Question 5: Currently, EVE is being used to support security guards, as a service robot for retail, for logistics and packaging and in healthcare. Apart from these, what other application areas do you think this type of robot can be used for?

To answer this question, respondents were asked to write their ideas out as text. Here, the respondents came up with a wide variety of different suggestions. The most frequent suggestion was to implement EVE as a tool to help within different areas of cleaning. Respondents suggested using the robot for cleaning both inside and outside. Here, EVE could act as both an assisting role as well as being the one performing the cleaning itself – for example by cleaning workspaces and offices outside of working hours.

The second most suggested application area was the service area. There were a lot of sub-areas within the service area in which the many uses of EVE could be seen as beneficial. Respondents suggested the robot being used in hotels, delivery, restaurants, museums, or in general as a tool that could be used to convey information as well as other uses connected to communication. In short, it was pointed out by several of the respondents that robots such as EVE have the potential to reduce the workloads of a multitude of daily routines within a great many areas.

Other respondents also suggested that EVE could be a useful addition in areas such as safety and security work. Here, the comments were mainly focused on EVE as playing an assisting role to workers such as security guards or airport security. Another respondent suggested that robots such as EVE could potentially be very beneficial if used for traffic regulation and similar tasks. Among many of the suggestions, whether directly or indirectly, there is a clear wish for robots such as EVE to relieve the workload for humans. This was especially mentioned in relation to dangerous, strenuous, and unappealing tasks. Many suggested that using EVE for factory work and especially for heavy and repetitive lifting were voiced by the respondents and one mentioned that:

"I can imagine EVE also working in storage buildings, doing the heavy lifting that would otherwise be too much for a human to handle."

These suggestions were also related to the fact that many consider robots such as EVE to be beneficial in helping to mitigate human degeneration, for example by using them in storage facilities and warehouses. Furthermore, some respondents suggested that it would be useful to implement EVE to conduct: *"Work performed in environments where hazards to human health pose challenges".* Another respondent had a similar suggestion and argued that the robot could be used for environmental management. Lastly, some also suggested using EVE for companionship and one respondent – perhaps somewhat humorously – mentioned that EVE could be used to tell jokes and keep one company. A more serious suggestion was to use EVE as an avatar, for example in classrooms, where it could be operated remotely by the person teaching the class.

However, there were also some that were sceptic towards expanding the use of EVE and one important comment to highlight was made by a respondent that argued: *"Less is more. A universal robot will not work"*. This comment can be used to reflect upon which tasks and situations are most appropriate or suited for the use of EVE. There were also some respondents that generally though that robotic technology is already imposing on too many aspects of society.

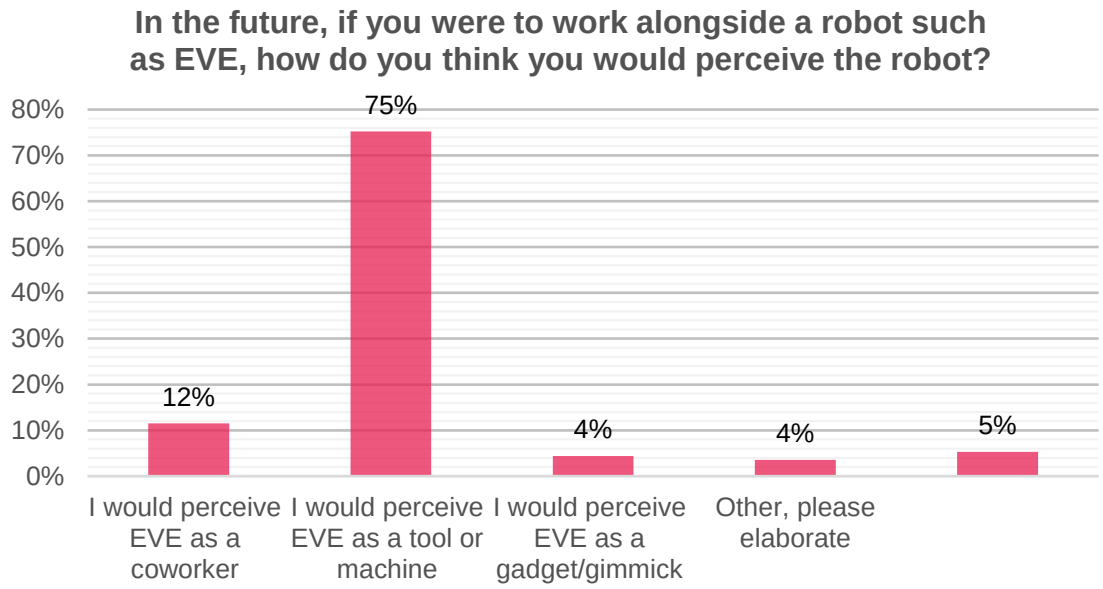
The results of the focus group conducted among the participants of the Robotex International festival show that a humanoid robot designed to look like a human being too strong can cause negative emotions. "Such a robot can actually have a rather frightening effect, that if you are used to robots being like boxes and completely ordinary machines, then this here already creates some emotions."

Question 6: In the future, if you were to work alongside a robot such as EVE, how do you think you would perceive the robot?

Respondents were asked to reflect on how they would perceive the robot if they were working alongside it. More than 75% of the respondents agreed with the statement that they would perceive EVE as a tool or machine. Here, several respondents also elaborate and argue that they find it difficult to perceive a robot as a co-worker and even if they did, they would perceive it in a rather different manner than a human co-worker. Thus, it

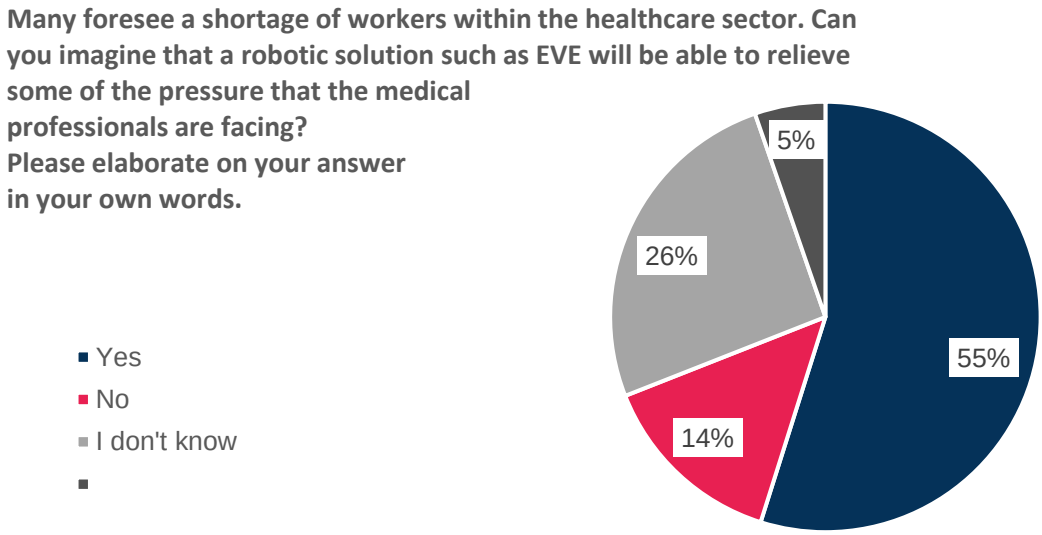
seems that most respondents are somewhat unwilling to see the robot as an ordinary co-worker, in the elaborative answers a respondent wrote that they would view the robot: *"as an additional device"*, and another respondent elaborated that EVE would be: *"a different type of co-worker, not human"*. This indicates that even though the robot has some limits towards being an equal to human co-workers it could be viewed as an additional resource by the person that may collaborate with the robot. Only 12% of the respondents would perceive the robot as a co-worker and a little less than 5% would perceive EVE as a gimmick or gadget.

The distribution of answers to this question are perhaps not surprising. However, they are interesting insofar as so few respondents were willing to consider EVE as a something akin to a co-worker. Many of those who elaborated on this question did so by once again bringing up the need for human interaction and its importance. Some of the respondents argued along the following lines, saying that: *"He will have the appearance of a person but for me it is a working tool"* and *"Whatever the human aspect sought in its appearance, it remains a machine"*. Answers that indicate that for some, this type of robotic technology is still far away from being accepted as a co-worker in the workplace. There were however also positive elaborative comments by respondents that considered EVE to be more akin a colleague already, as one respondent stated: "*Both of us would be doing important tasks, so we would rightfully so be considered equals."*



Question 7: Many foresee a shortage of workers within the healthcare sector. Can you imagine that a robotic solution such as EVE will be able to relieve some of the pressure that the medical professionals are facing?

The last question examined how respondents saw EVE as a solution to the increasing pressure medical professionals are facing.



More than half of the respondents (55%) answered that they could imagine EVE being a solution that could help relieve some of the pressure that is already on or may befall medical professionals. 14% of the respondents did not think that this was the case and 26% answered that they did not know.[8]

As with several of the previous questions, respondents were once again very focused on the potential that EVE has for relieving and assisting medical professionals without replacing them. Many respondents argue that these types of robotic solutions must be utilized in manners that help the medical professionals focus on their primary tasks. For example, one respondent points out that:

> *"Currently, health care staff perform all sorts of tasks that are outside their domain. Robotic assistance would allow staff to focus on the patient in a purely medical manner"*

This sentiment is generally echoed throughout the elaborative answers as many consider EVE to be a very useful way to free up medical staff from time consuming tasks and allowing them to focus on the human being instead and robots such as EVE can perform a wide variety of tasks that will do exactly that. Respondents mention uses such as: *"Heavy lifting tasks, cleaning duties and deliveries […]"* as well as *"Moving the beds from one room to another. Carrying patient's luggage when leaving the hospital"* among many other possible uses. A general sentiment among those respondents that are supporting

[8] The remaining 5% did not answer.

an implementation of EVE, is that the tasks of the robot should be limited to specific tasks which will not deprive important time from medical professionals' interaction with their patients. Furthermore, the answers to this question echoed those of the previous question, namely that EVE is perceived by many as an additional resource to medical professionals.[9] The respondents see how EVE can help by performing tasks that have been assigned to medical professionals over time but remain outside their professional field.

If the respondents perceive the challenges within the healthcare sectors as structural issues as described in some of the elaborated answers. Some of the respondents might not see EVE as a sustainable solution towards handling the growing pressure the medical professionals are facing, but as a step towards a greater focus on professional competencies being utilised in a challenged environment. There were some that were not quite sure about what to answer and a little more than a quarter of the respondents answered "I don't know" to whether a robotic solution such as EVE would help medical professionals. The answers from this group of respondents are supported by various elaborated answers to the question. where the respondents do not understand the challenges for medical professionals as being the tasks they are performing, but instead are connected to the growing number of elderly citizens, employee shortage within the healthcare sector and fundamental issues of the management systems within the healthcare sector. These answers might also be connected to the 14% who answered "No" in the survey.

[9] Question 6: *In the future, if you were to work alongside a robot such as EVE, how do you think you would perceive the robot?*

4.6 IDMind

This report presents the results of a collaboration between IDMind (PT) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

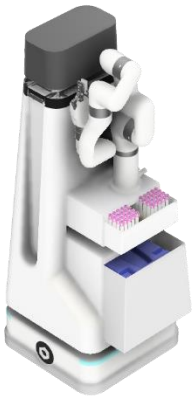
Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.6.1 Presentation of IDMind

The company IDMind has in cooperation with a team across 10 organisations[10] developed a robot as part of the the EU project[11] called Harmony. Harmony is a modular mobile robot, with multiple storage spaces and a robotic arm for the manipulation of small objects. The objective of the mobile robot is to implement it into a hospital environment to perform a wide variety of tasks, and on-demand deliveries. It also has multiple features related to interaction tools, communication of intention, aesthetics, and feedback — to be integrated in a natural way in people's day-to-day routines.



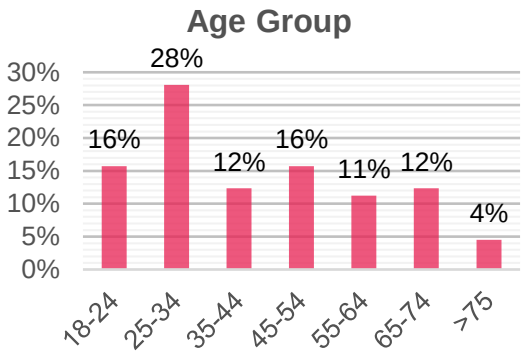
The Harmony robots will perform tasks which are physically demanding and repetitive for humans, and thereby freeing them to perform other tasks. Additionally, the robots will optimize processes, collaborate with the staff when needed and interact socially.

[10] Eidgenössische Technische Hochschule Zürich, Delft University of Technology, Rheinische Friedrich-Wilhelms-Universität Bonn, The University of Edinburgh, University of Twente, C.R.E.A.T.E., Karolinska Universitetssjukhuset, Universitätsspital Zürich, ABB

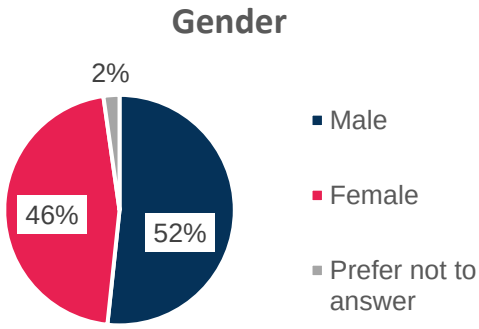
[11] European Union's Horizon 2020 research and innovation programme under grant agreement No 101017008

4.6.2 Demographics

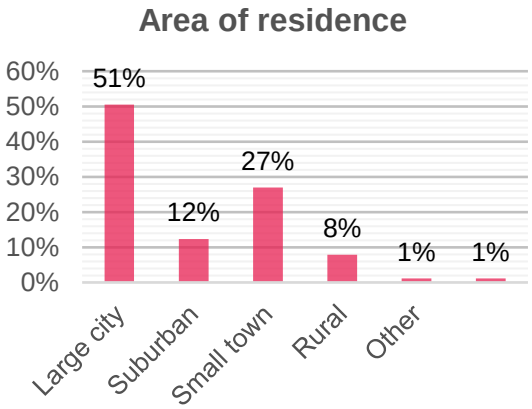
The survey received a total of 89 responses. There was a decent age distribution, although age group 25-34 accounted for a larger part than the other age groups at 28% of the total responses. Age groups 18-24 and 45-54 followed, each accounting for 16% of the total responses. Only 4% of the responses were from people aged 75 or above.



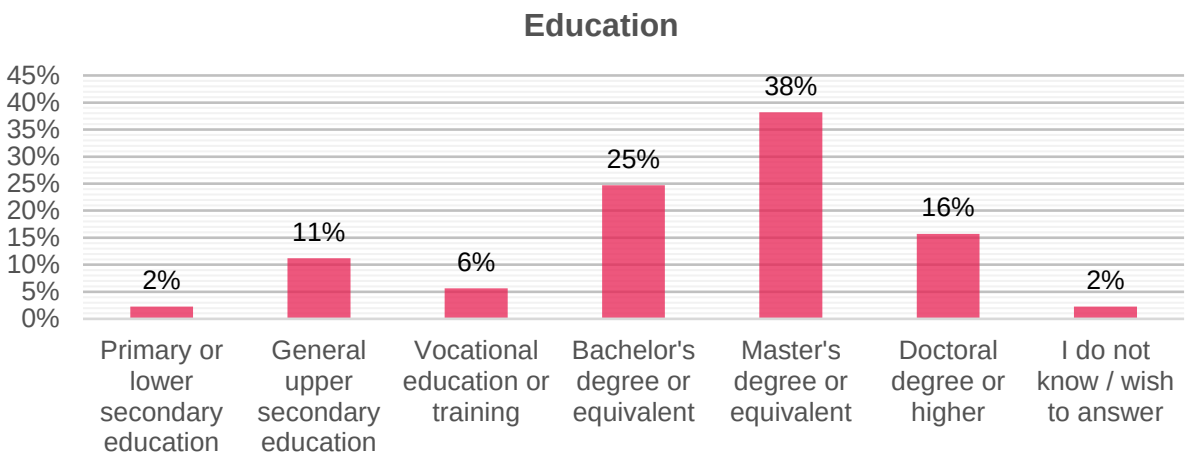
Gender distribution was relatively even, with 52% of the respondents being male and 46% being female.



A little more half (51%) of the respondents said they live in a large city, followed by around a third (28%) who answered they live in a small town. 12% answered they live in a suburban area, while 8% answered they live in a rural area.



Respondents were generally highly educated. 16% answered they hold a doctoral degree or higher, while 38% answered they hold a master's degree or equivalent, and 25% answered they hold a bachelor's degree or equivalent.



The survey responses were distributed across 14 countries, of which 13 were European. The remaining non-European country was Malaysia, although this country accounted for only 1% of the total responses. Among the countries with most respondents was Denmark accounting for 16%, Norway accounting for 15%, and Lithuania accounting for 11%. France and Portugal each accounted for 10%, and Estonia accounted for 9% of the total answers. The remaining countries all had significantly less respondents.

To briefly sum up, the majority of respondents for this survey were younger or middle-aged, highly educated and living in larger metropolitan areas. These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses on the following pages, it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.6.3 Survey results

Question 1: What type of tasks would you want a robot like this to perform?

To explore the potential business opportunities and use-cases of a robot like Harmony the citizens were first asked to give input on what type of tasks they would want a robot like this to perform. Looking at the responses it is evident that respondents see a potential for the robot to carry out tasks that will help optimize efficiency in the workplace and relieve humans of repetitive tasks, freeing up time and allowing them to direct attention at more intellectually demanding duties. In particular, tasks that involve fetching, transporting, and delivering objects such as prescribed medication, medical equipment or meals and drinks to patients seems to present an obvious opportunity for the robot.

> *"From experience, a lot of time is lost to moving objects, when working with repetitive tasks, e.g. laboratory work. Having a robot transporting for you could free you up to continue with the actual tasks."*

Various levels of object management were suggested, and in addition to relatively simple tasks like bringing supplies locally, respondents also proposed that the robot could be used to carry out slightly more advanced jobs involving more steps, like refilling storage spaces, packaging goods, and managing shipments. It was also suggested that the robot could take care of cleaning chores and 'household work', and one respondent even said it could be used for cooking. Another respondent, mentioning distribution and delivery, asked whether it could have refrigerated compartments, alluding to the possibility of handling and delivering perishable supplies and goods such as certain foods, medicine, or biological material. Similarly, the ability to safely carry and manage fragile objects like samples, test tubes, and so on was deemed useful among the respondents. In general, as one respondent put it, the robot seems to exhibit particular potential for *"Tasks that require little or no human interaction, like getting heavy things from storage places, cleaning closed areas…"* Besides the economic gains resulting from having to spend

less time on these types of tasks, it could also mitigate the risk of work-related injuries from daily wear and tear, such as arthritis or back problems.

Evidently, most responses suggest tasks associated with minimal human interaction and complexity; this could either be due to the way respondents interpret the immediate affordances of the robot, prompting them to make assumptions about its capabilities and limits, or it might be due to a general reluctance to let (some types of) robots become entangled in social constellations. However, some respondents did suggest jobs and tasks that would indicate a certain level of trust in the robot. For instance, some suggested that the robot could collect, store, and manage data related to, for instance, medicine for patients: "*A data program could give correct medicine [on the] right time, and even give [the] right dose to the patient*". Additionally, one respondent suggested that the robot could "*[transport] samples in combination with doing the actual analysis*".

While these tasks still don't necessarily involve proximity to humans, they do involve a high level of sensitivity and require much more precision and safeguarding against algorithmic errors, data breaches, and other factors that can potentially have an adverse effect on human health, safety, and privacy. That some respondents are apparently willing to accept the (perceived) risks associated with letting a robot manage personal and laboratory data suggests that it is possible to obtain considerable accept and trust in the robot's capabilities and potential among humans.

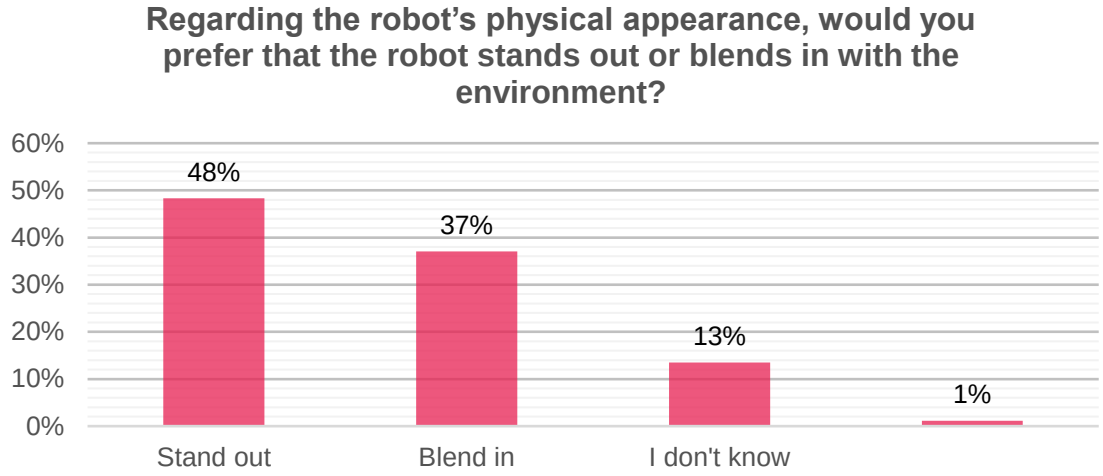
This trust can, according to some of the responses, even be extended to situations where the robot would need to fulfil a social role and engage in interaction with humans. A few respondents said they believe the robot could provide both company and medical or physical assistance. One respondent said that in addition to delivery tasks, they also believe that "*these types of robots could provide company 24/7*". Another respondent noted that it would be useful for carrying out tasks that would be difficult for a disabled person to do.

In addition to hospital settings, a large part of the responses also suggested other areas and locations in which the robot could provide assistance. Among these, the most prominent included:

- Food services, where respondents saw potential in letting the robot serve as a waiter or deliver food from restaurants
- Factory and service work, where it could assist workers and mechanics by carrying and automatically dispensing tools, and carry out repetitive tasks
- Retail, where it could bring goods from stock to store, pack orders (with many small parts), sort and take stock of goods.

Question 2. Regarding the robot's physical appearance, would you prefer that the robot stands out or blends in with the environment?

There was generally disagreement between the responses regarding how visible the robot should be in daily life. Almost half of the respondents (48%) thought the robot should stand out from its environment, while 37% would prefer that it blends in.



Looking at the elaborative responses, people had very different reasonings and arguments for their respective opinion. Of those in favour of a robot with a distinct presence, safety and accessibility were the most frequent themes. Several respondents argued that the robot needs to be clearly visible and distinguishable from its surroundings since "*blending in could lead to accidents, possibly with very bad consequences*". While no respondents specified exactly how they thought it could lead to accidents, it is fair to assume that this concern is based on the potential risk of colliding with the robot if it is not easily noticeable, or perhaps that it might not be properly monitored, increasing the risk of it making undetected errors. In relation to the former, one respondent noted that, "*If the robot blends in it could be a problem for people that have sight problems,*" which raises an important point and calls attention to ethical questions on inclusion and accessibility. As mentioned, the latter – accessibility – was also at the center of several of the respondents' arguments; not just in relation to potential disabled individuals, but just as much in terms of what might also be called usability. In this case, a reoccurring argument was that for the robot to be useful, especially, at the workplace, it must be easy to locate and identify; as one respondent said, "*If it goes unnoticed, it will be useless*". Importantly, another respondent noted that, "*Especially in a hospital environment, all equipment must we well identified for use*". This comment not only points to the needs of a specific user group for whom a visually anonymous robot may in fact equal more work; it also shows a certain perception of what the robot is – namely, equipment on par with other tools.

On the other hand, arguments supporting the view that the robot should blend in with its environment mostly related to trust and accept on basis of familiarity or how naturally the robot seems to fit into its surroundings. One respondent noted that "*If it blends into the environment then it would be easier to accept it as it seems as if it would fit there*", while

another respondent advocated for the robot to blend in if in a hospital environment so as not to startle the patients.

Some also had somewhat conflicting opinions as they considered the statement in light of different interests and needs, encompassing several of the points discussed above:

> *"It feels important that it blends with the surroundings and fits in the peaceful environment of a hospital but at the same time it feels important that it stays noticeable on the medical staff's peripheral vision."*

Interestingly, some responses also implied a third dimension positioned somewhat between the 'stand out' and 'blend in' dichotomy. These responses again expressed a preference for familiarity and association, but might to a greater extent approach the notion of "uncanny valley", which one respondent advised to avoid:

> *"They should not look like machines (but most do). The first thing people will do is try to humanise them with decoration, hats, colour, etc. Much better to start out looking 'like' a friendly (small) human."*

Another respondent noted that the concept illustration of the robot reminded them of a robot from the Disney movie Wall-E, and that they thought that *"he has a fun and reassuring appearance"*.

In general, several responses revolved around the inherent differences between humans and robots and, while some were in favour of giving the robot characteristics reminiscent of a human (or animal), some were directly against it and might even want the robot to have a distinct visual appearance simply to maintain the robot/human divide:

> *"There is still a difference between human and robot, and the difference must be made clear."*

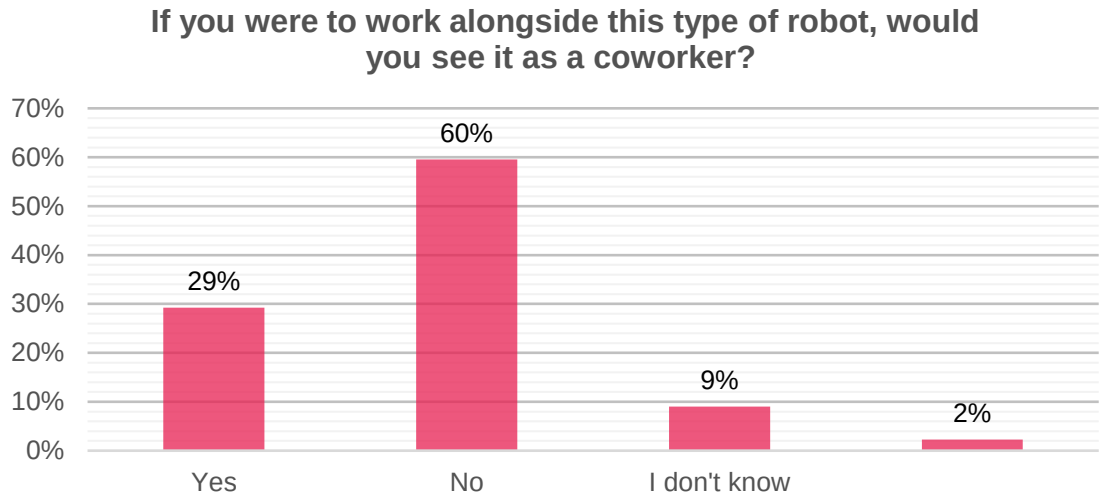
Of course, there is an interpretive quality to the statement analysed in this section, in that people may have different perceptions of what it means to 'blend in' or 'stand out', and no examples are provided for context. For example, it was obvious that some thought that to blend in it would mean to be almost invisible to the environment, while others associated the expression with familiarity.

In any case, it is evident that the appearance of a robot that will exist and work among humans – no matter the level or frequency of actual interaction – is a very important aspect to consider, and that it is a nuanced matter presenting significant design challenges. Ultimately, the way the robot presents itself visually may be the deciding factor in whether people are willing to accept it and are able to use and interact with it in the ways it is intended.

Participants in the focus group interviews conducted during the Robotex Festival also pointed out that such a model seems likeable as a service robot. *"I like it the most. To make it too human-like, it seems to me, well, why? After all, he has his specific task, he should still be more like a machine."*

Question 3. If you were to work alongside this type of robot, would you see it as a co-worker?

To explore the potential and the barriers of using a robot like this in a collaborative work setting the citizens were asked to give insights to whether they would see it as a co-worker.



Most respondents (60%) said they would not consider the robot as a co-worker even in a situation where they would work alongside each other, while under a third (29%) said they would. Only a few respondents elaborated on why they *would* see it as a co-worker, while, on the other hand, a large number of responses provided arguments for the opposite. This is not very surprising, since the willingness to perceive a robot as a co-worker implies a complete acceptance and recognition of the robot's role in that context, and people may not feel the need to 'defend' or explain this view. On the other hand, as was evident from the responses, those who would not perceive the robot as a co-worker had various reasons to explain their stand.

Still, there may be several factors that influence the robot's relation to humans. For one respondent, the fact that the robot would be performing crucial tasks and therefore generate value meant that the respondent would call it a co-worker:

> *"I would consider the robot a coworker, because they would do a lot of the repetitive work and heavy lifts, making it as important for the workplace as myself."*

However, for most respondents, the perceived value and importance of the robot and its role in the workplace would not be enough to grant it the status of a co-worker. Instead, the value the robot could deliver would in many instances grant the robot the status of a useful tool. Indeed, '*tool*' and '*machine*' were words frequently used to describe how respondents would perceive the robot. For instance, one respondent argued that instead of a co-worker, they would view the robot *"Rather as a tool, because the interactions seem quite limited"*. This also hints at another argument that was frequently raised by

respondents as an explanation for why they would not view the robot as a co-worker: For many, the social connection that exists between two humans is necessary in order to establish a mutual co-worker relationship. This connection also fosters and nurtures a mutual attachment stemming from the inherent uniqueness of each individual. The robot is (most likely) bound to the workplace and as such will always be 'inventory' - regardless of its capacity for interaction - and embedded in that single context.

"I'd probably not see it as a coworker, because a coworker is more than just another worker in my experience. A robot will not replace another human in a work environment."

Furthermore, as opposed to humans, the robot does not have autonomy to choose to be in a given situation, such as performing tasks at the workplace, or interacting with humans. For one respondent, this (lack of) autonomy constitutes an important distinction: *"I view a robot as a helping tool made to help me, and a coworker a person who chose the same Job as me, not someone who was made for one sole purpose[...]"*

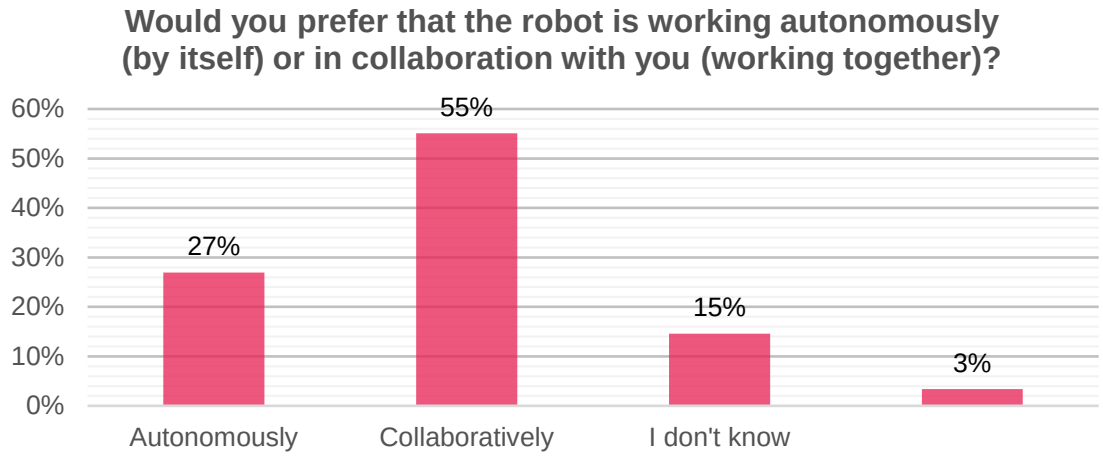
The fact that the robot is 'non-human' generally seemed to constitute a barrier for the respondent's capacity, or willingness, to perceive the robot as a co-worker. This is not only due to the lack of social connection, but also because of a robot's missing ability to understand and interpret concepts and objects like sentient beings do. As one respondent said, *"Probably not if it uses current AI technology (e.g. current AI systems don't understand space as a squirrel, a monkey or a year old human does. Future robots, using new designs (e.g. based partly on chemical computations) might be much more intelligent."*

Thus, while the robot was perceived as a capable tool for many respondents, its lack of several attributes that would make it more 'human-like' means that most would not be able to accept it as a co-worker in the sense they would another human being.

The results of the focus group among the participants of the Robotex International festival show that as a service robot, the design of this robot is round and cute, and you don't feel like you have to interact with the machine too much. "Here, you expect some kind of emotion from him."

Question 4. Would you prefer that the robot is working autonomously (by itself) or in collaboration with you (working together)?

To follow up on the previous questions and getting a greater understanding of using a robot such as Harmony in a work environment the respondents were asked whether they would prefer the robot to work by itself or collaboratively with humans.



Interestingly, although there was a clear reluctance toward perceiving the robot as a co-worker, respondents expressed a clear willingness to work closely together with the robot. More than half of the respondents (55%) would prefer to work in collaboration with the robot, while less than a third (27%) would prefer that the robot works autonomously. 15% of the respondents answered that they don't know what they would prefer, which might be because the answer for some would depend on the specific context or task, or because it might be difficult to imagine a situation relevant to one's own life where one would have to work alongside a robot. It's important to keep in mind that the questions and statements presented in the survey are hypothetical in nature, since they ask respondents to *imagine* scenarios in which they encounter the robot. Since they have no actual experience to base their answers on, it may be difficult to provide an answer with enough confidence, and so some respondents might prefer to 'play safe' by remaining neutral or at least undetermined in their response.

The inconsistency between the responses to the previous question (whether respondents would view the robot as a co-worker) and the responses to the present question may appear somewhat paradoxical; however, it's important to note that the reluctance to regard the robot as a co-worker does not (necessarily) equal an aversion to the robot, or robots in general. Rather, as discussed, the notion of a co-worker seems to be associated with certain qualities exclusive to humans. Evidently, this does not mean that people don't want to *work together* with the robot. According to the responses, the desired level of collaboration mostly depends on the value that the robot could deliver in a given situation and, to many respondents, both autonomous and collaborative modes of work and task execution could be useful.

"The two seem possible to me and desirable. The principle is that it relieves staff of repetitive spots, so it must be autonomous. On the other hand, it can facilitate the actions of a human caregiver."

While the comment above argues that the robot's specific role and duties will determine to which degree it should work autonomously or collaboratively (i.e., if it is meant to fulfil a role that entails simulating human interactions, collaboration is necessary) most responses pointed to the fact that the robot's work might regularly require human

intervention and so can not work autonomously all the time. For instance, drawing on personal experience with robots in the workplace, one respondent said:

"Obviously it depends. I've used robot document duplicating machines over many years - a human sets up a task and presses a button, but may have to help if a paper jam occurs."

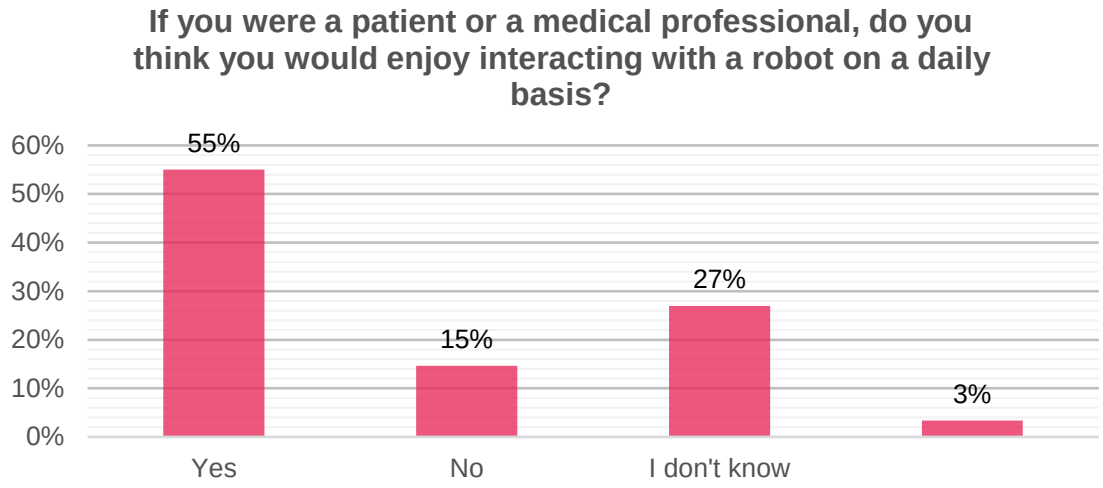
In addition to purely pragmatic arguments such as the one above, some responses were more concerned with the complexity of human practices. Notably, one respondent argued that *"It's not possible to automate all the necessary responses to the chaos of human behavior."* Arguments like these, of course, refer mostly to expectations towards the robot's capabilities and less to which degree of interaction respondents would find most desirable. However, for some respondents, the prospect of having to adapt to the introduction of non-human employees raised concern, because it might disrupt and change the way humans behave, interact, and work: *"When people have to work with machines, they must adapt to them and become more machine-like, which is sad and unhealthy."*

On the other hand, as another respondent pointed out, this process of adaptation could have positive outcomes, and the very fact that the robot disturbs status quo could prove to be a desirable effect: *"Working together with robots would make people more accepting towards change."*

For those respondents leaning mostly towards a robot that would work autonomously, the prospect of increased freedom seemed to be of great importance. By not having to interact with the robot and simply letting it execute the tasks it is programmed to, it could free up time for the humans who would otherwise be in charge of carrying out those tasks: *"The more work it can do by itself, the more time is saved for me and my human colleagues to go about tasks the robot is incapable of performing."*

Evidently, which degree of collaboration with the robot is most desirable is very much a matter of perspective and reflects a well-known - and sensible - wariness towards change. However, there is also little doubt that while the robot for the most part is perceived as a welcome addition to the workplace by virtue of the value it can add, people may not be ready to accept it as a co-worker and might view collaboration mostly as a pragmatic necessity rather than an opportunity for a new type of work relation.

Question 5. If you were a patient or a medical professional, do you think you would enjoy interacting with a robot on a daily basis?



Interestingly, responses to this question once again seem to contradict the previous insights. More than half of the respondents (55%) answered 'yes' to whether they think they would enjoy interacting with a robot on a daily basis if they were a patient or medical professional, whereas only 15% answered 'no'. According to several of the responses, the robot would be enjoyable to interact with by virtue of the services it could provide. Echoing some of the previous responses, several respondents referred to the ways in which the robot could provide *"an extra arm that does not tire out",* relieve humans of repetitive tasks and increase efficiency. One respondent also emphasized how these benefits could ultimately lead to better care for patients, making the robot a welcome sight:

"Hopefully, it would save a lot of time and effort in the workplace; and as a patient, this means that I might have better access to good care - whether it's in the hands of a human or the robot."

A few respondents also remarked that they think the robot looks welcoming, which makes it more attractive and easier to trust. For instance, one respondent said: *"The robot looks cute, safe and is here to release us from the more annoying aspects of our work."* This also indicates that people might be more inclined to interact with the robot, and find the interaction enjoyable, if the robot has a pleasant appearance that is likely to be associated with safety, familiarity and friendliness. On the other hand, it is important to note that regardless of how comfortable some may come to be with the robot, it cannot completely replace humans (at least not with current technology) in matters pertaining to social contact. Elaborating on their response to the question, one respondent said, *"If it is not personal care. It must not take over the physical togetherness".* This sentiment is not new, but a well-known argument against social robots, and it remains relevant and indicates important boundaries for the purposes robots serve.

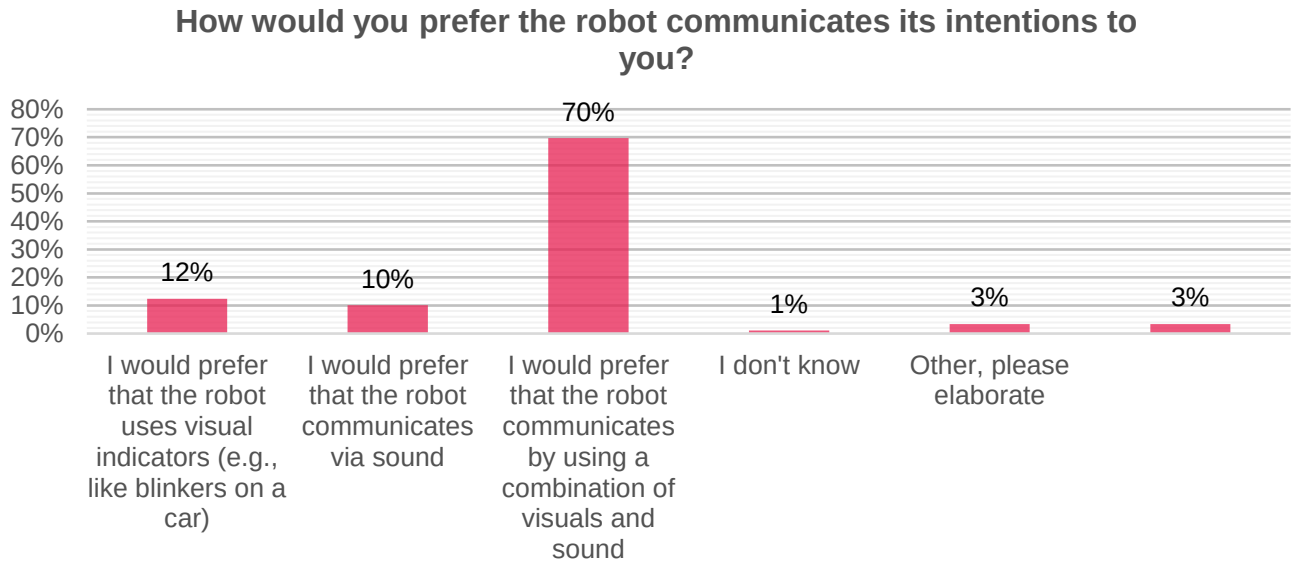
These types of associations may be evoked not only from the robot's appearance, but also from its very status as a technological artefact. While some people might seek human qualities in a robot, or even be repelled by attempts to inscribe any human-like attributes into it, others might judge the experience of interacting with a robot on other

parameters. One respondent noted that*, "It is not dissimilar to interacting with a personal assistant on a phone or smart home."* This provides a completely different reason for why one might enjoy interacting with the robot; humans are already accustomed to smart devices, and many seek entertainment and enjoyment from engaging with these technologies. For some, interacting with a robot may feel similar.

Returning to the distribution of direct responses to the question, a significant number of respondents (27%) answered 'I don't know'. Like previously discussed, this may be due to difficulty with assessing a hypothetical question. Furthermore, this particular question has an added dimension in that it asks respondents to not only imagine themselves in a future situation, but also in certain roles that may be difficult to identify with. Another reason, however, could be that these two roles - healthcare worker and patient - present two very different perspectives that may also entail different opinions. In other words, several respondents expressed that whether they would enjoy interacting with the robot depending on whether they were a medical professional or a patient. Generally, respondents thought they would enjoy interacting with the robot if they were a medical professional, because the robot could act as an assistant and lessen the workload. What's also important to note is that in this situation, the relation between the human and robot is that of worker and assistant. For a patient, the relation is different, and it may feel like a much more vulnerable position where the robot is in control - especially if it acts as a caregiver. While the medical professional will be the one that gives the robot instructions, the patient may not be able to have much influence on what the robot does, and they may not be able to communicate their needs in a way that the robot understands or can respond to*: "As a patient this will depend on the situation, simple things the answer would be yes, in an emergency the answer would be no."* However, the robot might also hold the potential to bring variation and stimulation to hospitalized patients' everyday life. One respondent said that*: "As a patient, I will be amused to see funny robots walking in the hospitals."* Thus, the robot might bring value not only through physical labor, but also by bringing joy with its very presence.

Question 6. How would you prefer the robot communicates its intentions to you?

Despite opposing opinions regarding to which degree the robot should stand out or blend in with its environment (see Q1), most respondents seemed to prefer clear and multi-sensory communication from the robot: almost 70% said they would prefer that the robot uses a combination of both visual and auditory communication, while 12% said they only wanted the robot to use visual indicators, and 10% said they would only prefer the robot to communicate via sound.



Arguments for having the robot use multiple modes of communication (visual and auditory) were especially centred around inclusivity and accessibility, which would be particularly relevant in a hospital setting:

> *"Multimodality is essential, especially in a hospital, to enable it to interact with potentially disabled patients (hearing impaired, pathologically visually impaired or temporarily following surgery)."*

Among these responses, there was a general sentiment that anything that improves communication would be desirable, and one respondent even suggested that the robot could use sign language. However, there were also arguments for why one type of communication would be preferred over the other, and why some types might be inappropriate in some situations. For instance, one respondent made an important point:

> *"The advantage of the visual is the sound discretion, which is important in a quiet environment (so that it remains quiet) or one that is already noisy enough. And for the person who works with it all day, too."*

This point adds another perspective to questions about convenience, usability, and safety. Noise is a common issue at many workplaces, and it poses a health risk that could be exacerbated by a robot using auditory communication. The argument also resonates with some of the other responses arguing that the appropriate mode of communication depends on the context in which the robot is placed, as well as the specific situation. For instance, one respondent argued that "*A simple beep might suffice as a request for me to move out of the way. A combination of words and gestures might be required if the robot wants to do something more complex with some assistance from me."*

Additionally, a number respondents were in agreement that "*the main thing is that they are not too annoying*", as one put it. In the same vein, another respondent said that *"Robot communication should be natural, not too disturbing"*. In continuation of this and

building on the notion of ‘natural communication’, a third respondent said they preferred “*The least invasive means possible. Sound would almost certainly become annoying after a while*.”

4.7 RobStruct

This report presents the results of a collaboration between RobStruct (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.7.1 Presentation of RobStruct

Robstruct is a Danish construction technology startup that develops applications for mobile robots, with the intent of implementing them in the construction industry. Their solution is based on the idea that it is possible to alleviate the pains construction companies experience with regards to worker health, workforce shortage, and sub-optimal productivity.

For example, this type of robot can be connected to a trailer that can help move large and small objects on construction sites such as bricks, tools, waste etc.

The solution is built on the idea that it is possible to create mobile robots that are intuitive to use and adaptable to their environment and the tasks they are set to perform.

At the core of RobStruct's philosophy is the need for improving worker health by alleviating the construction workers from repetitive and physically demanding tasks such as continuous lifting, carrying, and towing.

By eliminating non-value-creating and time-consuming tasks via autonomous executing, RobStruct solutions enable construction staff to focus on actively building. Their solution aims to increase productivity and improve the mental health of workers.

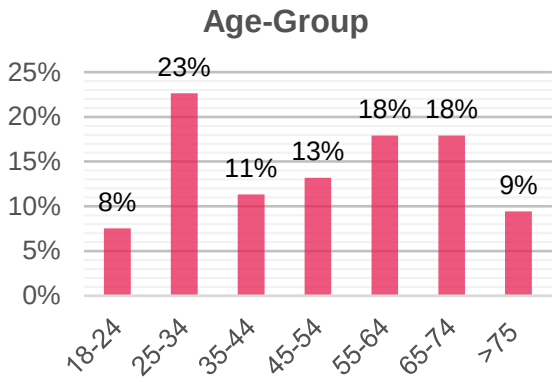
4.7.2 Demographics

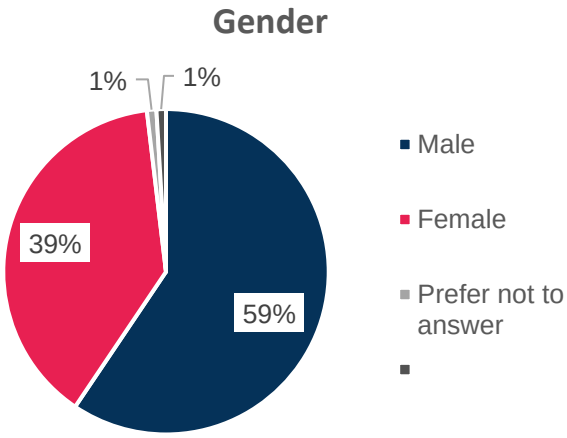
The survey received a total of 106 responses. The survey received a well distributed number of respondents from most age groups. Citizens in the age groups 25-34, were best represented accounting for 23% of the total responses. These were followed by the age groups 45-54 and 55-64 each accounting for 18%. The age group least represented was the young people between 18-24 with 8%.

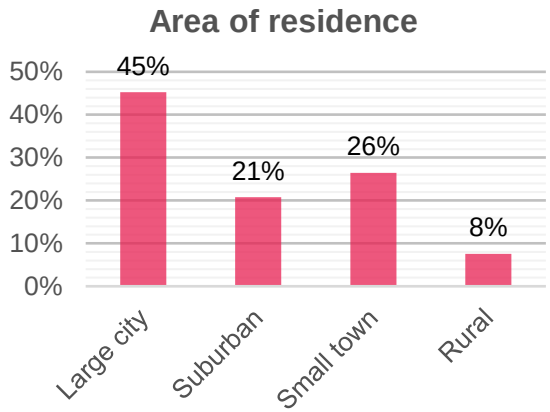
The gender distribution of citizens had a higher distribution of males accounting for 59% whereas the females accounted for 39%. The remaining either answered 'other' or did not specify their gender.

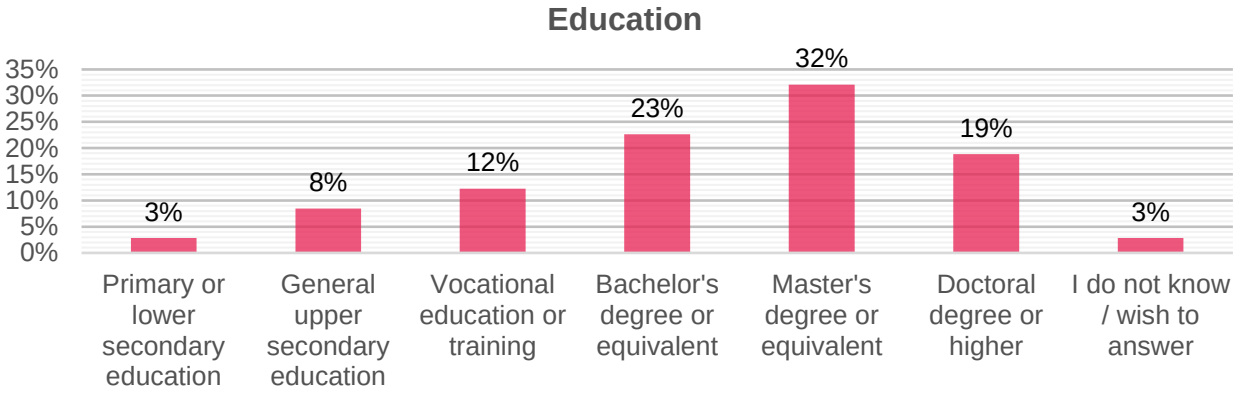
Looking at distribution of areas of residence, a total of 45% of the participants answered that they lived in a large city. The second most chosen option was small town with a total of 26%, followed by suburban with 21% and rural with 7%.

Participants were generally highly educated with 74% answering that they held either a bachelor, master's degree or higher, whereas only 24% held primary, secondary or vocational education.









The survey received answers from participants from at least 13 different countries. However, 21% chose not to disclose their country of origin making it difficult to give exact information on where respondents participated from. But citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe.

These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.7.3 Survey Results

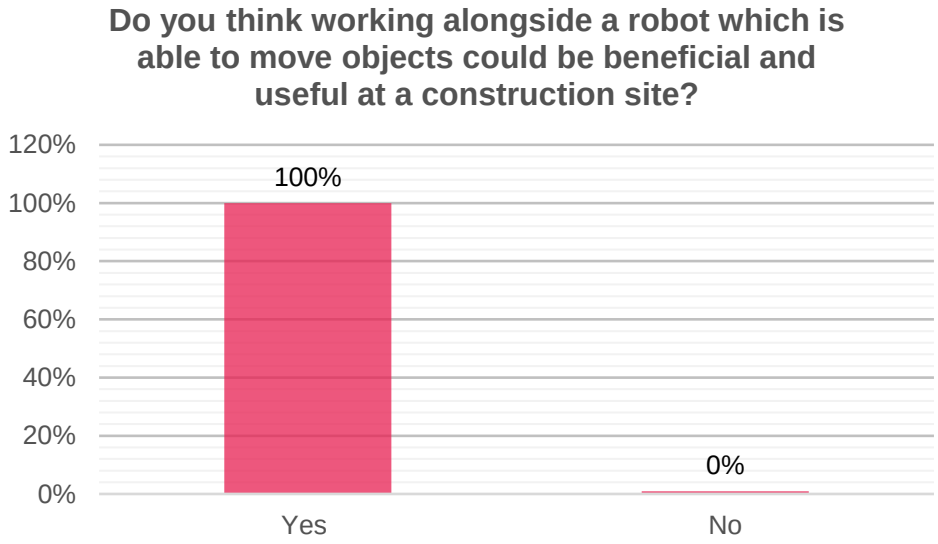
Citizens were asked six questions regarding their perceptions of the robot, exploring the robot-human interaction at a construction site. Additionally, the questions explored what opportunities there might be for a robot like RobStruct, but also evaluating potential barriers towards the robot.

To set the stage, the citizens were put in the following imaginative scenario and asked to answer questions based on this:

Imagine that you are working at a construction site, and you meet your new coworker. It is a mobile robot capable of helping you with multiple daily tasks. The robot can transport equipment, waste, and a wide array of building materials and it can find its way around the site on its own.

Question 1: Do you think working alongside a robot which is able to move objects could be beneficial and useful at a construction site?

All of the respondents agreed that it would be beneficial to work alongside a robot which can help move objects while working.



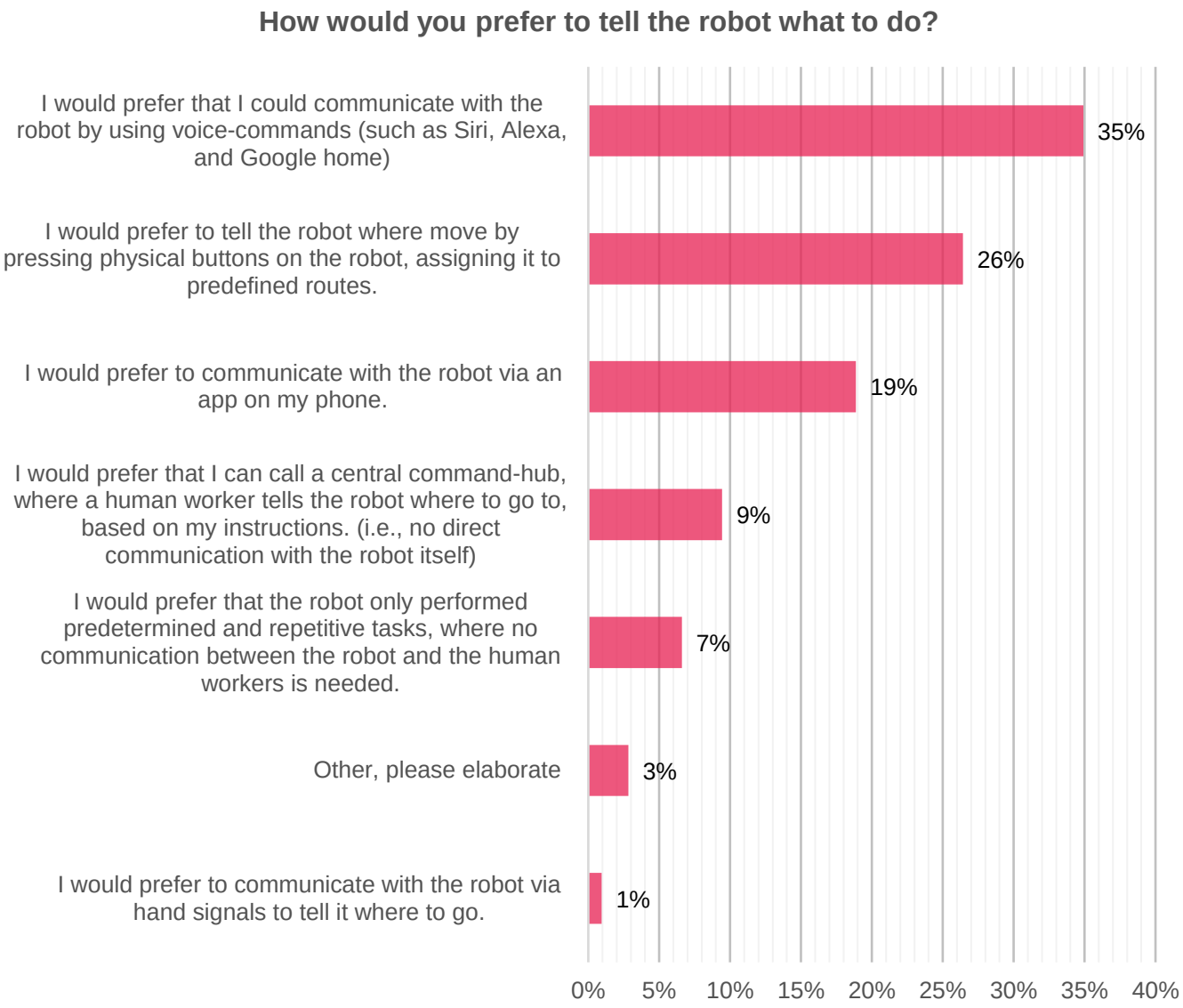
Looking at the elaborative answers it is clear that the citizens see great value in freeing construction workers from doing repetitive and physically demanding lifting-jobs to hopefully reduce wear and tear on their bodies over time and improve their work conditions. One respondent said *"It will increase the time that construction workers can spend on constructing, as well as improving safe work conditions, and inspecting buildings, making sure that every procedure is being followed."* which was backed up by several others *"[it] Would lead to better concentration on important tasks rather than item logistics."* and *"Yes, the wages of the workers on the building sites are already low, if technology can help their daily work, why not!".*

A few respondents did however question the functionality of the robot, although they in general agreed to it being useful. One found it difficult to see how the portrayed robot could deliver significant help and value based on the pictures the respondent had been presented with and another respondent feared that the robot might be in the way and have people bumping into it or stepping on it, *"I'm already afraid of walking on it.".* Taking the elaborative answers into consideration there is an indication that the intended idea behind the robot is good but further work on applying real life use cases to the robot will enhance the perception of the robot and ensure it gives the added value to a construction site. It is important to bear in mind that the citizens were only portrayed with pictures of prototypes as the robot is still in its developing stage.

Participants in the focus group interviews conducted during the Robotex Festival also pointed out that the robot seems ineffective for the given tasks. *"Useful in some ways, just a waste in others. He's so small."*

Question 2: You have just loaded the trailer attached to the robot with waste, and a specific tool that your human coworker on the opposite side of the construction site needs. How would you prefer to tell the robot what to do?

To help the developers get insights on how the robot-human interaction can be designed the citizens were asked to give input on how they would like to communicate with the robot in the imaginary scenario.



The responses indicate that the preferred means of communication to the robot is either by using voice-commands or by interacting with an interface on the robot such as physical buttons. Only a few said that they did not want to have direct contact with the robot, answering that they would prefer a central command-hub or that the robot only did repetitive tasks where no communication is needed. Among those who choose voice commands it was explained that this would be a more fun way of communicating and that *"This type of technology is widespread, and well tested. People are familiar with it, making it easier for recently hired employees."*

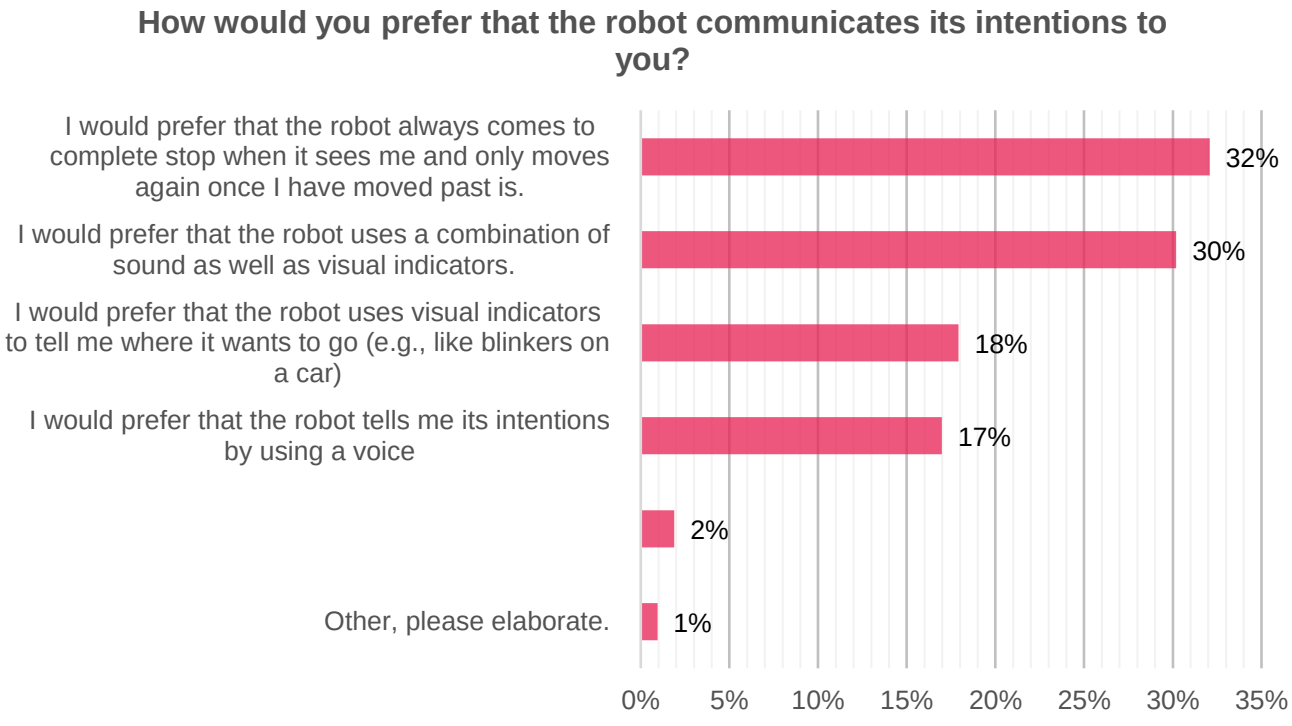
Among those who chose to communicate through a physical interface such as buttons their reasonings were mainly because of practical considerations of the work environment not being ideal for technologies using voice commands because of loud noises*: "The construction sites are dirty and noisy environment, the use of physical buttons seems to me to be the most rational and the most comfortable"* and *"this makes it possible to compensate for the noise present on the site (inappropriate voice command), I think it is necessary, otherwise we lose the interest of this new colleague, to be able to communicate directly with him)".*

Those who choose to communicate via an app on the phone highlighted that this would be ideal because then the human would not have to be near by the robot. However, others had concerns towards using an app underlining that *"If the employee has personal protective equipment (gloves, helmets, fuses, masks) on the construction site, then the use of a mobile phone may take more time than the touch of a button".* Another respondent also highlighted that it is important that the use is adapted to the work situations and that having an app would just be an additional means of communication they had to carry around.

Looking at these responses is not only interesting from a design perspective, but they also give a small indication that there is a general trustworthiness towards the robot and willingness to collaborate with a robot and give it instructions. The citizens seem confident that they will have the skills and be able to communicate with a robot and only 16% preferred to communicate through a human command-hub or not to communicate at all with the robot.

Question 3: Later that day, you encounter a robot delivering materials on a narrow path. You are unsure if you should step to the side or if the robot will navigate around you. How would you prefer that the robot communicates its intentions to you?

To explore how the robot can navigate comfortably around a construction site both for the humans it encounters and the robot itself the citizens were asked to choose between different ways the robot potentially can indicate its intentions. In the diagram below the options and distribution of answers are shown.

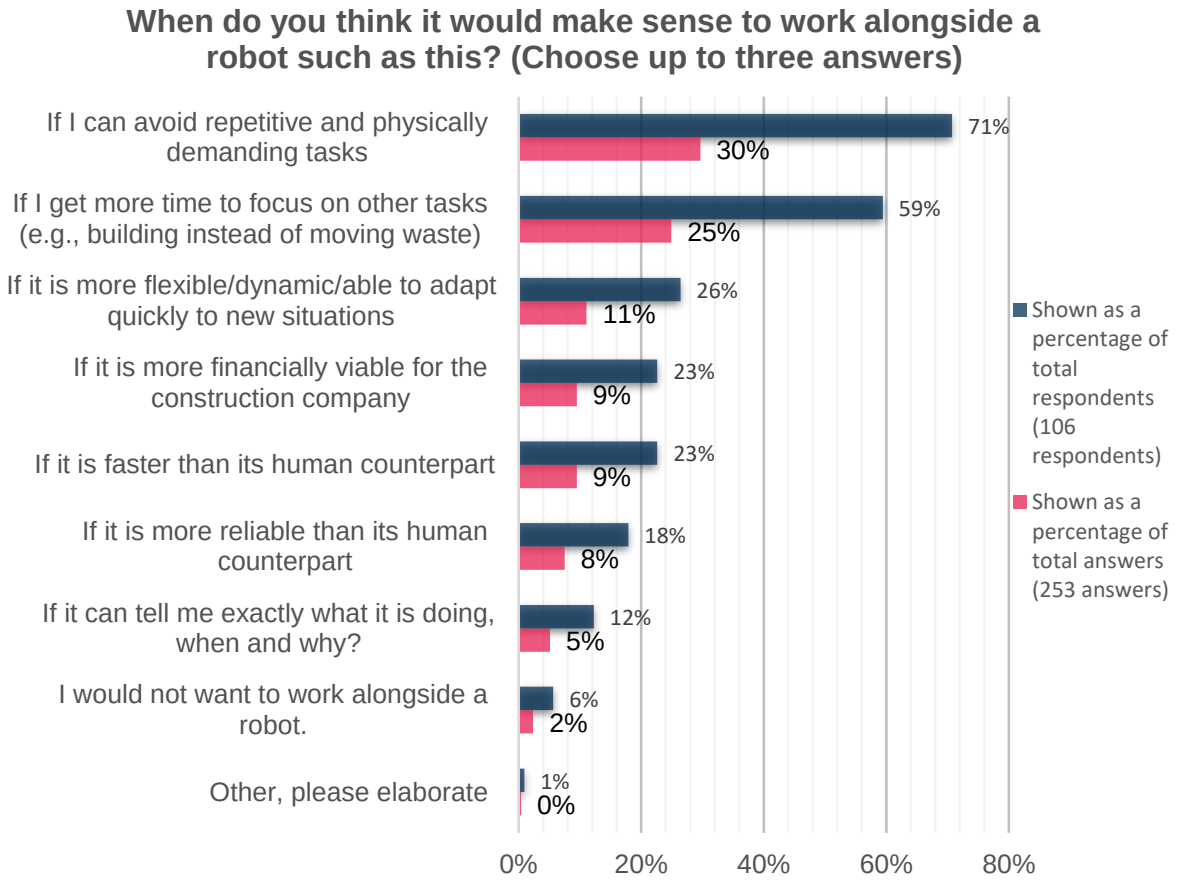


Approximately two thirds of the respondents preferred to have the robot show its intentions either via visual indicators (18%) sound indicators (17%) or a combination of the both (30%). Among the elaborative answers, respondents suggested that because construction sites can be in a loud and perhaps unpredictable environment it is important that the robot can use multiple modes of communication. One suggests loud sounds and some kind of visual indication such as an arrow to show the robot's trajectory. Accessibility was also mentioned by two people as something the design of the robot should consider.

There was also a large group (32%) who preferred the robot to come to a complete stop. One respondent mentions that this will be the safest and most reliable and another points out that *"in construction it is often loud, and people could be wearing noisecanclers. It is best that the robot operate on the premise of the workers, not the other way".* Ultimately determining what mode of communication most suitable for this robot cannot be settled in this kind of survey as it very much depends on the situation and use case of the robot, which was also pointed out by some of the respondents. However, the answers can give indications of directions worth considering in the further development of the robot.

Question 4: When do you think it would make sense to work alongside a robot such as this? (Choose up to three answers)

To get an idea of the value proposition of the RobStruct robot, the citizens were asked to choose up to three different incentives where they thought it would make sense to work alongside such a robot.

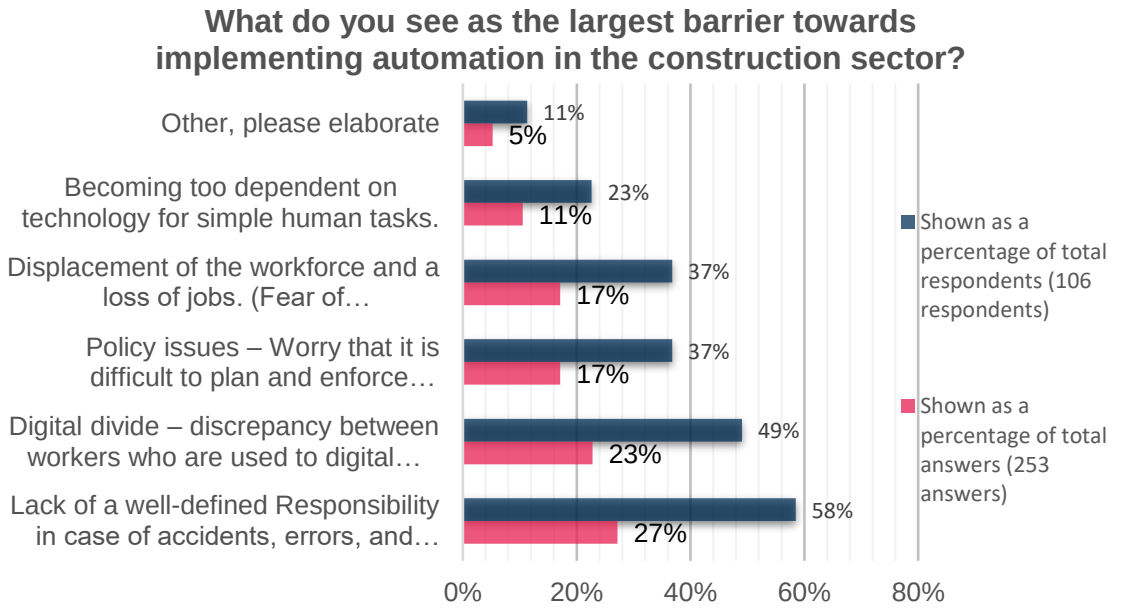


Looking at the answers it is clear that many think it makes sense to use such a robot in use-cases where it relieves humans in repetitive and physically demanding tasks and/or when it can relieve work to give them time to do other tasks such as building instead of moving. A few also choose that it would make sense to use such a robot if it could outperform its human counterparts in performing tasks such as being more flexible, faster or reliable.

Only 6% answered that they would not want to work alongside a robot. There seems to be a general acceptance towards robots working in places such as construction sites as long as they are well designed for the environment and can help relieve workers. We can see this as positive attitude towards the business potential of having a robot such as this working along side humans.

Question 5: What do you see as the largest barrier towards implementing automation in the construction sector?

To uncover some of the challenges towards implementing robots in the construction sector, the citizens were also proposed with five potential barriers of which they could choose up to three they found the most concerning.



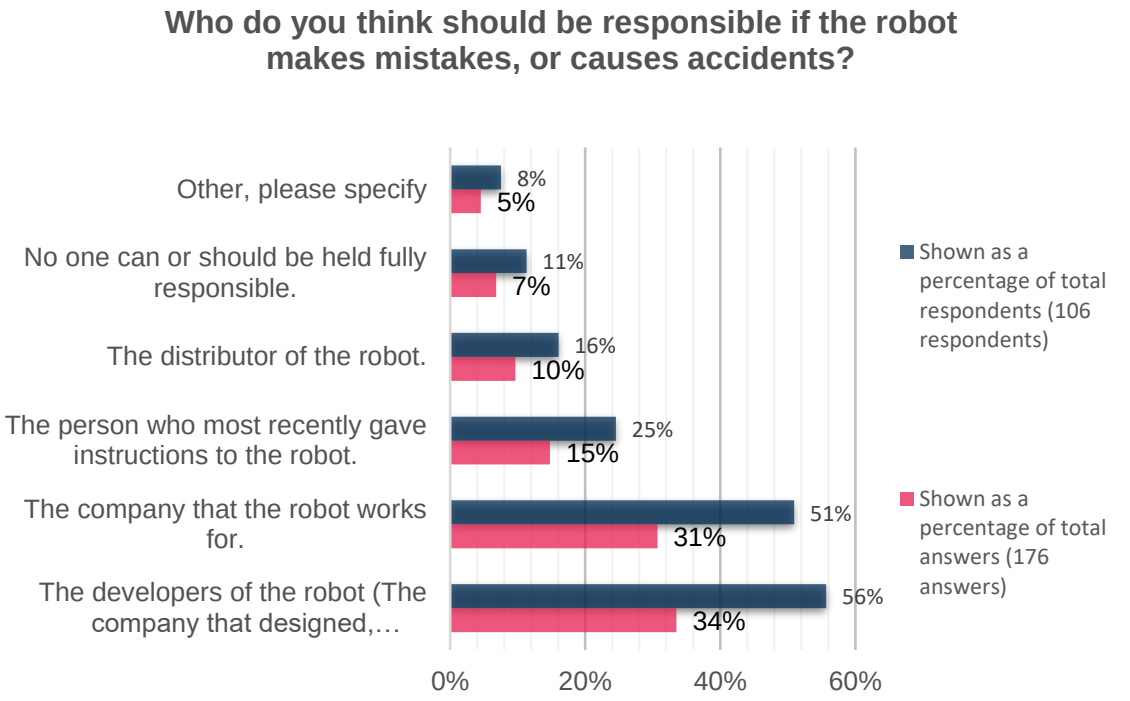
58% of the respondents identified the lack of well-defined responsibility in case of accidents, errors, and flaws concerning the robot as one of the most concerning barriers. One respondent however pointed out that the *"lack of well-defined responsibility in case of accidents is easily preventable if regulations are being developed alongside the robotics."* This then raises the question of who should be responsible for developing these regulations? Many (37%) also foresaw that policy issues might become a barrier, one respondent elaborated: *"everyone can get used to robots. But to enforce laws and policy is something that takes more time."* There's both a wish for regulatory actions but also a fear that this can be time consuming and ultimately slow down the technological advancements. The fear of digital divide and discrepancy between workers who are used to digital technology and workers unable to utilize digital technology was also chosen by

more than half of the respondents. This goes well in hand with many also being concerned about displacement of the workforce and loss of jobs.

In addition to the given options, multiple respondents also pointed towards lack of mature technology or scepticism towards it being possible to develop robots that are agile enough to work in a complex environment like a construction site as the main barriers. One respondent explained: *"The robots simply aren't yet good enough for the complexity of our world. Where are all the self-driving cars that were promised…" and another: "The integration of robots into this sector will be more difficult, than for factory automation for example, because of the completely unstructured environment and wide variability."* Some simply think that the tasks at a construction site are too complex and dynamic for it to make sense investing in robot solutions.

Question 6: Who do you think should be responsible if the robot makes mistakes, or causes accidents?

To elaborate on the barrier of responsibility the citizens were also asked to give their thoughts on who should be responsible if the robot makes mistakes or causes accidents? The respondents could choose up to two answers.



Here it was clear that the developers of the robot and the company/entrepreneur that bought the robot to use it at the construction site should be the two main responsible actors. Looking at the elaborative answers, two of the respondents compare it to how we determine responsibility for malfunctions with the vehicles we use everyday, where car and plane manufacturers are held accountable for any type of malfunctions or accidents that are not related to the human controlling the vehicle: *"Just like with airplanes, the producers should be held accountable for anything related to their products. That is to say, then they should also be credited for the things that works out good."*

Several respondents however point out that it might not be so simple and that it very much depends on the situation and the accident which also raises an ethical issue. One respondent says that if the robot makes a mistake then it should be the company owning the robots responsibility but if the robot can purposefully be instructed by a human to put another person in a harmful situation then it is the responsibility of the human giving the instructions. Another respondent explains: *"Obviously it is going to depend on what sorts of mistakes or accidents occur and why they occur. Highly trained humans can make mistakes and unintentionally (or sometimes intentionally) cause accidents. Responsibility assignment can be complex task."*. Determining who has the responsibility is quite a difficult question to answer and it might also need regulations or laws to determine. But by having the question of responsibility and ethical dilemmas in mind in the developing phase of a robot, some of the unwanted scenarios can perhaps be avoided by well thought design, programming, and testing of the robot. Therefore, it can be recommended that the developers of the robot ensure that they at an early stage consider ethical, societal and legal barriers.

4.8 Panza Robotics

This report presents the results of a collaboration between Panza Robotics (SK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.8.1 Presentation of Panza Robotics

Carrying out routine tasks, such as area surveillance, condition monitoring of heat, toxicity, chemicals, or predictive maintenance represents a significant part of the costs for almost every municipality or private company. The costs are getting higher if the tasks are performed in potentially hazardous or hard-to-reach areas affected by earthquakes, or places like construction sites, landfill sites, nuclear power plants, oil stations etc.

The solution is to carry out these tasks by using the robot Artaban – a universal multipurpose robotic platform designed to support these types of routine or dangerous operations across various industries. Using Artaban could play a key role in reducing costs, minimizing failure rates, and protecting the health and safety of citizens or employees.

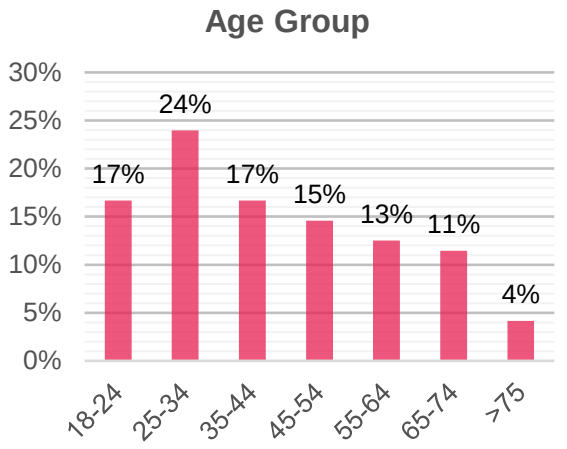
Using smart autonomous robots will become “the new standard“ across various industries and will surely have an impact on people as well. The use of autonomous robots will encourage an expansion of knowledge, leaving a growing demand for new skilled workers and new positions in various industries. In addition, there are also environmental and low carbon economy contribution benefits, as Artaban monitors various environments and helps to predict dangerous conditions or hazardous situations.

Furthermore, Artaban reduces personal transportation and carbon emissions. It is important to create a more socially sustainable use of robots as it is not the aim to create new technology, which replaces people or cancels jobs. Rather, Panza Robotics are developing (semi) autonomous four-legged robots with embedded sensors to move around people and help them to accomplish their everyday tasks.

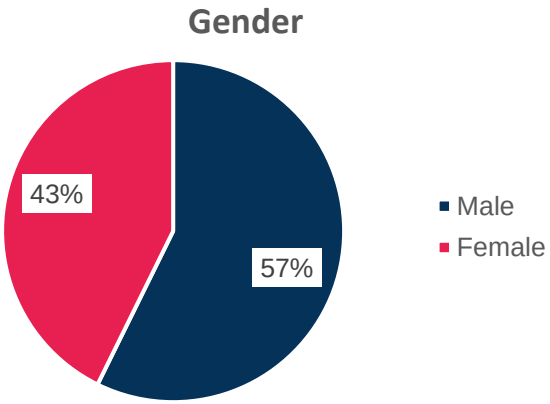
4.8.2 Demographics

In total 97 respondents were engaged in answering questions about the robot Artaban by Panza Robotics.

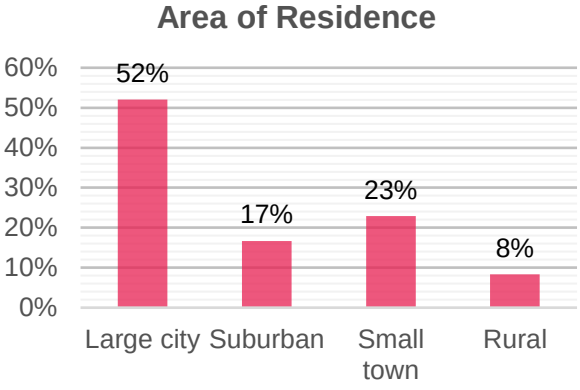
Respondents answering the survey were mostly citizens between the ages 25-34 and this demographic made up for 24% of the total answers to the survey. Following this, age groups 18-24 and 35-44 each made up 17% of the total answers. The rest of the age groups were evenly divided with 45-54 coming in at 15%, ages 55-64 at 13% and 65-74 at 11%. Finally, the least represented age group was 75 or older with 4%.



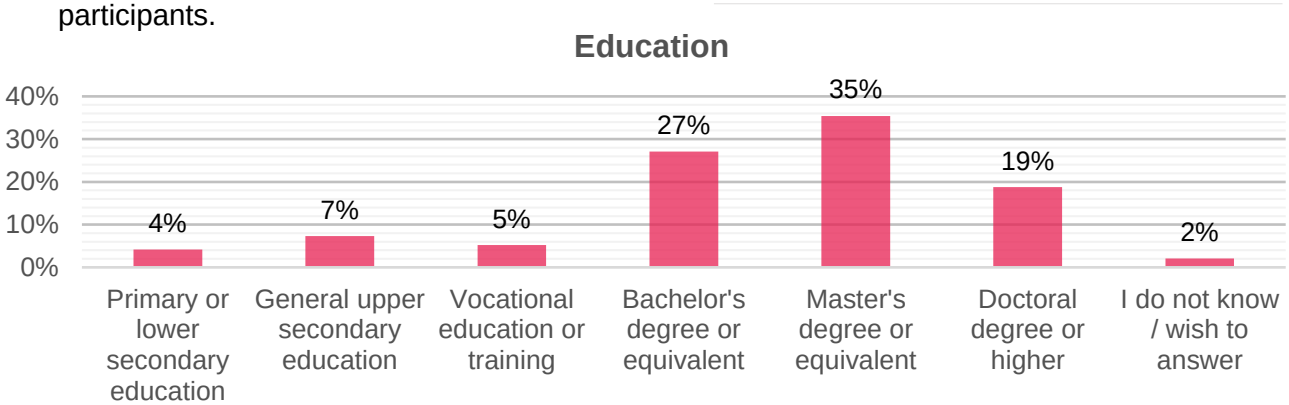
The gender distribution in this survey was shifted towards male respondents with them accounting for 57%, while female participants made up the remaining 42%.



Looking at the areas of residence of the respondents, the distribution was more uneven. Over half came from large cities, with this category accounting for 52% of the total respondents. The second most chosen category was small town with 22% while suburban had 16%. Participants coming from rural areas made up only 8%.



The survey attracted citizens with a higher degree of educational background and 35% of the participants answered that they held a master's degree or equivalent. Following this segment, bachelor's degree or equivalent was the second most chosen answer accounting for 27% of the participants.



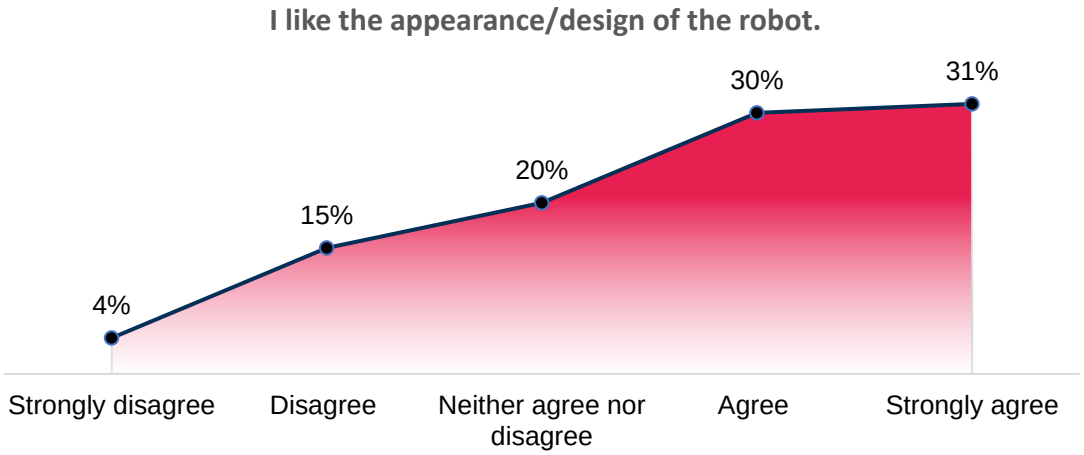
More than 15 different countries were represented in the survey, with France being the country with the most respondents accounting for 16.7% of the total answers. This was followed by Denmark with 13% and then Norway with 11%. 24% choose not to disclose their country of origin.

These specific demographics may influence the answers and tendencies described in the report. Therefore, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.8.3 Survey Results

Question 1: I like the appearance/design of the robot

To get a first-hand impression of the opinions of the robot respondents were first asked to consider the design/appearance of the robot Artaban. Here, responses were mostly positive, and a combined 61% answered either 'agree' or' Strongly agree'. 14% choose 'disagree' and only 4% choose 'Strongly disagree'. 19% of respondents choose 'Neither agree nor disagree', showing that several respondents did not form an opinion about the robot, or did not think particularly about it. See figure the below:



There were several respondents that chose to elaborate on their answer. Many of these answers praised the design, commenting that the robot had a *"Good, friendly, non threatening, clean design"* and that it: *"Looks capable of any terrain traversal and is bright and can be easily detected."* Others mentioned that the robot looked *"cute"* and that the animal-like design was preferable to more humanoid designs. The fact that some respondents were very enthusiastic about the quadrupedal and animal-inspired design might hint at a tendency to be more accepting of robots that resembles something towards which there is a certain familiarity, and one respondent mention that:

"It's easy to recognise, and I think it looks cute. I would feel safe if I worked at a place where Artaban would be roaming around".

However, there were also comments on the design which were less positive, and some respondents mentioned how *"It looks a bit creepy"* and that the robot looks *"mean"* which indicated that some might be put off by its animal resemblance.

The results of the focus group among the participants of the Robotex International festival differed somewhat in the data collected by the survey. The reason may be the more positive attitude of the participants in the robotics event towards robots.. "That I have this feeling, yes, that he is made more fiercely. He is fierce even if he is made a little scarier. I would like to have one like that in my home."

Question 1.2 If you have any recommendations for changes in the design, please comment them here

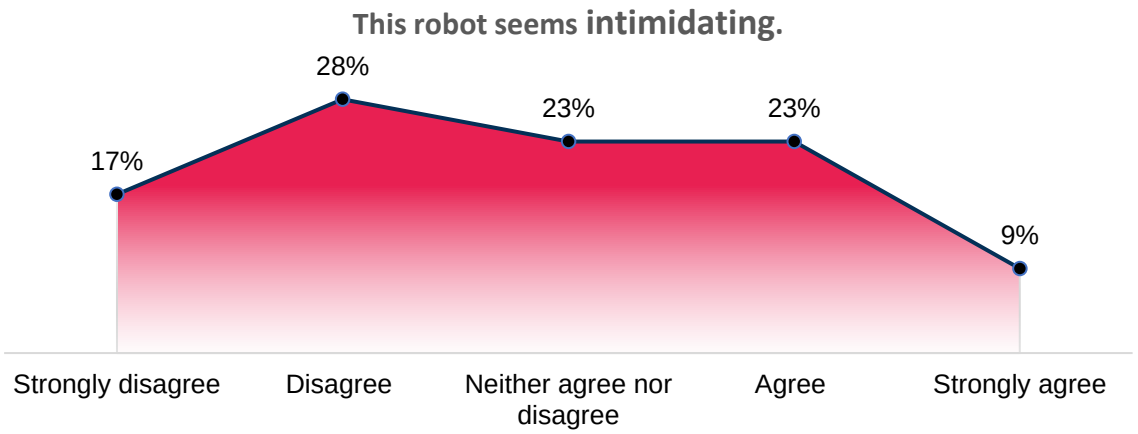
Respondents were asked if they wanted to further elaborate on the question concerning design and appearance by asserting their own recommendations for changes in the design. Here, some respondents show a minor dislike towards the angular design and point out that – because of this design choice – the robot looks somewhat more like a weapon than a collaborative tool and one respondent notes that:

"Even though it looks like a dog and therefore has a familiar appearance, it looks a little threatening. Maybe because of the colours or the shape, but it looks more like a weapon than a tool that could help us."

In general, respondents seem to be either in favour of the dog-like/animal-like design or to be against it. Some also mentioned the angular shapes and how they contribute to making the robot look somewhat intimidating and that one way to make the robot seem more approachable and friendly could be by adding more rounded shapes. There were also a few comments regarding the functionality of the design and one respondent mentioned that the robot looks like it might trip and crash when encountering obstacles and another suggests that it could be more practical if the robot used wheels or crawlers, instead of legs.

Question 2: This robot seems intimidating.

When asked whether the respondents found the robot intimidating the answers were distributed relatively broadly. The most chosen answer was 'Disagree' with 27%, indicating that many respondents were not too negative towards it. 17% choose 'Strongly disagree", meaning that a combined 44% of respondents considered the robot not to be intimidating. Many also did not seem to have an opinion on whether they found the robot to be intimidating as 22% answered 'Neither agree nor disagree" The remaining 32% chose either 'Agree' or 'Strongly agree'. See the figure below:



Many respondents elaborated on their choice and the written answers to this question echo some of the sentiments from the earlier question. Here, one respondent elaborates on the design in the following way:

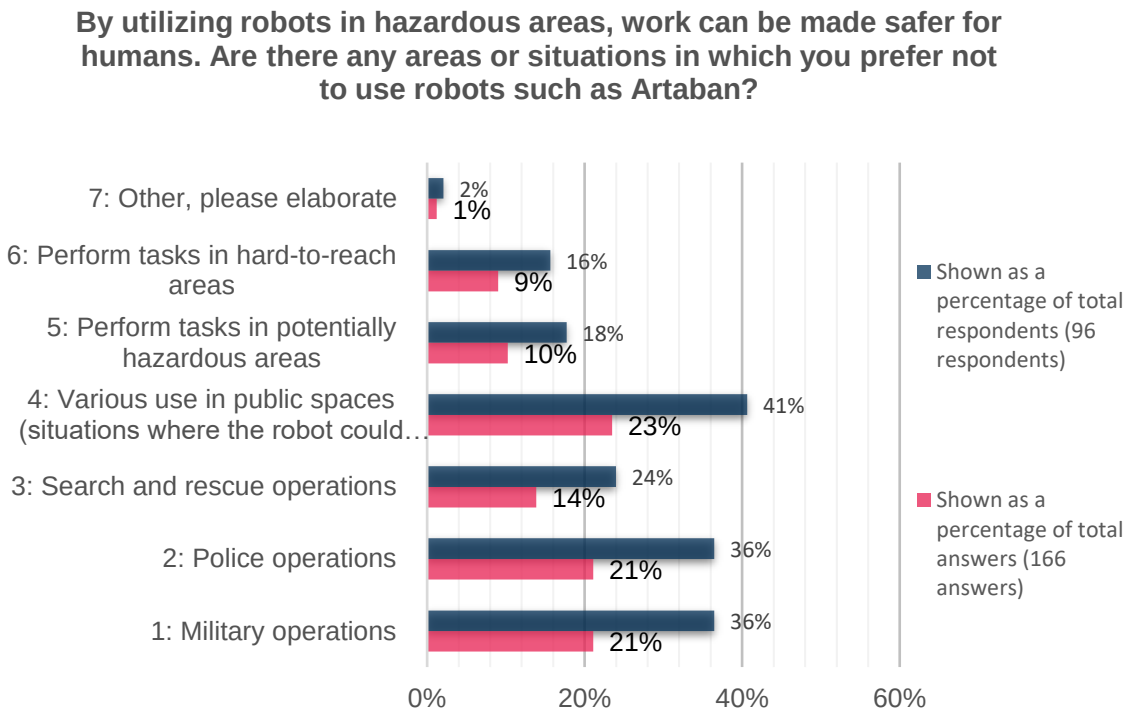
> *"It is replicating a small pet-like animal (dog/cat), this is good. And if it walks around on a construction side (for example) I do not see where the problem should be. It will melt into the environment and people will get used to it."*

Furthermore, "*cuteness*" and animal-like appearance are again highlighted and one respondent notes: *"I love dogs, it looks like a dog, and its color scheme are crazy, it is perfect"* while another notes that: *"It has a very safe appearance".* So, while some respondents had comments and recommendations concerning the current design, most did not find the robot intimidating.

Question 3: By utilizing robots in hazardous areas, work can be made safer for humans. Are there any areas or situations in which you prefer not to use robots such as Artaban?

Ensuring a healthy and successful implementation of new robotic technologies is also about defining limitations. Here, respondents were asked to choose 3 areas where they did *not* want robots such as Artaban to work. Respondents were purposely only given the opportunity to choose 3 to make them reflect more critically about their answers.

Here, the most chosen answer was 'Various use in public spaces (situations where the robot could potentially be in close contact with citizens)' with a total of 23% of the answers. Following this was use in 'Military operations' and 'Police operations' with 21% each. The rest of the votes were distributed between 'Search and rescue operations' with 13%, 'Perform tasks in potentially hazardous areas' with 10% and finally 'Perform tasks in hard-to-reach areas' with 9%. See the figure below:

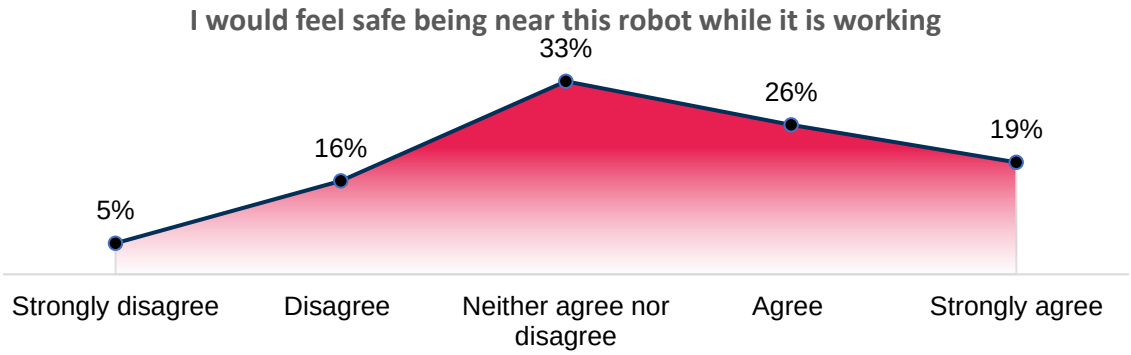


The distribution of the answers to this question might be an indication that respondents are sceptical towards the use of these robotic solutions in public spaces where people who are not familiar with the robot may potentially be present and in close contact with the robot. This may be because of a more deeper grounded and general fear about new robotic technologies and what effect these might have on society – especially if used in public spaces. One respondent elaborated on a worry regarding having robots in public spaces: "*Robots should not be used in public spaces. I am not in favour of surveillance of citizens. It is an invasion of people's privacy, of their freedom."* As Panza Robotics are in the early stages of development they can use this feedback to identify business opportunities within areas that are more prone to accept the robot by looking at implementation in restricted/controlled areas or under circumstances where the people encountering the robot are acquainted to it or trained to be around it.

There was also a noticeable disdain towards using Artaban in situations involving military or police. There seems to be a general sentiment throughout, namely that respondents were critical towards the use of robotic technology for military purposes or in situations that might potentially cause harm.

Question 4: I would feel safe being near this robot while it is working

To follow up on the previous question the respondents were asked about safety. When asked the rather broad question about whether respondents would feel safe being around the robot while it is working, many did not seem to have an opinion and the distribution of answers showed that 32% opted for 'Neither agree nor disagree'. However, while many found it difficult to form an opinion, respondents were generally positive towards being near Artaban in a work situation. Here, 25% choose 'Agree' while 19% opted for 'Strongly agree' for a combined 45% placing their answers in the high end of the scale. At the other end 16% 'Disagree' while only 5% 'Strongly disagree'. See the figure below:



One respondent noted that it might not be the case that someone will feel safe around this kind of robotic application from the beginning. However, it might very well be something that people will get used to in the same way that people get used to other new types of technology and tools over time - a quite common phenomenon.

Granted, one of the reasons that many of the respondents felt that they were unable to form an opinion, might be that the question itself was so broadly formulated. There are several factors that need to be specified more clearly, such as working conditions, types of interaction etc. This in turn might therefore make such a question rather difficult to answer at face value as it involves being asked whether one would feel safe around a new and perhaps previously unknown technology, which can be very difficult to answer. However, such a question might also evoke a more intuitive answer amongst the respondents.

A focus group interview conducted among participants at the Robotex International festival reveals that "He does work that we don't want to do. He is very necessary. It doesn't even matter if he is scary to us."

Question 5: Artaban is a robot with multiple purposes, such as surveillance, healthcare, waste management and much more. Apart from what you have been shown, what other uses can you think of?

When asked to consider further uses for Artaban, respondents came up with some interesting takes on the usefulness of the robot. A lot of respondents mentioned or

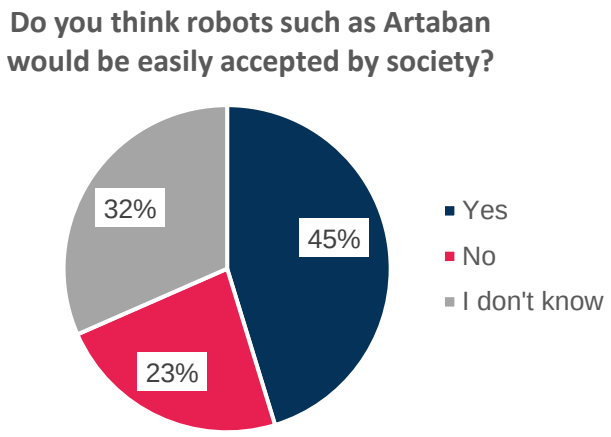
highlighted some of the functions that had already been presented. As respondents had already been introduced to quite a few application areas in which the robot can be utilised, many answered that they did not have any ideas for how to use the robot further.

However, here several respondents mentioned how they can see Artaban being used for multiple different entertainment purposes – for example as a pet or an artificial dog-toy. Some respondents also highlight using Artaban for Search and rescue operations, for example as: *"on demand scalable forest surveillance and/or search and rescue"* and for monitoring biodiversity, food, or in the fields.

There were also few who did not like the idea of using Artaban further and mentioned – perhaps somewhat sarcastically – that it could be used for *"scaring civilians"* or that it should be doing *"Something far away from people"*.

Question 6: Do you think robots such as Artaban would be easily accepted by society?

Finally, respondents were asked whether they thought that robotic solutions such as Artaban will easily be accepted into society and here 45% answered 'Yes' while 23% answered 'No' and 31% answered 'I don't know". See the figure below:



Here, some of the reasons presented by the respondents were answers such as: *"If people can be exposed to fewer dangerous situations it will surely win the foothold"* Another respondent answered that:

> *"I think Artaban would be a lot easier to accept in society. For one, it's cute. But, also, people won't have to work at a place where they risk breathing in toxic fumes from leaks."*

Respondents also mentioned the design as a crucial factor when it comes to social acceptability. Here, focus is once again on the animal-like design which, for some, is mentioned as a feature that helps boost acceptability. The fact that the robot has an instantly recognizable design that resembles a canine can help people be more open towards accepting the robot into society. One respondent already assigned gender-like features to Artaban when they mention that: *"She is like a dog and people like dogs"*, appealing to the fondness many hold for dogs and their often social and likeable nature

as pets and companions. For others, however, this familiarity might evoke different feelings and one respondent notes that: *"It seems intimidating"* while another respondent writes that: "*I think the robot is very frightening for the average person who does not come across robotics on a daily basis."* It is obvious that acceptability of this kind of robot is something that respondents did not easily agree upon and that when designing multi-purpose robotics, asking citizens can provide valuable input that can help to increase acceptability of the particular solution.

4.9 X-Drive Robots

This report presents the results of a collaboration between X-Drive Robotics (DK) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

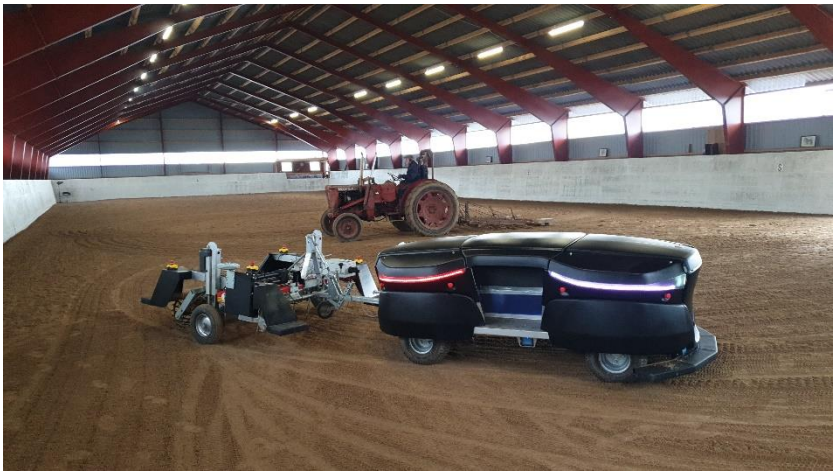
The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.9.1 Presentation

X-drive has developed a robot for pulling tools. A machine that aims at replacing all working situations which involves a person sitting on a tractor, pulling any kind of tool.

The robot is autonomous. That means it drives on a pre-set route, fulfilling the desired tasks, avoiding obstacles underway, and goes back to the charging station when needed. It is driven by electric motors, and thus is CO2-neutral, in contrast to regular tractors.

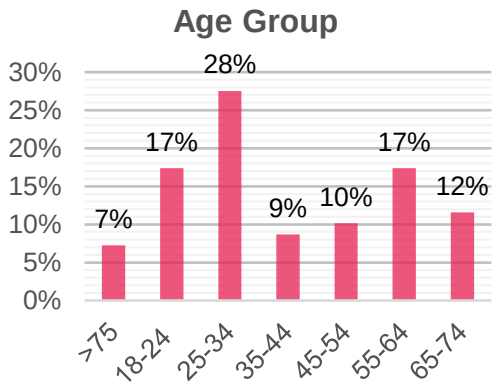


Currently the robot is used to maintain riding arenas by trimming, levelling and drumming the surface. But the company has the ambition to use the robot in many other contexts.

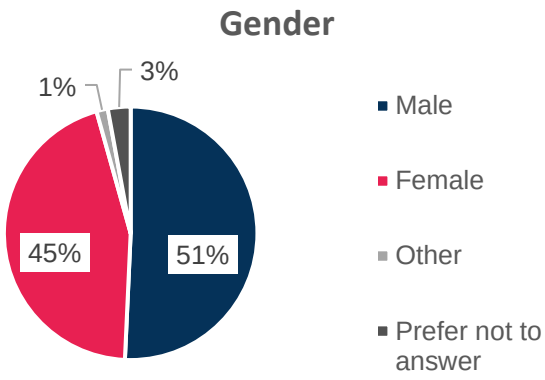
In our society today, we have plenty of jobs that are monotonous, hazardous, and physically demanding. The future vision is that the robot replaces human labour in these scenarios, thereby freeing up manpower and preserving the health of workers.

4.9.2 Demographics

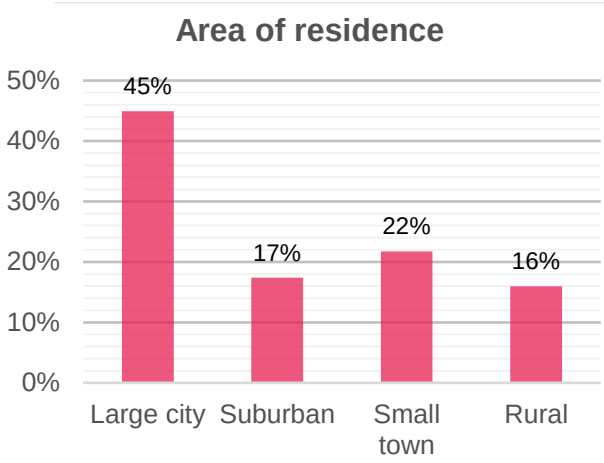
The activity engaged a total of 70 respondents from a total of at least 9 countries. Respondents that were engaged in the activity were quite broadly distributed. However, most of the respondents answered that they were part of the age group between 25-34 years old. This was followed by ages 55-64 and 18-24 each with 17%. The full distribution of the ages of respondents can be seen in the figure below:

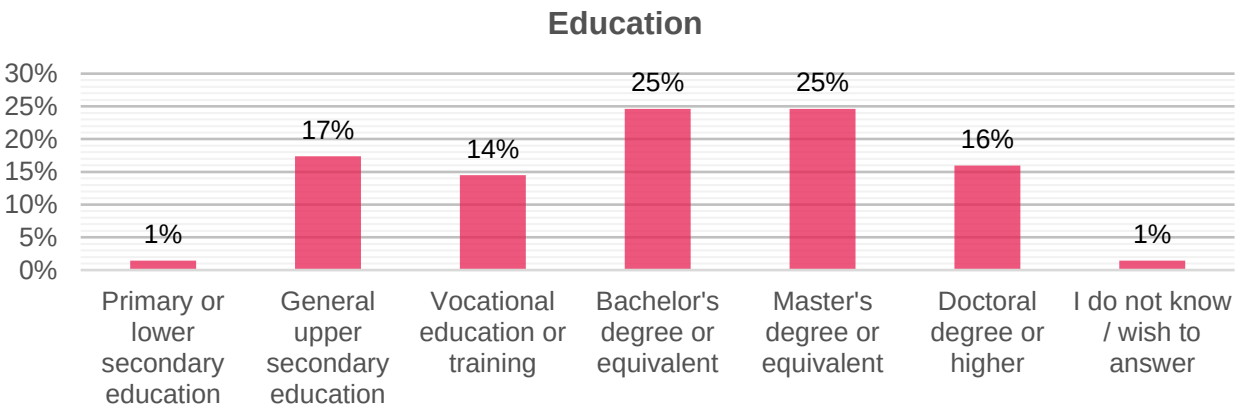


Respondents came mainly from Denmark, making up 29% of the total answers. Lithuania, France and Norway were also quite well represented. Gender distribution was ample, but with slightly more male participants than female.



Distribution of the respondents' area of residence was somewhat more skewed. Almost half of the respondents that were engaged in the activity answered that they lived in a large city. Following this, the rest of the respondents were distributed fairly equally between suburban areas, small towns and finally rural areas. Respondents were generally quite highly educated. About half of those who were engaged in the activity answered that they held a bachelor's degree or equivalent or a master's degree or equivalent. The overview of the distribution of the rest of the respondents can be seen in the figure below:



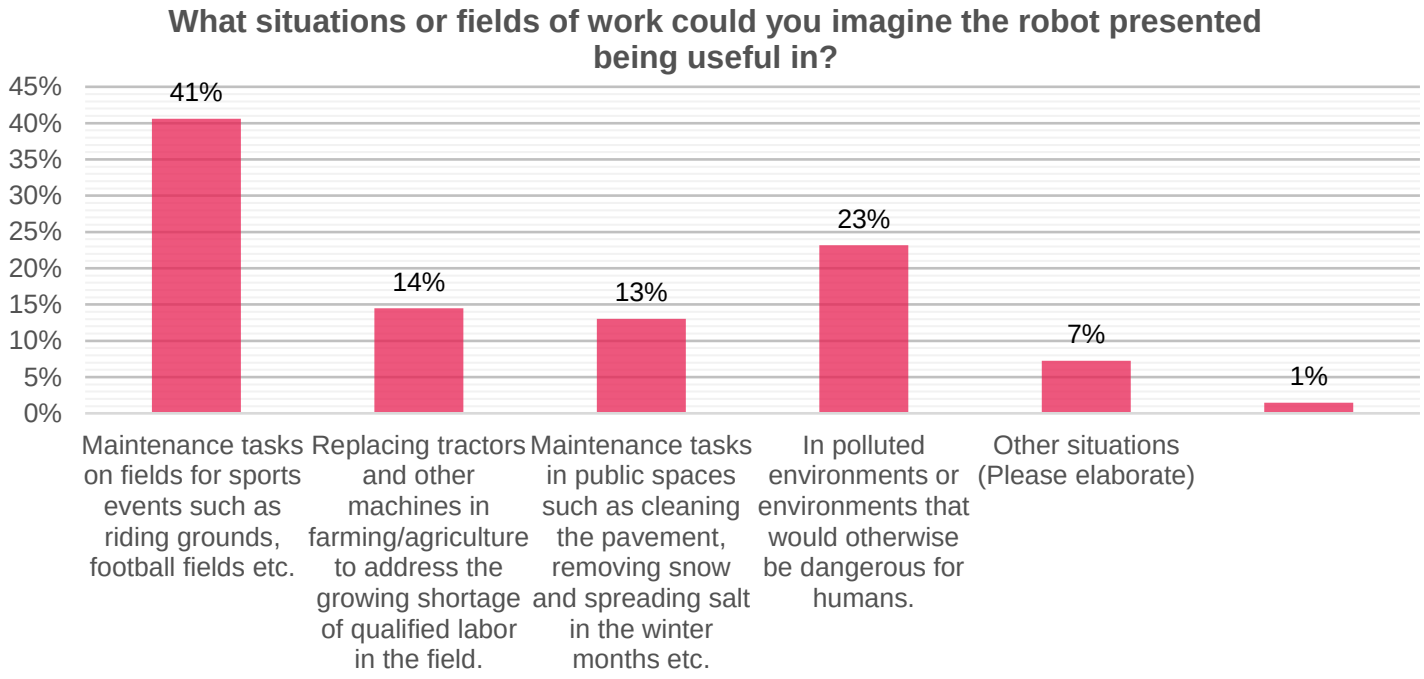


These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.9.3 Survey Results

Question 1: What situations or fields of work could you imagine the robot presented being useful in?

To explore the business opportunities for X-drive respondents were asked to consider which of the following areas that they could imagine the robot presented being useful in. Here, the majority of answers were directed towards using the robot for maintenance tasks such as fields for sporting events, football fields and so forth. Many also considered the robot to be useful in areas that might otherwise be dangerous to humans, such as areas with high pollution or other dangerous elements. The complete distribution of answers can be seen in the figure below:



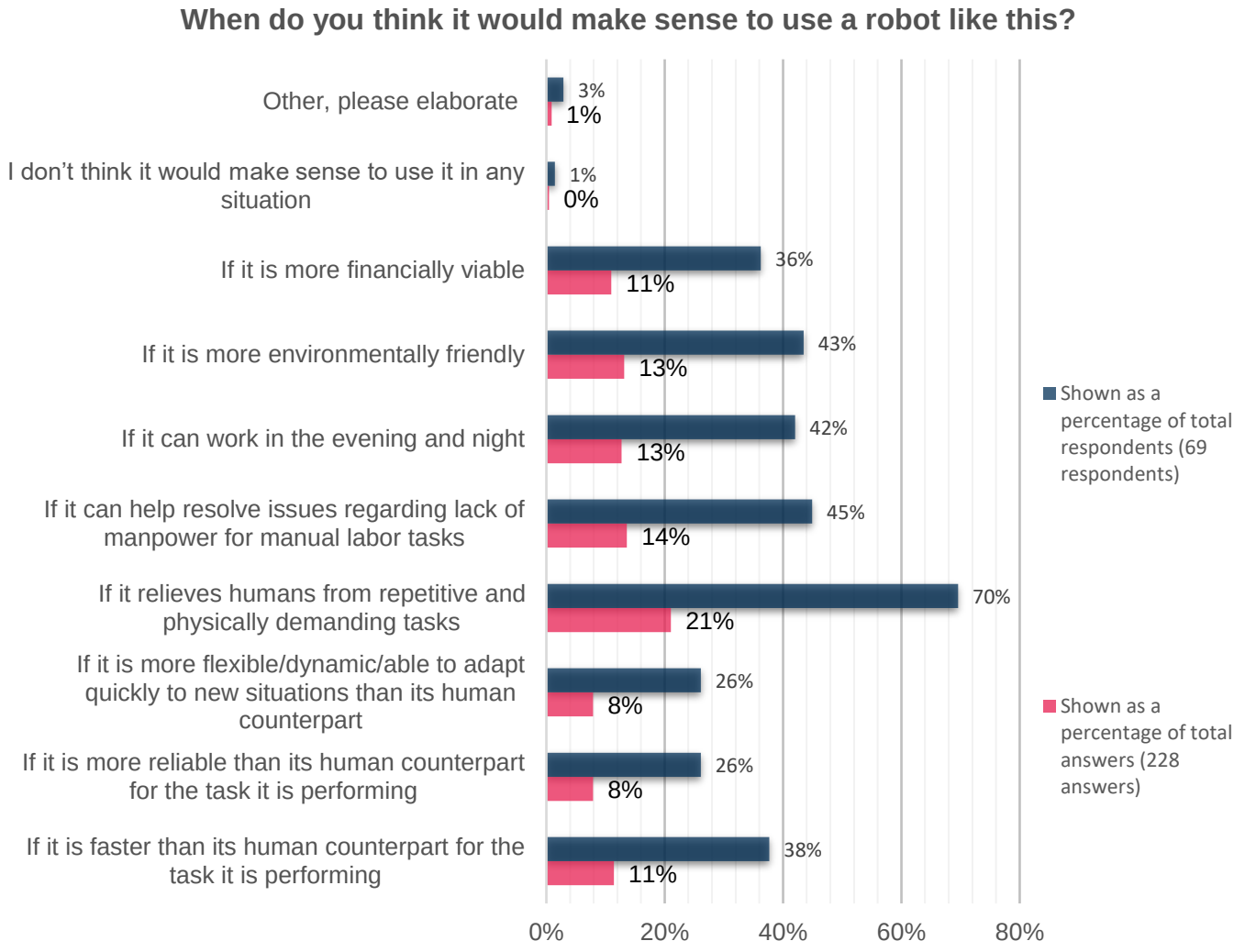
This question was limited to one answer, as such a limitation would make the respondents thoroughly consider their choice. There were many, however, that elaborated on this question by saying that they think all of the areas mentioned would be suitable for a robot

A focus group interview conducted among the participants of the Robotex International festival reveals that *"Such machines on the fields do not pose any danger, and I have no great enthusiasm either. There you need machines that do the work."*

of this type. One respondent mentioned, however, that some of the areas mentioned might be too difficult for the robot at its current stage, and argued that: *"Some tasks mentioned above may be too difficult for the robot, but cutting the grass or leveling the field seems feasible".* However, it is still evident that many saw a great potential in the robot and that they could imagine it being very useful in many different application areas.

Question 2: When do you think it would make sense to use a robot like this?

Respondents were asked to consider areas of use where they thought it would make sense to use a robot of this type. Respondents could choose as many of the answers as they wanted to. There was a broad division of answers to the question, but one answer received somewhat more attention than the others. The complete overview of how respondents answered, can be seen in the figure below:



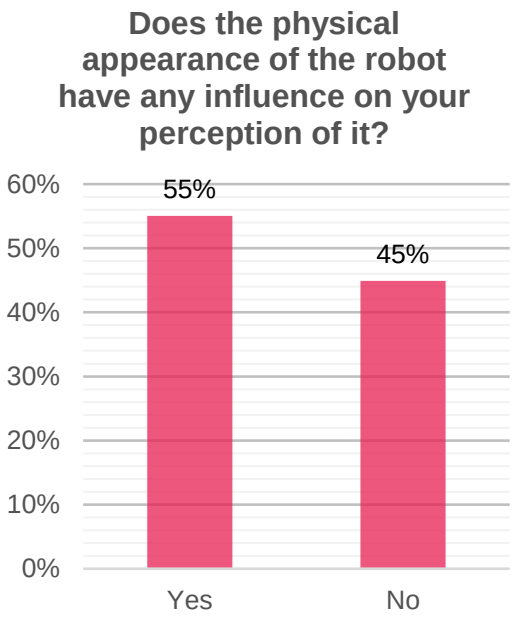
As can be seen, almost every area has received attention, indicating that respondents found all the possible uses of the robot to be something worthwhile to consider. The extra

attention to using the robot to relieve humans from repetitive and physically demanding tasks is interesting and points towards a want and a need for technology that frees workers from these kinds of tasks. Respondents mention that use of such a robot will be tied to the financial costs. One respondent mention that even though a solution such as this will not necessarily be cheaper than employing a human workforce but that it comes with several upshots to the implementation of this type of robot, such as the ability to work and perform tasks during the night, which can help reduce downtime of facilities such as stables, golf fields and many more.

Question 3: Does the physical appearance of the robot have any influence on your perception of it?

When respondents were asked to consider whether the physical appearance of the robot was important to their perception of it, the answer was somewhat evenly divided.

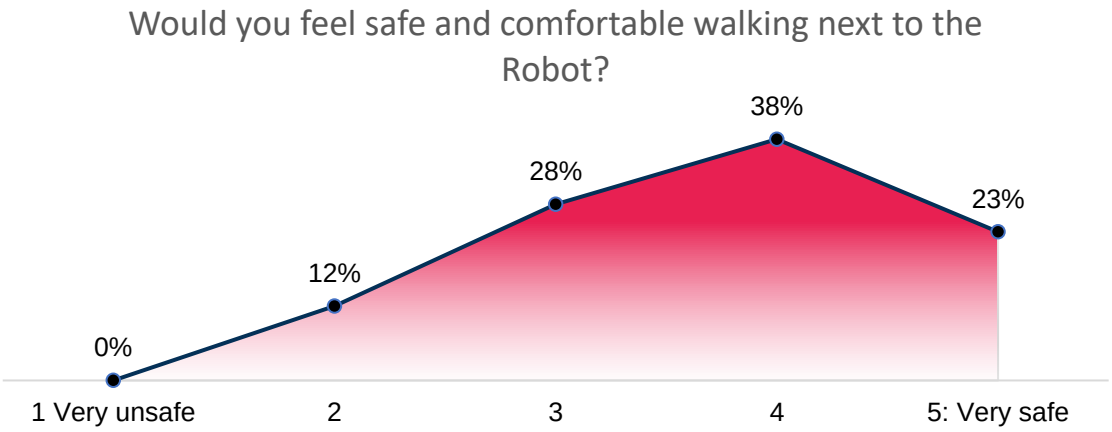
A little over half of the respondents answered 'Yes' to the question. This can be seen as a small indication that for many, looks do matter - to a certain degree. Many respondents chose to elaborate on their answer. Here it was mentioned by some that if the robot is able to do its job and do it well, looks are subordinate and one respondent notes that effectiveness prevails in cases like this while another notes that on first intuition it might seem important but that when reflecting on it, looks might not be that important. One respondent even mentions that as long as it is able to do a job better and more effectively than its human counterparts the robot could look terrible, and it would not matter.



For those that did consider looks to be important, answers were based on a couple of different assumptions. Some emphasised the fact that if the robot is intended to roam and work in various public spaces it should be nice to look at. One respondent mentioned that the looks of robots in general will be very important in the long run, arguing that when it comes to the look of a robot that moves and works next to people then *"[...] their appearance will have a big impact on whether they are trusted".* Another mentioned how a "*funny"* or "*relatable"* name combined with a familiar look, such as that of a "*small car"* or a "*lawn mower"* would make them consider the robot more like something akin to a public employee.

Question 4: Imagine that you encountered the robot on the sidewalk, cleaning the pavement or at the riding grounds. Would you feel safe and comfortable walking next to the robot?

When asked about a specific situation in which respondents were to consider an encounter with the robot and whether they would feel safe in such an event, many answered that they would feel quite safe. Respondents were asked to place their answers on a 5-point scale ranging from ‘very unsafe’ to ‘very safe’.



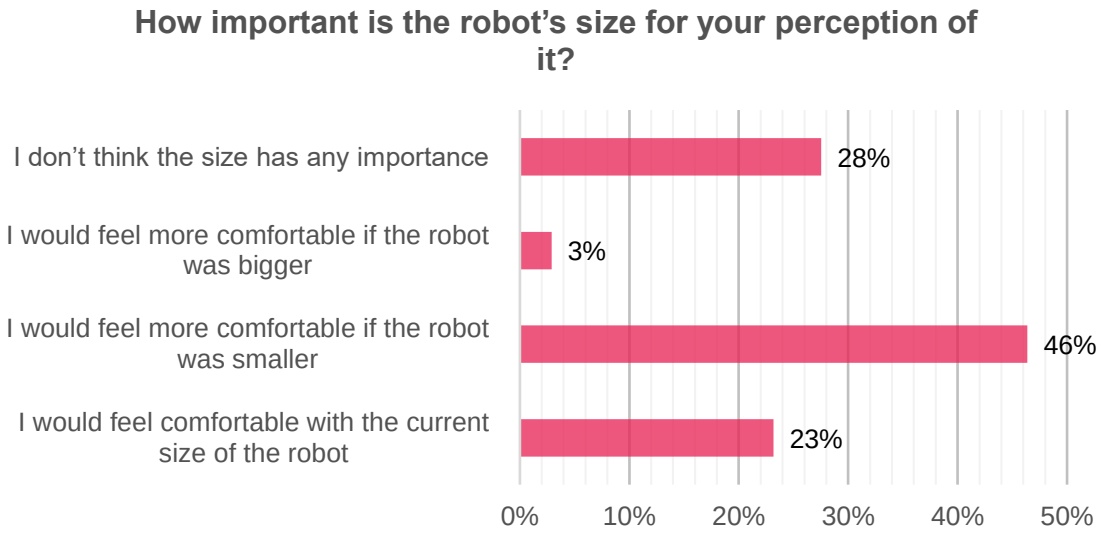
None of the respondents answered that they would feel very unsafe in this situation. On the contrary, many of the respondents answered that they would indeed feel quite safe and comfortable, with 37% placing their answer on the second highest point of the scale, and 23% answered ‘very safe’. These answers can be seen as an indication that respondents generally consider encounters with this type of robot to be unproblematic and quite safe. It is important to note that respondents gave these answers without being informed about the technical safety specifications of the robot and it is plausible that, had respondents known the full scope of the safety measures of the robot, answers would perhaps be even more positive.

Many respondents also made use of the option to elaborate on their answers and here, many positive additions could be found. There are some respondents that mention how current use of robotic technology has already made them accustomed to being in the vicinity of large, automated technology and that they therefore feel somewhat relaxed about the prospect of increasing use and implementation of the technology. However, some respondents still thought that there is a need for proper testing and documentation of said testing, so that information about the solution is widely available to the public. Further, respondents highlight rigorous testing of the robot before it is put to use and that the robot is able to give clear indications of what it is doing (where it is going, if it is about to start or stop etc.) as a mean to increasing trust.

Many respondents also placed their answers in the middle, indicating that they were unable to form a specific opinion regarding the question. Some of the worries that were mentioned by respondents were concerns with the robot running into people while it is working. A respondent mentioned that they were concerned about the robot driving into children or people with reduced mobility - or simply that it would run over one's foot. Another mentioned that the robot should come to a full stop when encountering an obstacle.

Question 5: How important is the robot's size for your perception of it?

As the X-drive robot is a rather large robot we wanted to explore whether the size of the robot influenced their perception of it in regard to safety and trustworthiness.



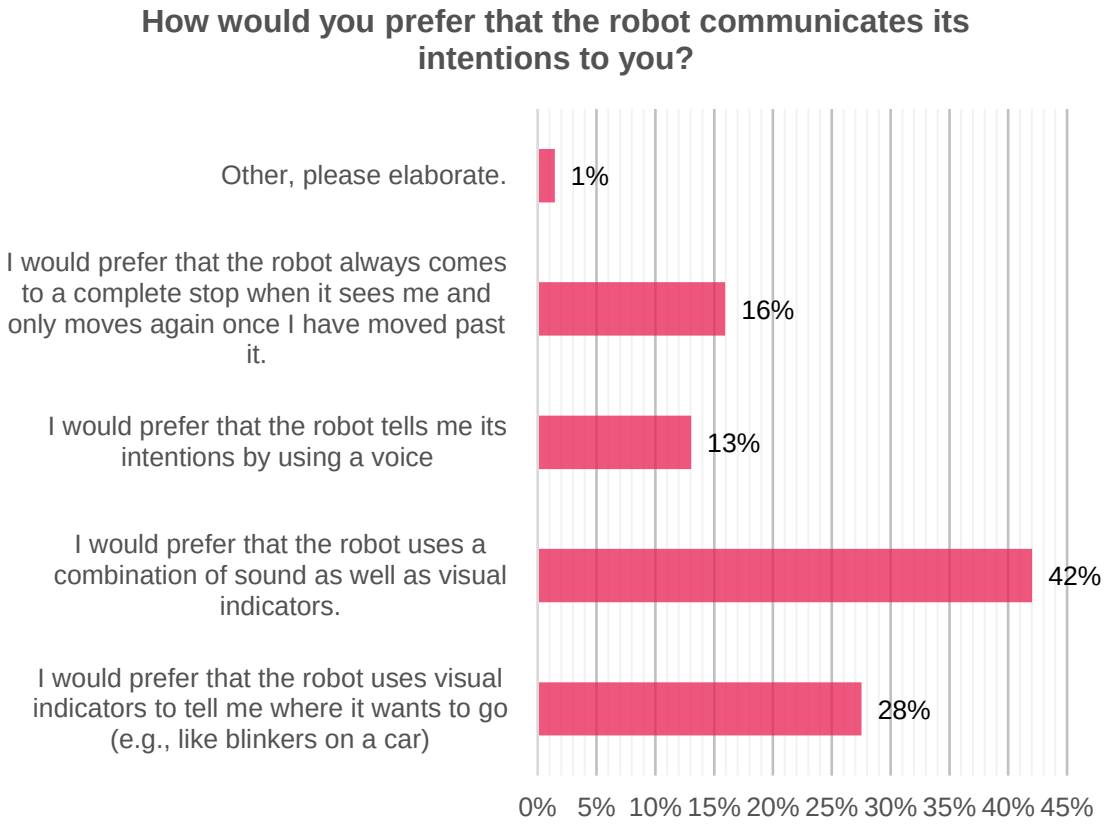
When asked about the size of the robot, and whether this was important for the respondents' perception of it, there was a majority of respondents that stated that they would feel better if the robot was smaller in size. This group made up almost half of the answer to this question with 46% of the answers. The other half were divided quite evenly between respondents stating that they were comfortable with the size of the robot, accounting for 23% while respondents that did not consider size to be something that were of importance accounted for 27%. Only 2% answered that they would feel more comfortable around the robot if it was bigger.

The distribution of answers seems to suggest a tendency to be less positive towards robots that are large in size. There can be many different and equally plausible explanations as to why this might be the case, for many it might be a combination of size and automation that causes them to be withholding or worried.

A focus group interview conducted among participants at the Robotex International festival reveals that the size of autonomous machines in the field is important, and the lack of a driver or operator makes the robot unsafe. *"Okay, as soon as there is a slightly larger machine that is not controlled by a human, then safety actually becomes important immediately. I would like to make sure that they do not run over anyone there."*

Question 6: How would you prefer that the robot communicates its intentions to you?

Respondents were then asked to consider how they would like the robot to communicate with them - for example if encountered on the street or in a work environment. Respondents were only able to choose one answer to this question. The distribution of the answers can be seen in the table below:



As can be seen from the table, most respondents were interested in equipping the robot with communicative devices that consist of a combination of sound and visual indication. A fair amount of respondents were also interested in the robot just using visual indicators, like blinkers on a car, to inform them of its intentions. Lastly some were interested in the robot using a voice while some also would prefer that the robot always comes to a complete stop when encountering humans and that it does not start to move before they have moved past it.

Several respondents also chose to elaborate on their answers. Here, it can be seen that there is a clear emphasis on the robot being able to give clear indications to the humans around it. One respondent mentions that it could be equipped with: *"sound if you get too close"* while other respondents mentioned that: *"In particular, I would like it to indicate verbally when it detects someone's presence to ensure that it sees me."* And: *"The robot has to tell me where it's going and stop so we don't "bump" into each other."*

Another respondent mentions that it is also very important that we do not forget that there are blind, deaf and otherwise disabled people in the world and that it is important that we do not forget to make technology with these people in mind, in order to make future robotics and technology as inclusive as possible.

Question 7: Are there any situations or fields of work you DON'T think a robot such as this should be used in?

Respondents were also asked to write an example of where they thought that it would not be a good idea to use the robot to explore where a potential implementation of the robot might be challenging regarding the societal acceptance of a robot.

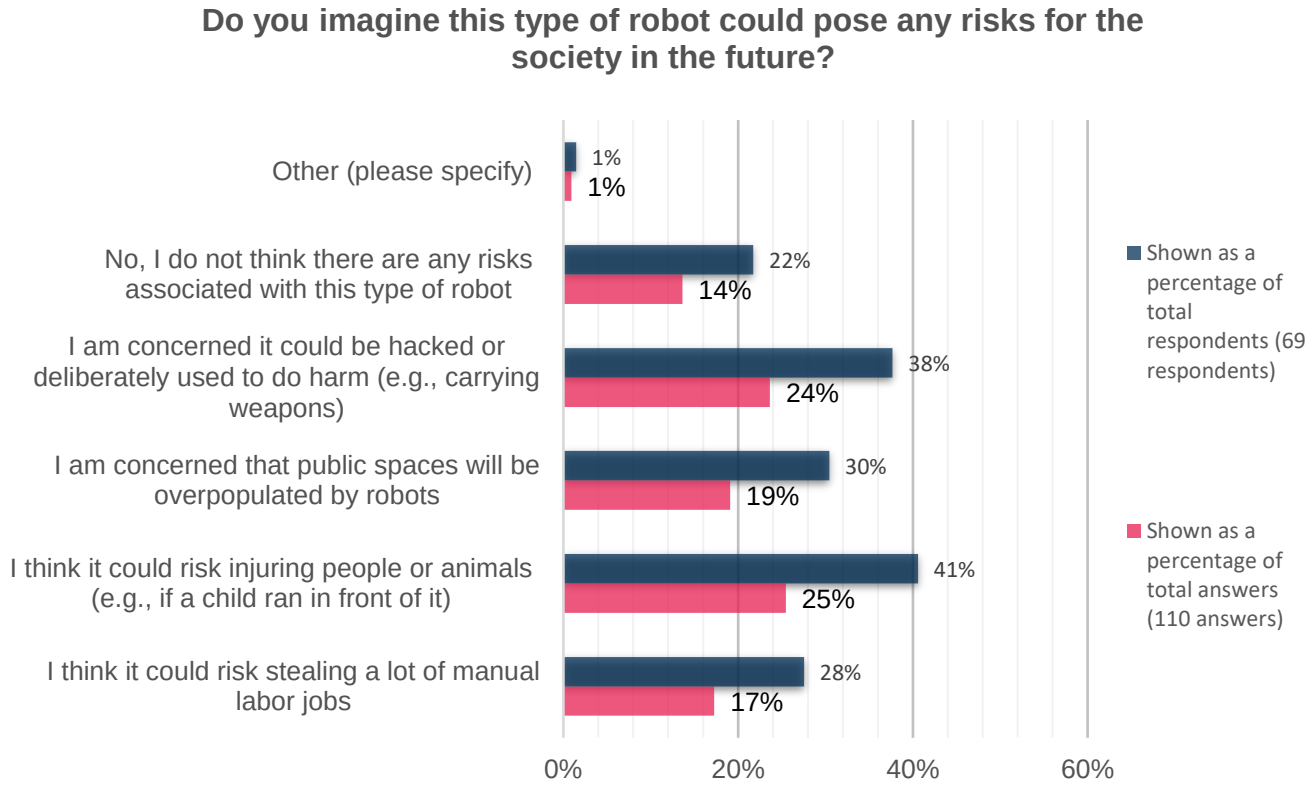
Here, there was a general aversion towards using the robot in areas where children are present. These aversions were generally based on the fact that respondents feared that the robot might potentially endanger smaller children, partially due to its size. Many respondents also mentioned a general fear that a robot such as this might endanger or harm animals or wildlife.

Respondents were also generally against using the robot in situations where it potentially performs worse than its human counterparts or where it is not financially viable. Some situations where respondents considered the robot to be unable to perform on par with humans were mainly areas lacking a plain/fixed surface - for example a rugged and uneven construction site littered with obstacles, or other non-flat areas.

Question 8: Do you imagine this type of robot could pose any risks for the society in the future?

Here, respondents were able to choose multiple answers and looking at the distribution of the answers, they are fairly evenly distributed.

There were many who thought that the robot could pose a risk when it comes to injuring people or animals, for example if a child ran in front of the robot. There were also a lot of



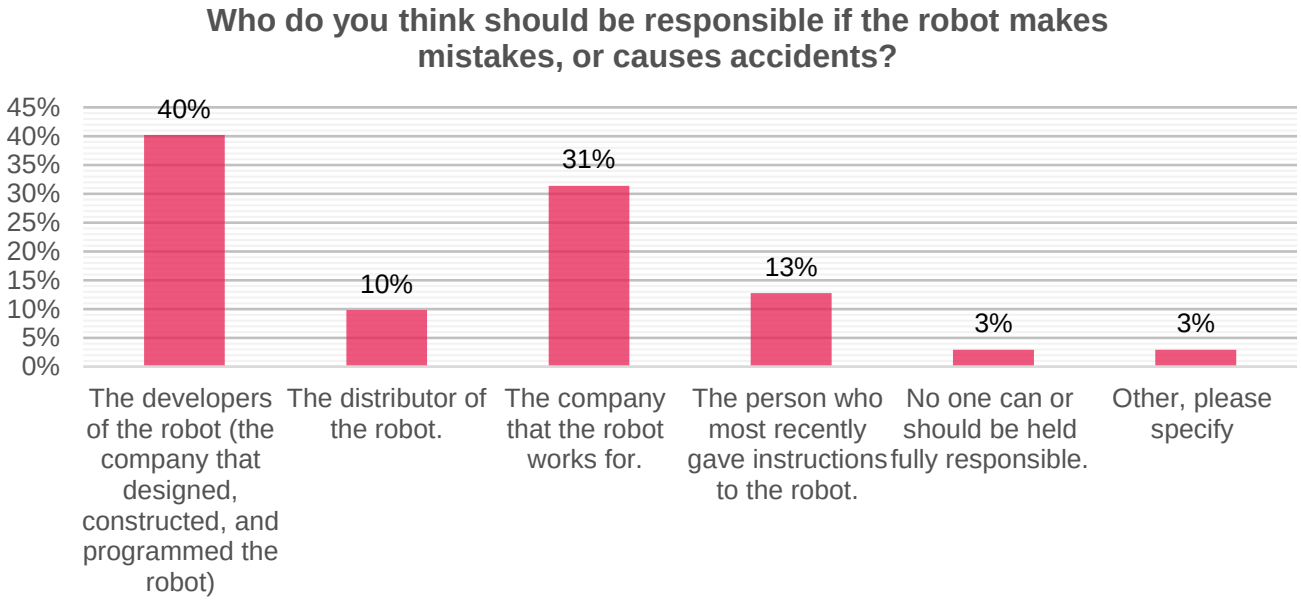
respondents that were concerned about the robot being hacked and deliberately used to do harm. The graph below shows the distribution of answers to the question:

However, even though many did have concerns about risks the robot could pose to society, there were also many that did not think that there are any risks associated with this type of robot and one respondent said that there would be: *"No more risk than with a horse or tractor"*. And as with implementation of new technology all these worries are something that needs to be managed.

Question 9: Who do you think should be responsible if the robot makes mistakes, or causes accidents?

To get a better understanding of people's expectations towards responsibility the respondents were asked who they thought should be responsible if the robot makes mistakes or causes accidents. A question such as this will undoubtedly be difficult to answer at face value. However, it might prompt some respondents to consider what kind of legal ramifications there might be associated with the uptake of this type of robotic technology. Here, respondents were asked to choose the two main responsible actors.

Many respondents answered that they considered the developers of the robot to be the main actors responsible if the robot makes mistakes or causes accidents. This answer was followed by several respondents answering that the main responsible actor should be the company that the robot works for. The distribution of answers can be seen in the in the graph below:



Naturally, this is a difficult question and not one that can be easily answered. This is also highlighted by respondents in the elaborative answers, emphasizing that it is something that depends on the specific situation or case. There are also several respondents who mentioned that responsibility in cases of harm or mistakes must be considered as a shared responsibility between different actors. One respondent also mentioned how cases where the robot causes harm or makes mistakes can become very problematic in cases without a well-defined division of responsibility. And, in general, questions such

as this are seen as one of the most important questions to ask with regards to development of new robotic technology, but at the same time one of the most difficult.

4.10 DARKO

This report presents the results of a collaboration between the project DARKO and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

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What is the Robotics4EU project?

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Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

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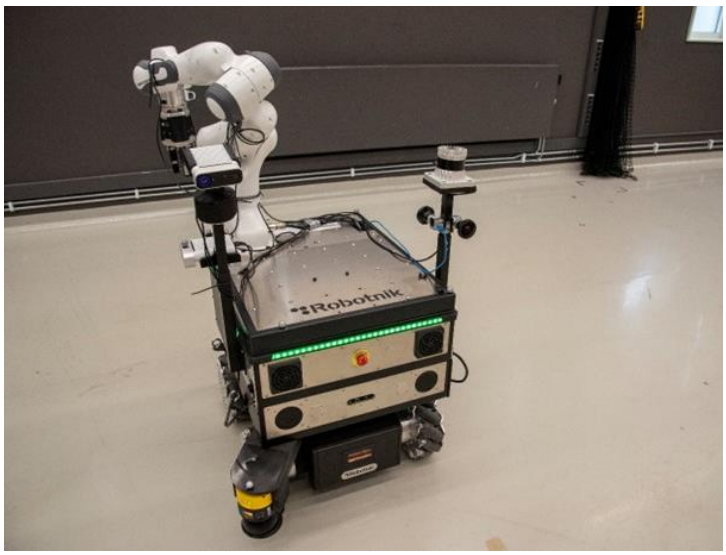
manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.10.1 Presentation

DARKO is a European research project that develops new methods for robots that should work efficiently together with people, particularly in logistics and production.

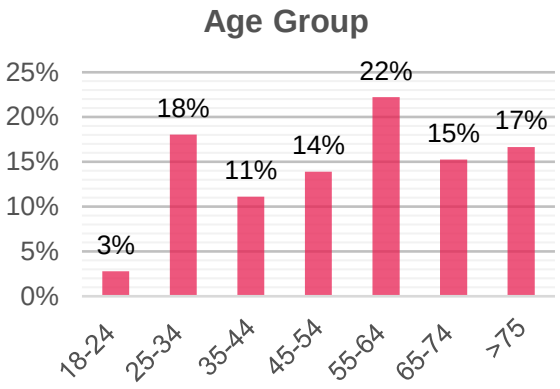
The central theme for the DARKO robot is efficiency. The robot should navigate efficiently around people – comfortably driving among them in a way that doesn't disturb its coworkers, while still reaching its goals on time. This includes being able to efficiently communicate its intents to the people around it, as well as recognizing their intents.



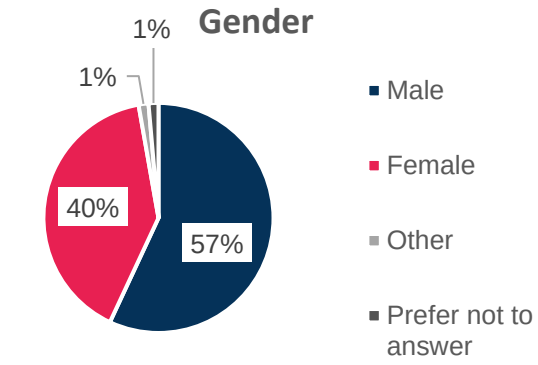
The robot should be efficient at handling objects – which also includes throwing an object into the target tray, rather than driving there to drop the object. Throwing will save both time and energy. The robot should also be easy for anyone to install at a new site – increasing efficiency by reducing the work effort and modifications that might otherwise be needed to adapt the environment for the robot.

4.10.2 Demographics

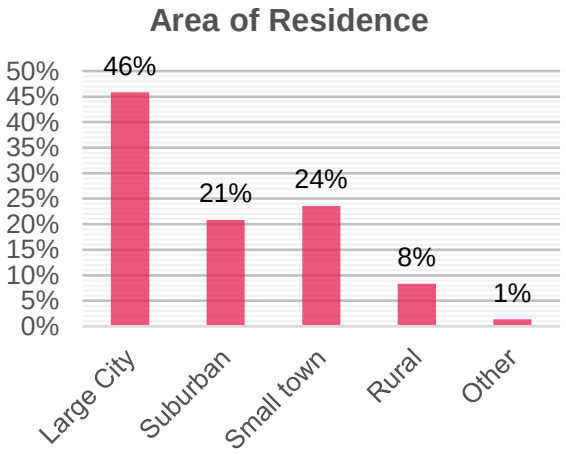
72 respondents answered the online consultation. The highest representation of citizens was the age group 55-64, accounting for 22%. While the distribution of the other age groups was divided closer to each other. The younger generation (18-24) and younger generations from 18-24 years were not as well represented.



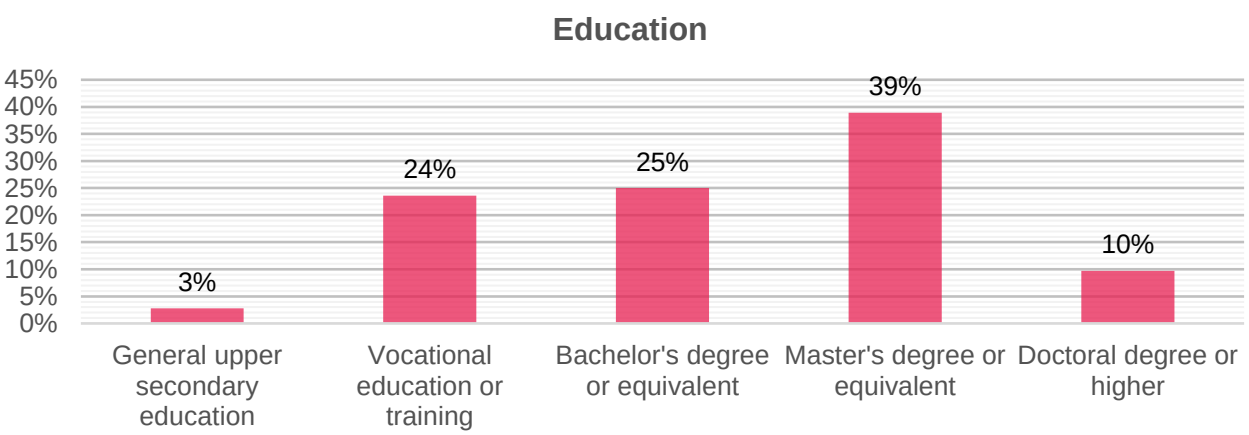
The gender distribution of citizens was leaning towards a little larger representation of male respondents, with male participants accounting for 57% and female participants accounting for 40%. The remaining either answered 'other' or did not specify their gender.



Looking at distribution of areas of residence, a total of 46% of the respondents answered that they lived in a large city. The second most chosen option was small town with a total of 24%, these were followed by suburban with 21% and rural with 8%. The remaining 1 % entered 'other' as their area of residence. These results reflect the expectations when taking the distribution of the age groups into account.



The educational level of the respondents was high with 39 % having a master's degree, a quarter of the respondents having finished a bachelor's degree, and 24 % had a vocational education or training. Every tenth of the respondents had a doctoral degree. The last 3 % had a general upper secondary degree.



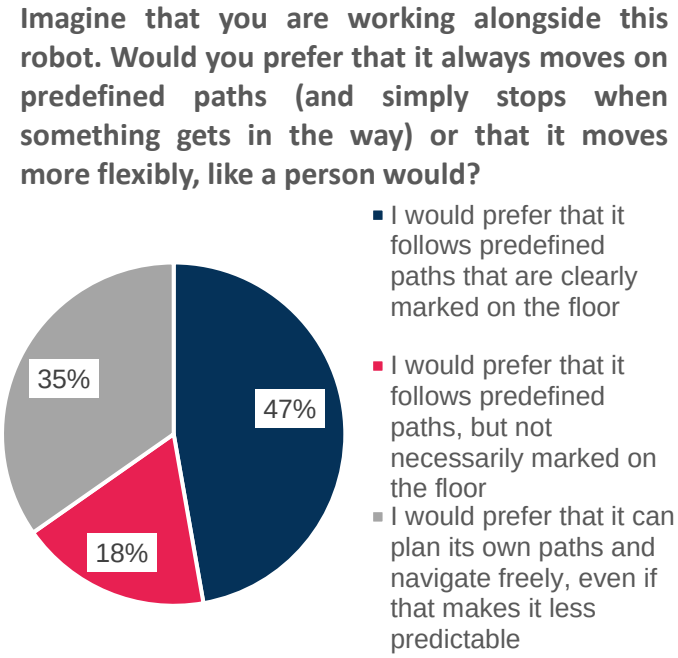
The survey received answers from at least 8 different countries, with Denmark coming in at the top with 44% of the total answers. Following this, Lithuania accounted for 12%, followed by both France and Norway with 10% and Estonia, Isle of Man, Latvia and Portugal each representing 1% each. 18% of respondents chose not to disclose from which country they came. Citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe.

These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robot solution.

4.10.3 Survey Results

Question 1: Imagine that you are working alongside this robot. Would you prefer that it always moves on predefined paths (and simply stops when something gets in the way) or that it moves more flexibly, like a person would?

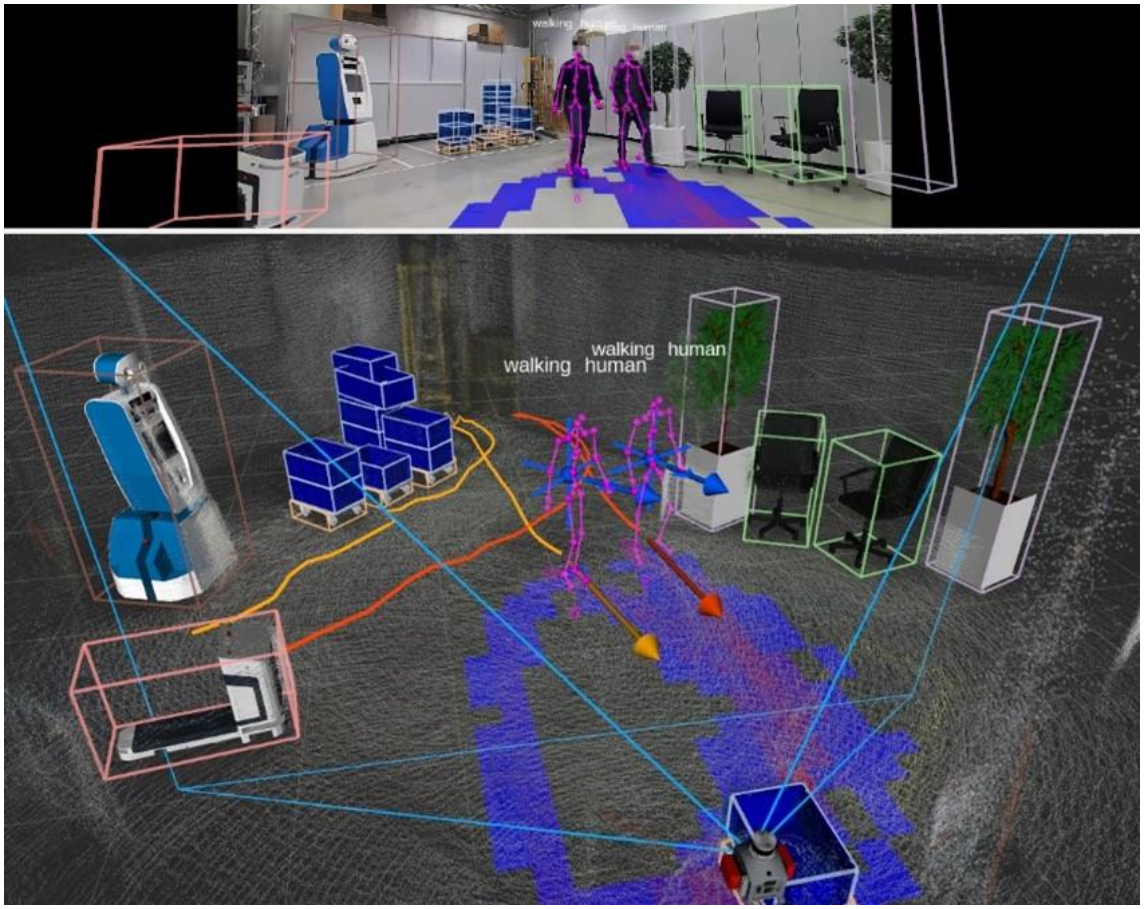
Almost half of the respondents would prefer the robot to follow predefined paths clearly marked on the floor. This might be more predictable when working with the robot, and you do not have to wait for the robot to navigate around the workers. 35 % of the respondents would prefer for the robot to plan its paths and navigate freely, even if it's less predictable. The last 18 % of the respondents would prefer for the robot to follow a predefined path, but these do not necessarily have to be marked on the floor.



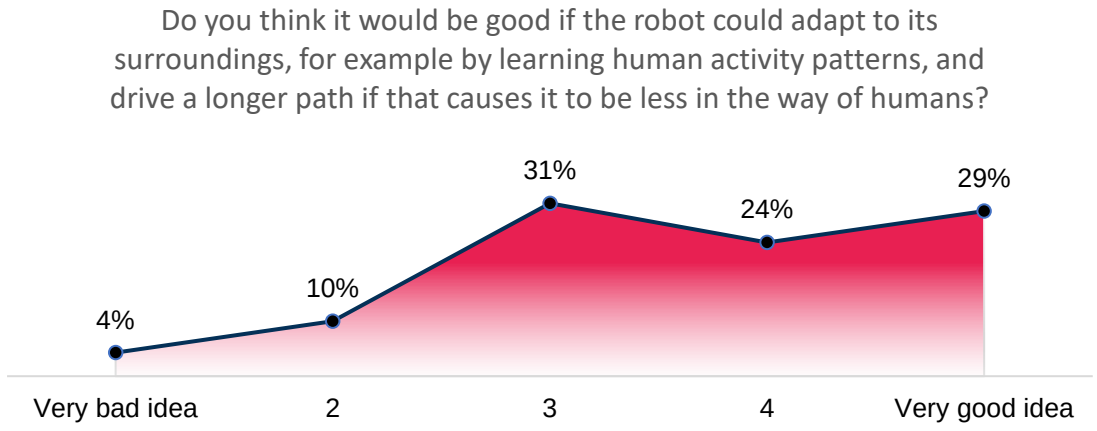
Looking at the elaborated answers there is a wide variety of answers to whether the robot should follow predefined paths for security reasons, and to wanting the robot to be as advanced as possible. Some respondents who choose predefined paths, have elaborated their answers, and understand predictable paths as being safer and mitigating the risks of injuries, while one respondent suggests having the robot move on a predefined path but with the technological advancement to move around obstacles. Other respondents expressed how having a robot following predefined paths is at a too low level of ambition as these robots already exist. So, to be in competition with existing robots the robot should be able to move freely and have a higher technological level as this is expressed as more effective by some of the respondents. This wide range of contrasts within the answers emphasises how different expectations to/of technology exist among the respondents.

Question 2: Do you think it would be good if the robot could adapt to its surroundings, for example by learning human activity patterns, and drive a longer path if that causes it to be less in the way of humans?

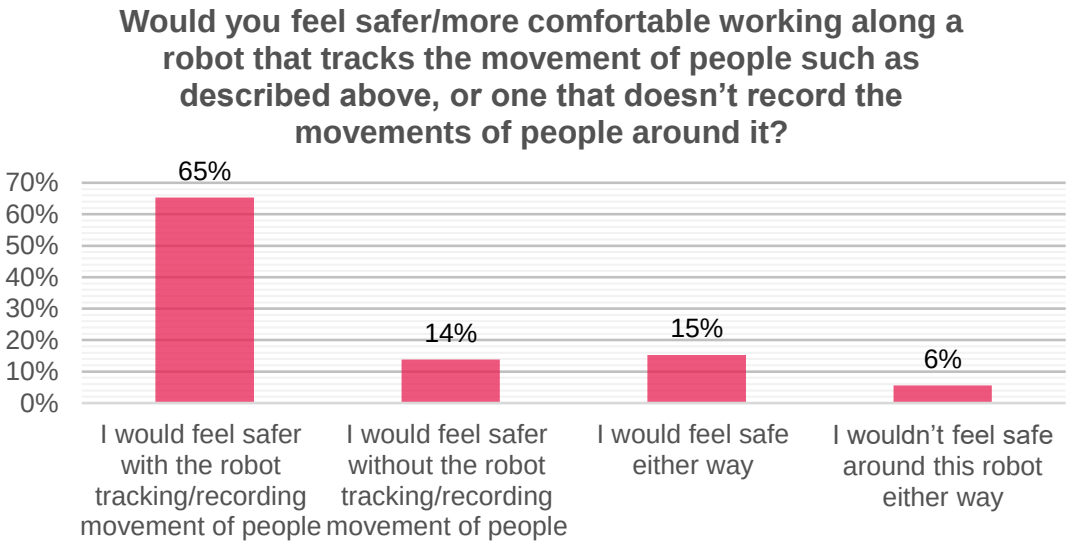
To explore whether the respondents thought it would be a good idea for the robot to adapt to its surroundings they were presented with the following images showcasing how the robot can perform tracking through cameras to detect people around it and predict how they will move. The purpose of this is to increase safety for the people around it, and to interact more naturally with them.



The respondents were asked to answer on a 5-point scale whether they thought it would be a good idea or a bad idea. More than half of the respondents are positive to the idea. About a third of the respondents choose the middle ground which can be an indication that they might be unsure about the idea of the robot adapting or that they are having difficulties understanding the question or technology presented. Only 4 % think it's a bad idea and 10 % are less keen to the idea. The results can be supported by the hesitations towards the robot in elaborative answers expressed in question 1.



Question 3: Would you feel safer/more comfortable working along a robot that tracks the movement of people such as described above, or one that doesn't record the movements of people around it?



65 % of the respondents said they would feel safer with the robot tracking/recording movement of people. This result can be supported by the former question where more than half of the respondents thought it was a good idea for the robot to adapt to its surroundings. Within the elaborated two respondents emphasised why they prefer to have the robot adapting to its surroundings: *"It increases the reliability of the robot but also it will be able to adapt to us and not the reverse"* and *"So I know that the robot can at least partially adapt to me, and therefore that I must not do all the work of adaptation".*

14 % of the respondents would feel safer without the robot tracking/recording movement of people. Some of the respondents have elaborated on why they do not feel safer with tracking technology: *"[…] Personally, in the situation of the photo I would not just feel comfortable. Being against it, if the robot is heavy or can grind my hand, I will not feel safe".* And another respondent expressed concerns regarding data protection: that *"there is a risk of personal registration".* The comment highlights the complications that can occur when having the robot track/record its surroundings, and to why some might feel uncomfortable with the management of the data being collected. However, another respondent in favour of the tracking technology argues that *"[…] The privacy issues implied in the question can be addressed independently."*

There are also a variety of comments concerned of the robot's technical ability to track the movement of people, and how well it can do this: *People are different, and are often replaced in workplace so it can be complicated to learn what 'people' do " and "I don't think humans are so programmed that we all act the same and I don't think we're at a level of development where it can succeed with a robot."* For some there is a mistrust in the technology being mature enough to adapt to complex environments and unpredictable movements. This is a barrier worth paying attention to, because even though the technology might be ready there can still be a lack of trust from humans.

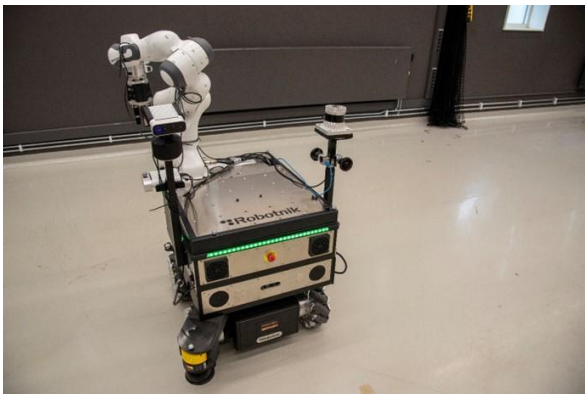
Another respondent mentions concerns regarding the technical maturity level: “I don't think man is so programmed so it acts the same and I don't think we're at a level of development where it can succeed with a robot”.

15% of the respondents would feel safe either way. This result can reflect how the question can be difficult for the respondents to imagine a scenario of them working along with the robot, and why they might not have a strong opinion towards a robot tracking movement. Lastly only 6 % of the respondents said they won’t feel safe around the robot either way.

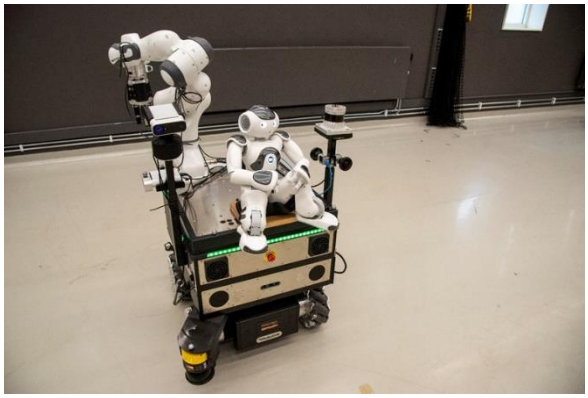
Testing different levels of communication

To explore the use of different levels of communication the respondents were presented to two different prototypes of the robot and asked to react to three of the same statements.

The first robot presented was a picture of the current appearance of the robot in the developing stage it is in now. The second robot presented was a picture of the same robot but now with the humanoid looking robot NAO (from SoftBank Robotics) on top of the DARKO robot. This was done to test whether some of the functionalities of a humanoid looking robot can have a positive impact on peoples first impression of a robot or if it is indifferent to their feelings towards it. The respondents were also informed that they should be aware that the addition of NAO was only to test a concept and not necessarily how the developers envision the final product.



Robot 1 in its current appearance



Robot 2 with a humanoid robot

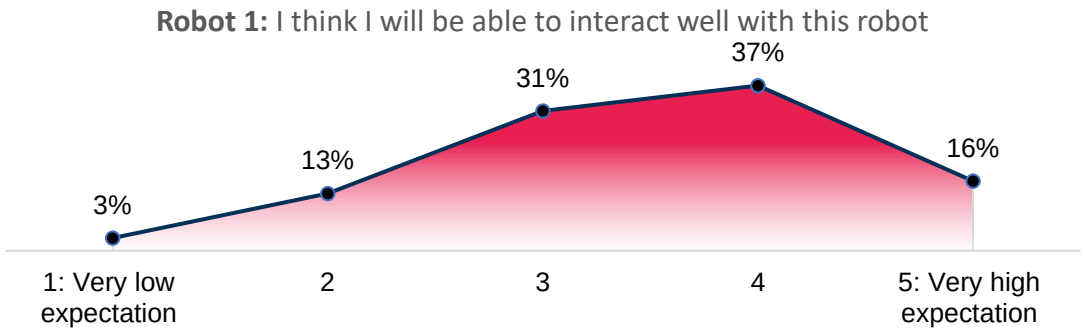
The respondents were asked to react to three statements indicating on a scale from 1-5 how very high or very low they expected to do the following:

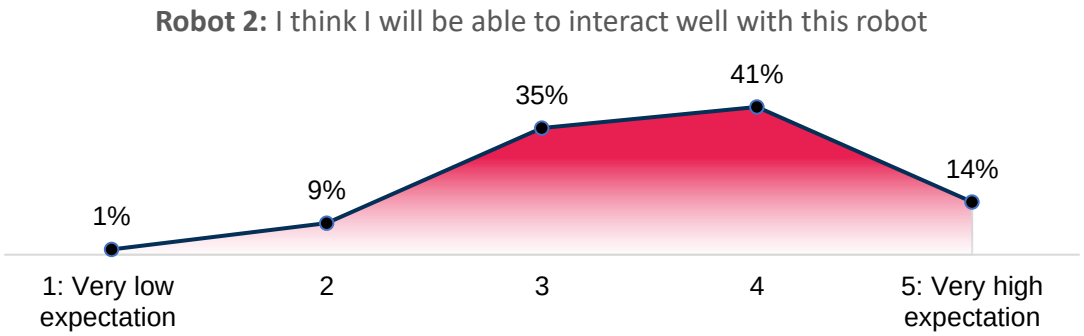
1) **I think I will be able to interact well with this robot**
2) **I would find this robot trustworthy**
3) **I would like to work alongside this robot**

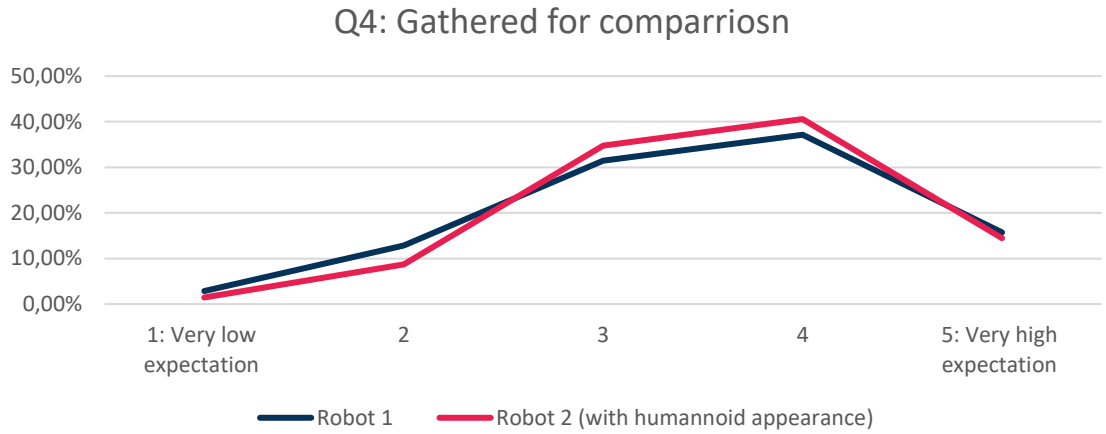
In the survey the respondents were first asked the above questions for the first robot and then they were presented with the second picture of the robot and asked the same questions again. In the report, we will however present one question at a time and then compare the responses of the two robots.

Question 4: I think I will be able to interact well with this robot

To explore the use of different levels of communication when interacting with the robot, the respondents were asked to indicate on a scale from 1-5 how very high or very low they expected to interact well with the robot. Below you can see the results from the two robots presented.





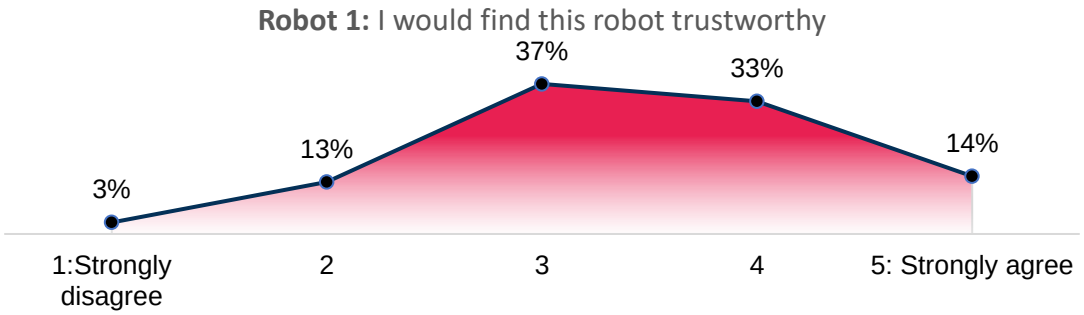


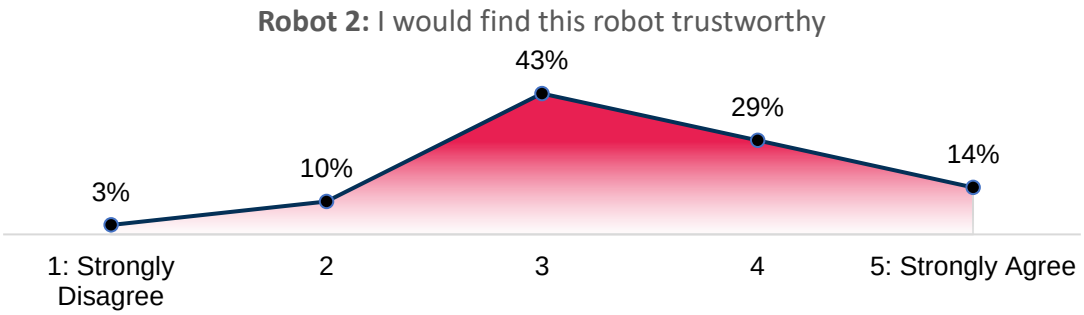
As can be seen from the comparison there's only a small difference in the respondents' answers. Robot 2 with the humanoid appearance scores marginally higher having fewer people answer that they had low or very low expectations towards interacting well with the robot but at the same time it also scores slightly lower in the other end of the scale with the very high expectations. Because the margin is so small and taking the number

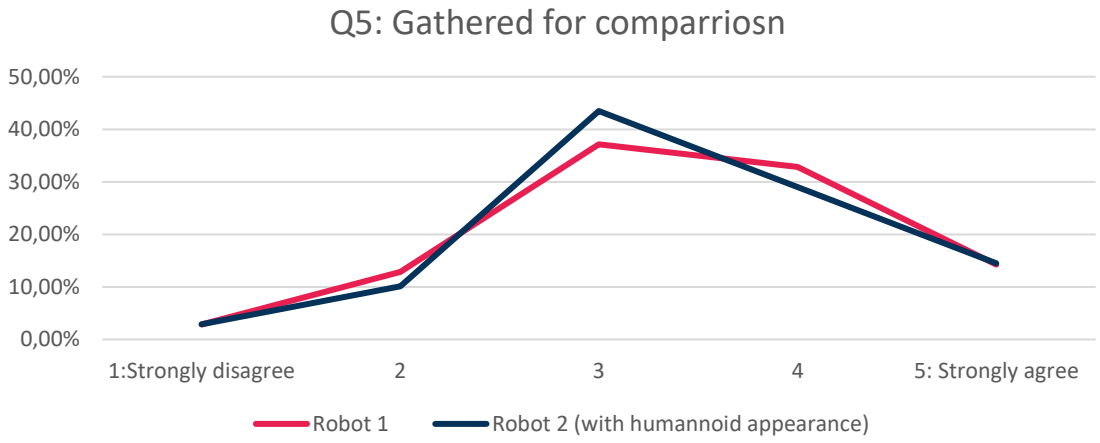
of respondents into consideration the result implies that the respondents generally are positive towards interacting with the robot regardless of the humanoid features brought by the NAO robot.

Question 5: I would find the robot trustworthy

The respondents were asked to enter on a scale from 1-5 how strongly they agreed or disagreed to the statement of finding the robot trustworthy.







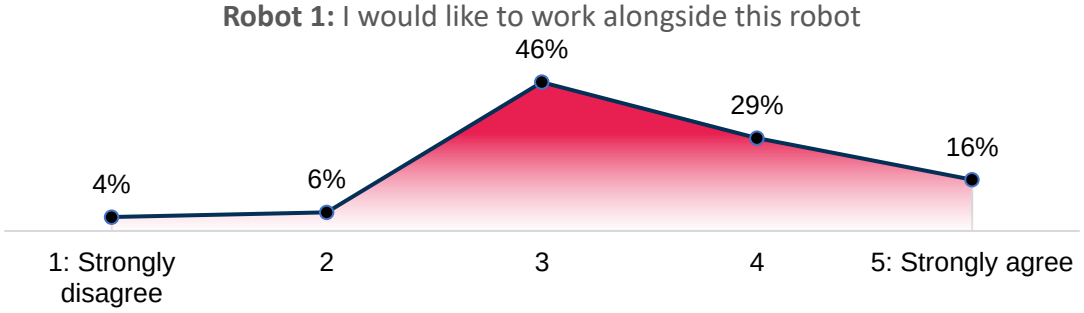
Once again, the results are very close to each other, the number of respondents strongly disagreeing to the statement are identical and the same goes for the number of respondents strongly agreeing to the robot being trustworthy. While respondents entering their score in the middle of the scale are a little higher towards the humanoid robot, this might be linked to the respondents being a bit more unsure how they should feel towards the humanoid robot not knowing what it can and can't do. It can therefore

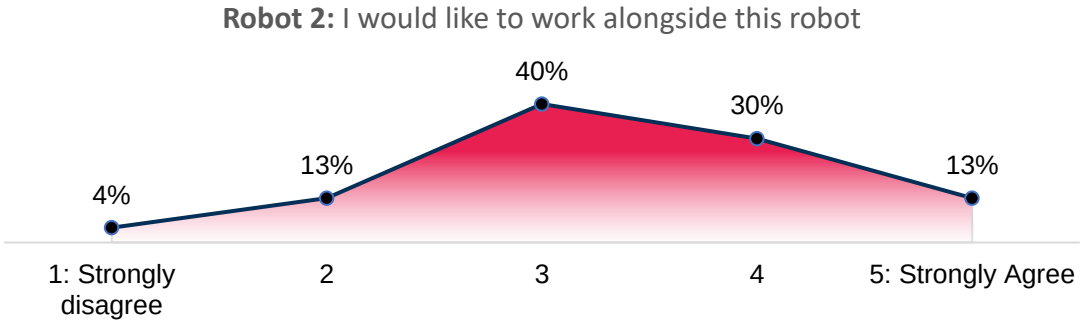
not be concluded whether giving the robot a face can generate a feeling of security and familiarity. However this is something that could be further explored with real-life testing with regular citizens where they can get a better feel of the robot and explore it better than what can be done through a picture.

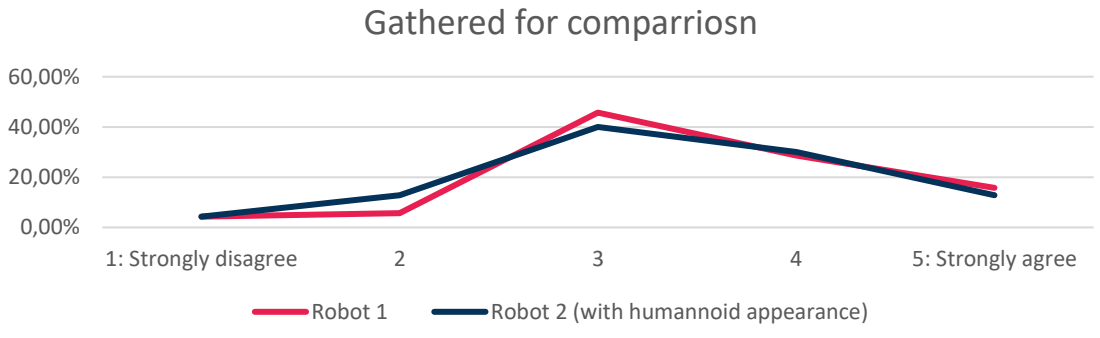
A focus group interview conducted among the participants of the Robotex International festival reveals that it is difficult to evaluate rudimentary robots and their functions when the first impression is of a machine in a very early stage of development. Trust is created by the need to see that the robot is mature. "The first thing that strikes me about him is that he is, as it were, at an early stage in its development. It is hard for me to understand what he is made for and what he does. Even if there is a description, the first feeling is that it is still too raw."

Question 6: I would like to work alongside this robot

On a scale from 1-5 respondents were asked to enter how strongly they would disagree or how strongly they would agree to like working alongside the robot.





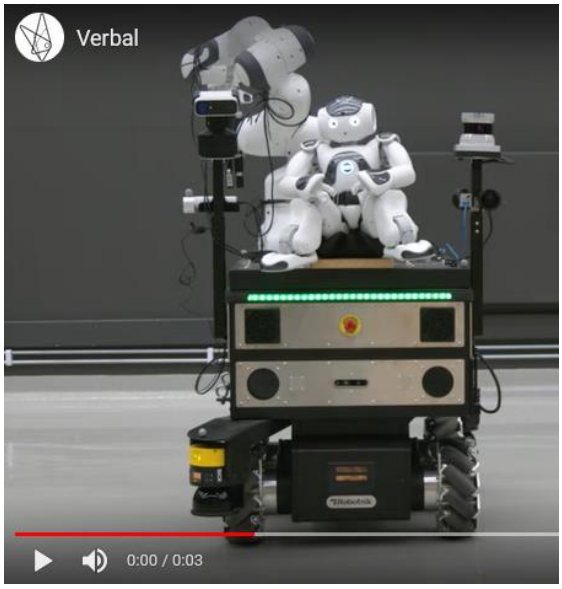


Once again, the results are very similar but here the respondents were a little more positive about working alongside the robot without the small humanoid robot on top of it.

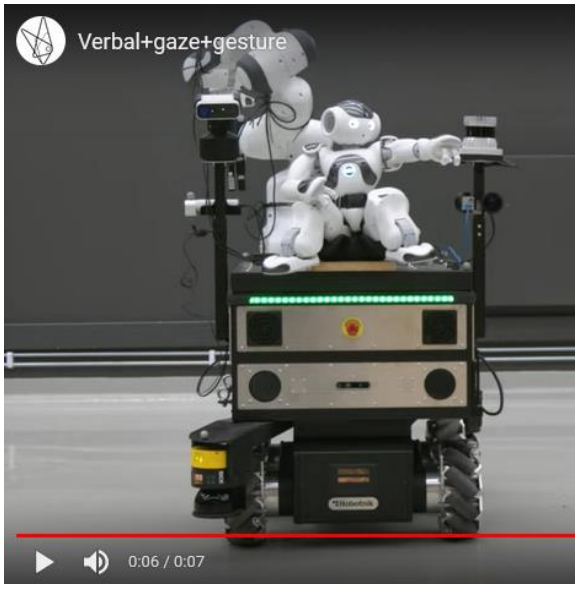
Looking at the results from the former 3 questions most of the answers were placed in the middle of the scale ranging from high expectations to low expectations and from strongly disagreeing to strongly agreeing. The distribution of the results is expected with conceptual questions where the respondents still haven't experienced in real life the situations they are being asked to respond to. The first 2 comparisons most of the respondents had a slightly lesser negative response to have the little humanoid robot on top of the robot, while with the last comparison a small margin of the respondents preferred working with the robot without the humanoid robot. Looking back at the former questions in the survey, the respondents have expressed they preferred having the robot adapt to the human's contra having the humans doing the adaptation. So, when the robot is doing most of the adaptation this can potentially help with the trust building towards the robot. Given a situation where they must work alongside the robot it does not seem to be as important to have a humanoid robot sitting on top.

Testing of verbal and gestures as means of communication

To further test the functionalities a humanoid robot can provide, the respondents were introduced to two videos of the robot with NAO in function. The first video has NAO informing its intentions by using a voice saying, "let's go to goal number 5". In the second video presented to the respondents, NAO informs its intention by using the same voice and a gesture by looking and pointing in a direction.



Video 1 (only verbal)



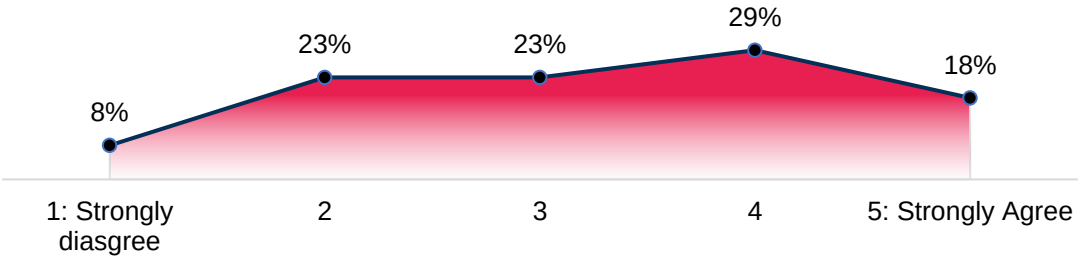
Video 2 (Verbal, Gesture & Gaze)

Respondents were asked both how strongly they agreed or disagreed with the robot clearly communicating its intentions and whether they thought this was appropriate way to communicate where the robot will go next on a scale from 1-5.

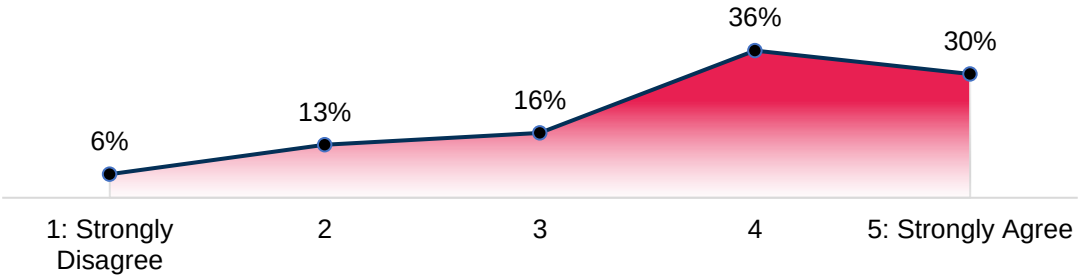
Question 7: Did the robot communicate its intentions clearly?

Looking at the results below the respondents were more prone to having the robot communicating its intentions by using both a voice and gesture. In the first video only 47% of the respondents agreed or strongly agreed that the robot communicated its intentions clearly, whereas in video 2 66% thought the communication was clear. Also, in the middle and the other end of the scale we see a clear difference between the two. However, we can also conclude that there still is a group of people who do not think the robot is clear in its communication one way or the other.

Video 1 (verbal): The robot communicated its intentions clearly.

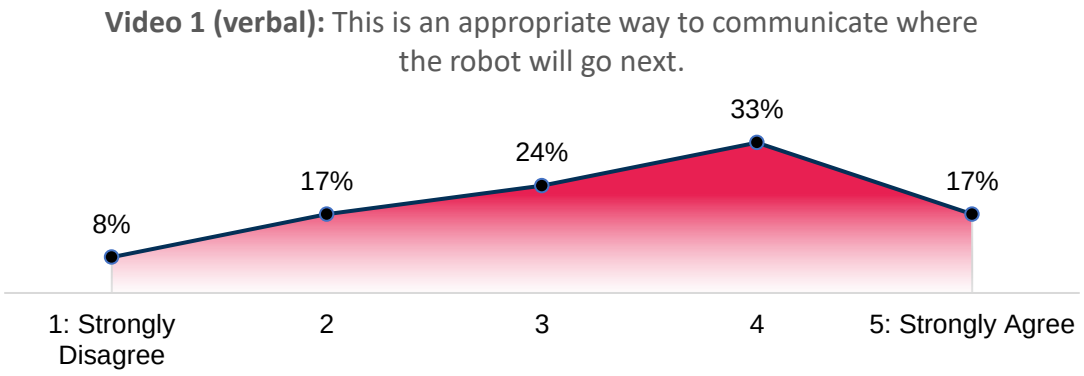


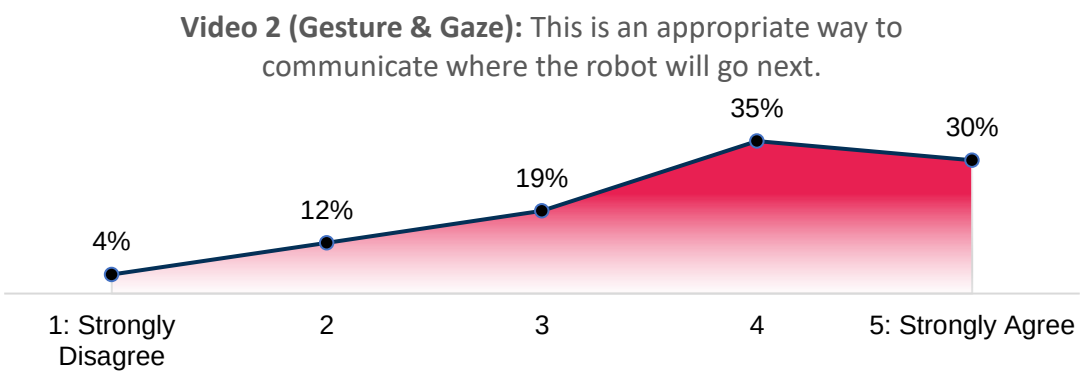
Video 2 (Gesture & Gaze): The robot communicated its intentions clearly.



Question 8: Do you think this is an appropriate way to communicate where the robot will go next

The respondents are again introduced to two videos, one with the robot communicating by using a voice and one video with the robot communicating using a voice and gesture.

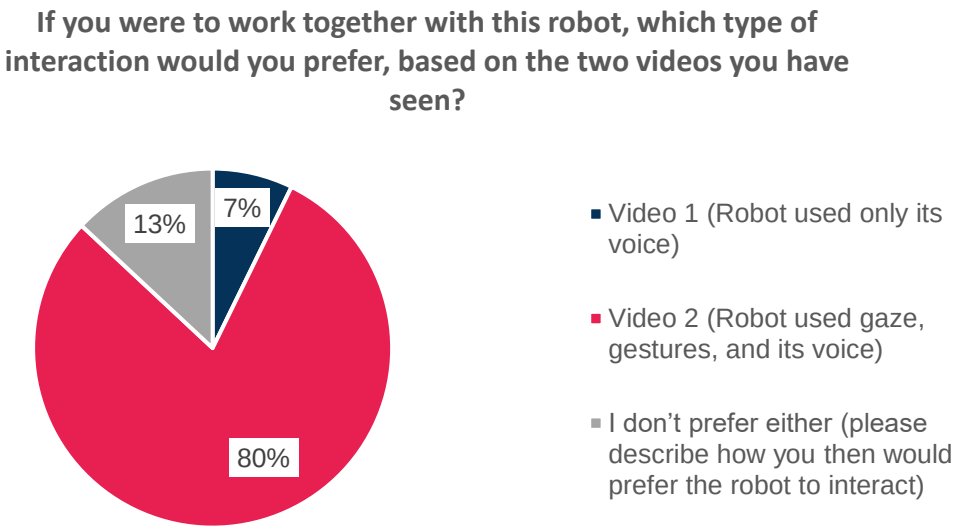




The results are similar to the former question. The respondents are more prone to having the robot communicating by using a voice and gesture. A higher number of the respondents disagree with communication being an appropriate way of communicating, when only using a voice to inform of where the robot will go next. Almost twice as many strongly agreed to having the robot use bot the voice command and gesture compared to only using the voice. Looking at the two previous questions we can conclude that there is an indication that the respondents would rather have communication in more than one way. In addition to this people with hearing or visual impairment should potentially also be considered.

Question 9: If you were to work together with this robot, which type of interaction would you prefer, based on the two videos you have seen?

Lastly the respondents were asked to evaluate which type of communication with the robot they preferred. They needed to answer if they wanted the robot to communicate using its voice or by using its voice along with gestures. If they didn't prefer either, respondents could describe how they wanted to interact with the robot.



80% of the respondents preferred the robot to communicate by using a voice and gesture. While 7 % preferred the robot to use its voice to interact. 13 % of the respondents didn't prefer either way of interacting with the robot.

Looking into the elaborative answers one respondent mentions how: *"we perceive differently, so therefore good with different actions"* supporting why using a gesture along with the voice is preferred. Some of the respondents do have reservations towards the voice being used. The voice needs to be clearer and asked for it to be in a more serious tone. Other respondents are asking for the use of led light for the robot to communicate where it is going. While another respondent mentions how humans do not communicate which directions on where they are moving, so this might not be needed with a robot. With this comment it should be considered that humans do use a lot of indirect body language and mimics that can show our intentions, which the robot does not have. To mimic this the robot can perhaps be accommodated by using lights, a display on the robot or by placing the humanoid robot on top of the robot by communicating its movements with gestures. One answer stands out from the others: *"it is easiest with only one indication",* the comment separates itself from the other comments and the 80 % preferring the robot to communicate using different approaches. The Comment might be in relation to the former comment on humans not explicitly expressing their movements, and therefore the communication might not be necessary.

4.11 STING Pollinator

This report presents the results of a collaboration between the STING Pollinator project (IT) and the EU-funded project Robotics4EU under grant agreement No 101017283. The collaboration is part of a European wide citizen consultation on validating different robotics business ideas from a societal perspective. In total 11 robotics applications participated in the activity and took part in exploring how citizens can be engaged and give input to the development of new robotic applications.

The assessment of each of the 11 robotic solutions was performed in an online, informed survey style consultation. Here respondents were guided through the survey via an online platform providing them with informative text, pictures or video material and questions about the specific robotic solution. The platform then collected the answers from each of the individual respondents which were further analysed by the Robotics4EU project.

What is the Robotics4EU project?

The citizen consultation presented in this report is part of Robotics4EU, a 3-year project funded under the European Union's Horizon 2020 research and innovation program. The project aims to ensure a more widespread adoption of robots within the areas of healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. To achieve this, the project is advocating for implementation of responsible robotics principles and raising awareness about non-technological aspects of robotics by organising community building and co-creation events bringing together the robotics community and citizens.

Why involve citizens' perspectives in the development of robots?

The collaboration between robotics developers and citizens rests on the core democratic notion that technology with the potential to have a significant impact on how we shape our future society, should not only be discussed by stakeholders, policy makers, experts, or businesses, it should also include opinions of the broader public who most likely will be directly or indirectly impacted by the changes the technology may impose over time.

There are several ways in which robot manufacturers can benefit from engaging citizens in their development processes. While citizens may not possess the technical knowledge required to build a robot, they are experts of the social worlds that new technologies will inhabit, change, or at the very least affect in some way or another. This type of expertise is equally important as professional expertise because it is what ultimately decides whether or not society will accept a new technology. Inviting citizens 'behind the stage' can help make sure that the manufacturers' solutions are aligned with society's expectations and needs. The citizens bring an 'outsider' perspective that can be an effective tool to detect and identify concerns and potential problems that would perhaps otherwise emerge only when the robot is fully developed and on the market. Thus, by adopting inclusive approaches from early in the development process, robot manufacturers will be better equipped to make informed decisions about their products and avoid costly mistakes that may ultimately render their solutions(s) unfit for society.

4.11.1 Presentation

“The Robot who wants to be a pollinator” is part of the European Initiative on Pollinators, within the STING project (Science and Technology for Pollinating Insects) by the European Commission.

The robot has been programmed to monitor biodiversity by observing insects and flowers in the field via cameras and sensors. The robot is in the very early stages of development and is what we call a prototype. Currently the robot gets assigned a farmer as its host. The farmer then places the robot in the field where he/she thinks it’s worth monitoring biodiversity. But in the future the robot is supposed to navigate by itself in the field.

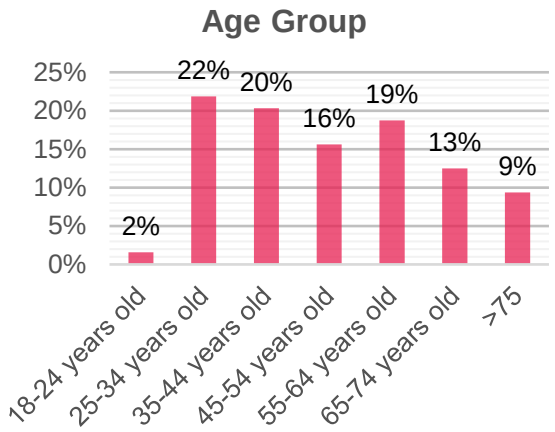
The results of the robot’s monitoring can be used to give researchers insights into the current level of biodiversity in certain areas without them having to spend several days in the field. These results can then be transferred to the farmers helping them to identify how they can improve biodiversity in their fields.

The robot is a rover equipped with two different cameras. One camera is capturing the landscape around the robot and streaming the video to Youtube. The other camera is pointing at flowers, monitoring the visiting insects, and recognizing pre-categorized pollinators through an autonomous insects monitoring system.

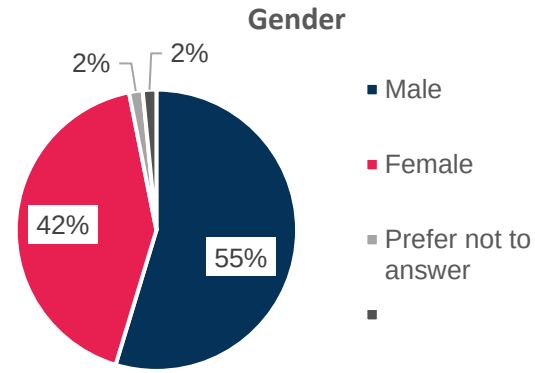
The robot will spend all day observing the flowers blooming in the field, and with its camera it captures all the insects visiting the flowers.

4.11.2 Demographics

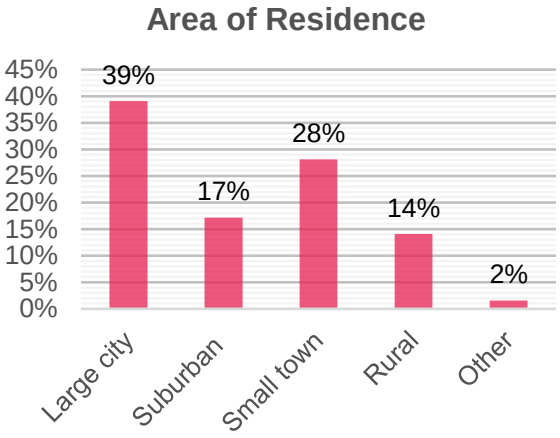
A total of 65 respondents answered the survey. The largest age group were respondents between ages 25-34, accounting for 22% of the total answers. Following this group, ages 35-44 were the second largest, accounting for 20% of the total answers. The rest of the groups saw the following distribution: Ages 45-54 years old accounted for 16%, ages 55-64 for 19% and 65-74 came to 13%. The categories with the fewest answers were ages 75 or older with 9% and 18-24 with only 2%.



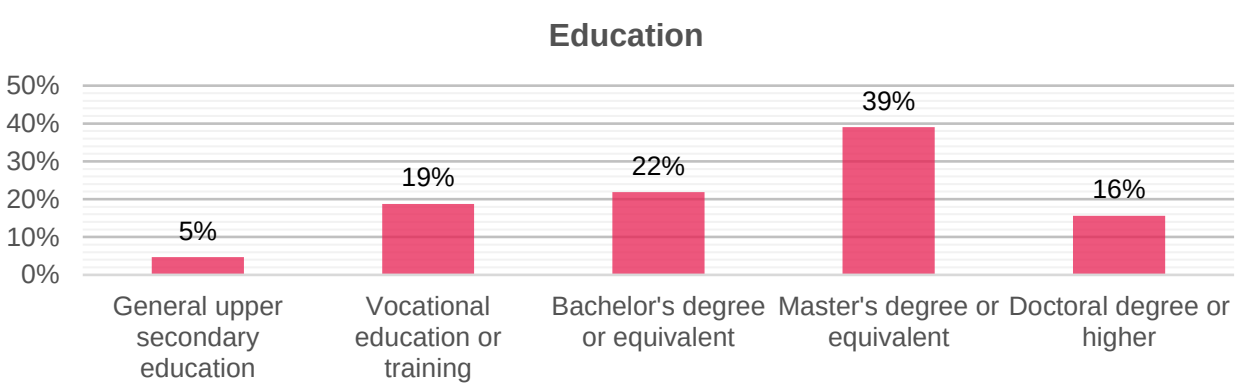
Gender distribution was divided between 54% male and 42% female, while 1% chose not to answer.



Looking at the distribution of areas of residence, the largest represented group of respondents were from large cities, accounting for 39%. Following this group 28% answered that they lived in small towns. 17% answered that they lived in suburban areas while 14% answered that they lived in a rural area.



The respondents that answered this survey were generally highly educated with 39% answering that they held a Master's degree or equivalent and 22% answering that they held a bachelors' degree or equivalent. 16% answered that they held a doctoral degree or higher.



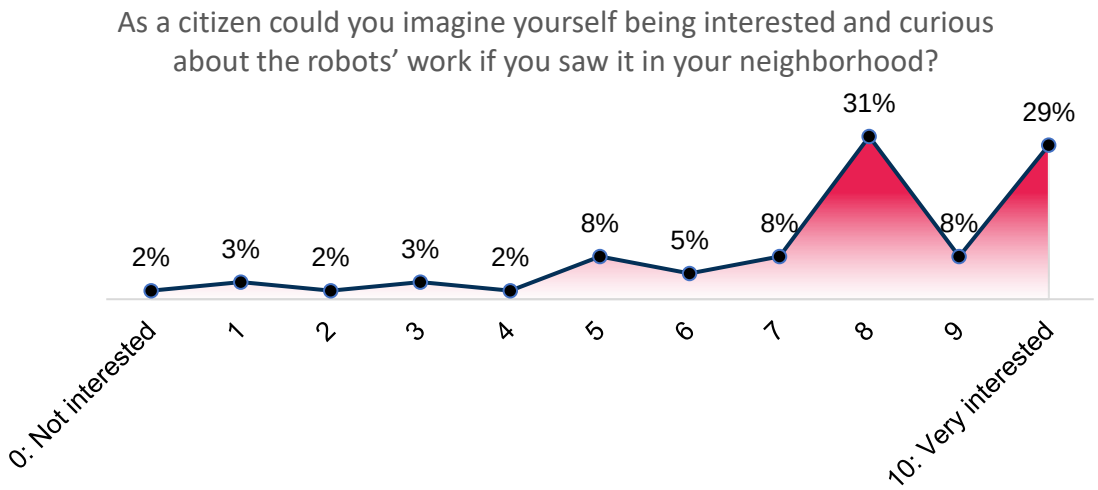
The survey received answers from at least 9 different countries, with Denmark coming in at the top with 39% of the total answers. Following this, France accounted for 17%, followed by Lithuania with 10% and Norway with 6%. 17% of respondents chose not to disclose from which country they came. citizens from both Central and Eastern Europe, Northern Europe, Southern Europe, and Western Europe have answered the survey indicating a diversity across Europe.

These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable input to the further work of the company's robotic solution.

4.11.3 Survey Results

Question 1: As a citizen could you imagine yourself being interested and curious about the robots' work if you saw it in your neighborhood?

Respondents were asked to rate the first question on an 11-point scale from 0-10 with 0 being 'Not interested' and 10 being 'Very interested'. Here, the responses were generally very positive, with respondents answering mainly in the high end of the scale, as can be seen in the figure below:



Several respondents also used the option to elaborate on their answer. Here, one respondent mentioned how the robot might be used to increase general interest in nature and biodiversity, by stating that:

> *"In my opinion, it would also attract the attention of people usually uninterested in nature and insects, who could become curious and enthusiastic through the robot".*

More respondents mention that the robot has the potential to engage citizens that might not normally be interested in these specific areas by bringing knowledge about nature and insects to local environments. Furthermore, this type of technology has the potential

to assist humans in fighting the climate problems that we face, as one respondent argues:

"With the general climate problem we face, any help is beneficial and technology is in many ways superior to humans in e.g. endurance, sensitivity".

The quote above show how fighting climate change and generating knowledge and focus on biodiversity can be aided using unyielding and highly specialised and sensitive robotic technology.

Question 2: How would you like to communicate with the robot? E.g., if you were to suggest a new place it could monitor or explore

Secondly, respondents were asked to consider how they would prefer to communicate with the robot, for example if they were to suggest a new area that the robot could monitor. Respondents were asked to choose the 3 options that they preferred, in no particular order.

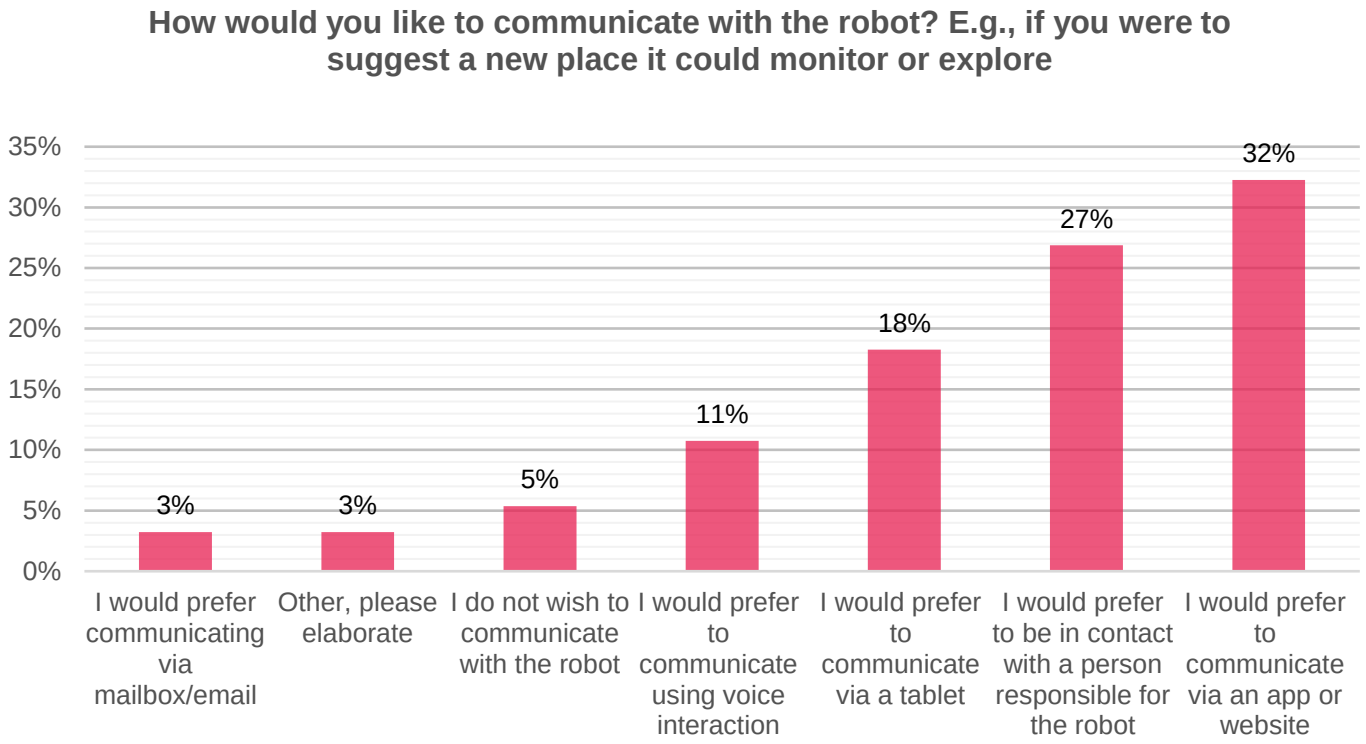
Here, the most chosen answer was the option to communicate with the robot via an app or a website, which received 32% of the total votes. As many are already familiar with using apps and/or websites for similar interaction with different technologies, this answer is not surprising. Furthermore, it might also be because many always have their phone at hand - also when walking in nature - making it an obvious tool for suggesting new places for a robot focusing on biodiversity to explore.

Following the option to communicate with the robot via an app or website, the second most chosen option was 'I would prefer to be in contact with a person responsible for the robot' with 26%. Having someone with knowledge and expertise act as the arbitrator between the robot and interested citizens could help engage more people as it might make it easier for them to partake in the projects that the robot is undertaking. One respondent mentioned that:

"Straightforward communication could easily take place via tablet, but there may be situations that require human interaction".

Comments such as this goes to show that even though it can be made easy to communicate directly with the robot, human interaction might sometimes be necessary as well.

The answer “I would prefer to communicate via a tablet’ was the third most popular answer with 18% of the total votes. For a full overview of the distribution of answers, see the figure below:

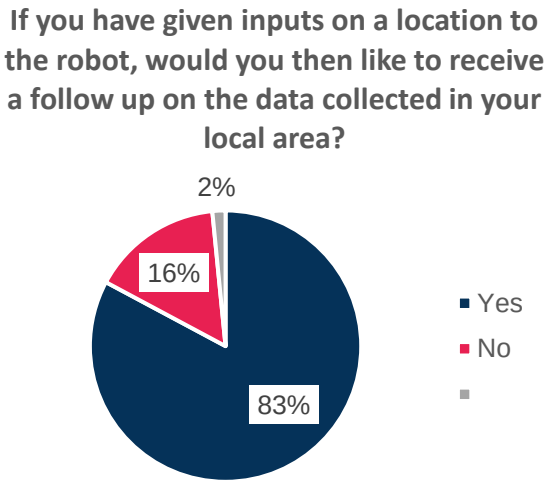


A few respondents mentioned worries towards communicating with the robot. One such worry was how the robot should prioritise between the many different inputs given to it. For example, how can the robot choose between different options if several citizens each suggest a myriad of different places that the robot should go and investigate the biodiversity. Another respondent questioned how the robot will be able to know where to go when instructed. Perhaps, the robot might need to have some sort of database of known locations or access to online map services that charts the local area that the robot is able to work in.

Question 3: If you have given inputs on a location to the robot, would you then like to receive a follow up on the data collected in your local area?

When asked about continuous inclusion regarding the findings and data collected by the robot, respondents were very positive with 82% answering that they would like to receive this kind of follow up information about their local areas.

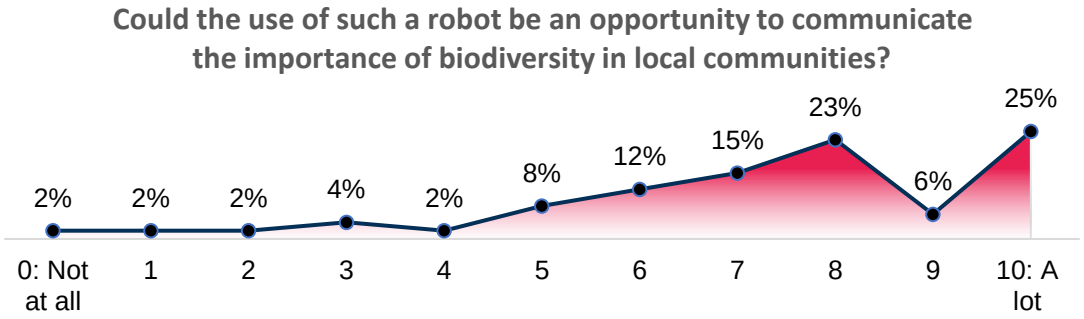
For example, respondents mention that: *"It would be interesting to know the results of the monitoring of the recommended location"* and that if they themselves have suggested an area for the robot to inspect it is because they think that it would also be worthwhile to know the results, one respondent stated that: *"If I have suggested a location, it is because I think there might be interesting sightings"*. These answers give here provides an indication towards the potential of this specific type of robotic solution, namely that it can help spark an interest in the local biodiversity and nature of citizens.



Furthermore, the distribution of answers suggests that people who find themselves interested enough to engage with the robot and suggest places that it could potentially explore are also people who will then want to be engaged further and receive follow-ups on the data collected and the findings made by the robot. One participant mentioned that: *"[it] could be interesting to find out if the proposed site had a high biodiversity"* whilst another mentioned that naturally it could be very interesting, but it should also be something that can be customized, i.e., it was also very important for users to get the possibility of *"[...] having a choice about the areas I want to follow"*. It is clear from the responses that they have a desire to be engaged with follow-up information, but they want the choice to limit this information to that which they find most important and relevant.

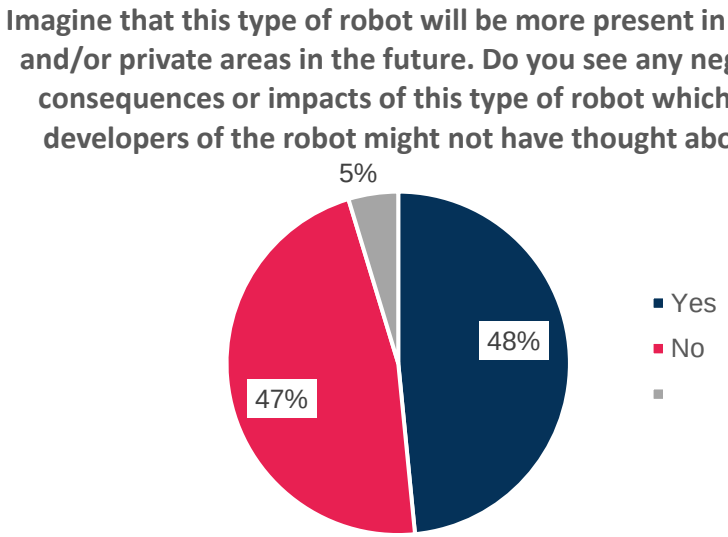
Question 4: Could the use of such a robot be an opportunity to communicate the importance of biodiversity in local communities? For example: Do you think having a robot monitoring biodiversity in your neighborhood would engage you to learn more about the topic of biodiversity?

Here respondents were asked to place their answer on an 11-point scale from 0-10. It was clear that respondents were overwhelmingly positive towards this idea as most of the answers were placed in the high end of the scale. See the figure below:



The distribution of answers to this question comfirms the previous indications, namely that respondents see a great potential in robotic soltuions such as STING.

Question 5: Imagine that this type of robot will be more present in public and/or private areas in the future. Do you see any negative consequences or impacts of this type of robot which the developers of the robot might not have thought about?
Even though there is a very positive attitude towards this robot in general, respondents still think that there might also be some negative consequences that could follow if these kinds of solutions are expected to become widely integrated into society. When asked whether there might be any negative consequences or impacts that robot developers might not have thought about, 48% answered 'Yes' while 46% answered 'No'.



For this question, a lot of respondents chose to elaborate on the reasons for their answers. The worries mentioned here can be divided into 3 different main categories.

1. Collection of data:

As with many other technologies that utilise camera equipment, respondents worry about how, why, and who collects the data that the robot is going to be gathering as it is working. This particular worry was expressed by a respondent stating that:

"It might autonomously take a position that could be considered invasion of privacy. Is the area going to be labelled as CCTV area or similar?"

Here, the worry is that by using this type of technology we might inadvertently create a society with unnecessary surveillance and monitoring of individuals without their consent. This type of worry was expressed by multiple respondents as one also states that: *"Monitoring of private individuals"* is something that might be a potential negative consequence and therefore something that should be taken very seriously.

2. Impact on nature:

Even though the aim of the robot is to monitor biodiversity and insect life, some respondents worry about the negative consequences of doing exactly this. As mentioned by one respondent:

"The robot can be a disturbance to the insects it is trying to detect, which in turn can distort the results of the detection and have a negative impact on biodiversity"

Others mention that it might scare birds or other animals away - subsequently impacting the biodiversity and skewing the results that the robot is trying to monitor. The general worry is that placing a robot such as this will interfere with the species in the area - both large and small.

A focus group interview conducted among the participants of the Robotex International festival reveals that people are used to different machines in agriculture. *"On the field, you're actually used to maybe a little more robust machines anyway. There, this one doesn't scare you anymore, one way or another, they don't cause so much uncertainty and generally don't cause as much emotion"*

3. Vandalism:

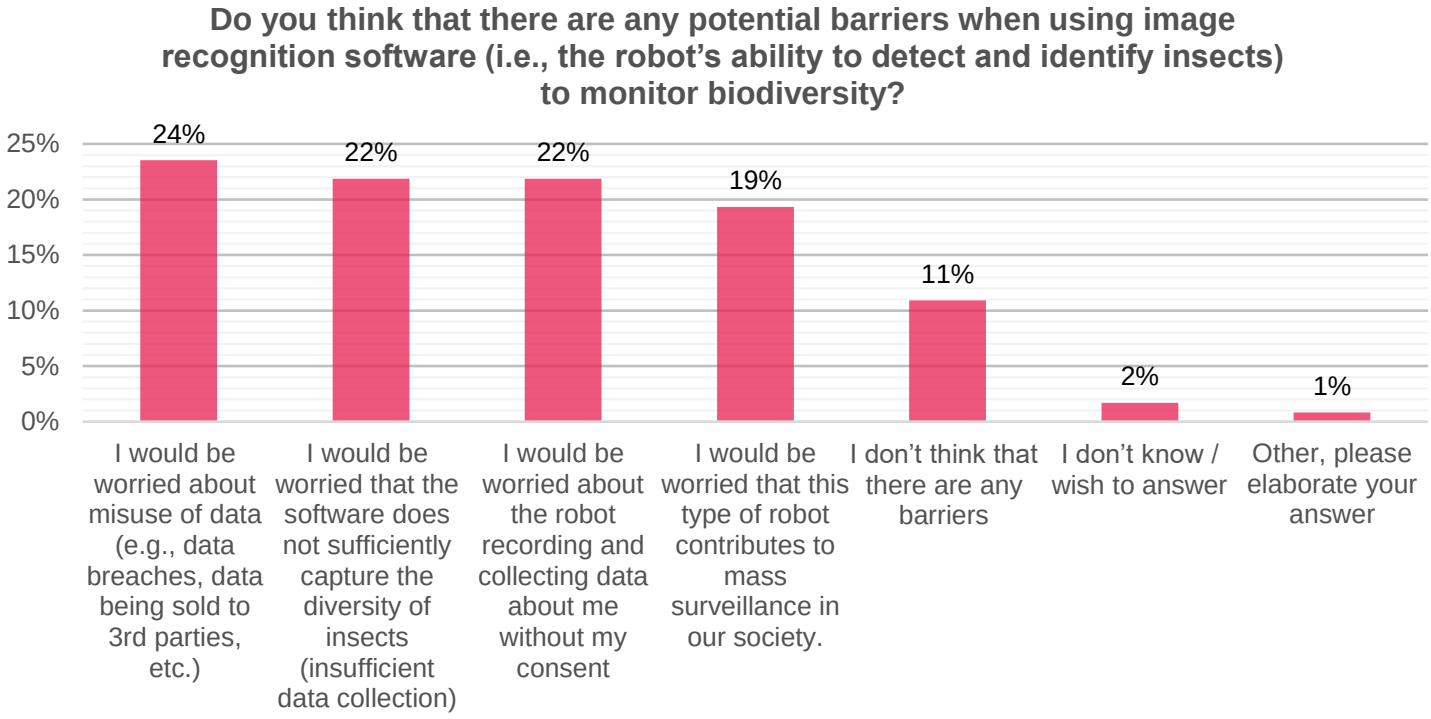
Other respondents worried about potential vandalism towards the robot. This worry is not concerned with how the robot functions or collects data, but rather a worry *about* the robot itself and how it might be treated by people. One respondent mentioned the possibility of equipping the robot with a hidden GPS to prevent theft and/or destruction of the robot. However, while some were concerned about vandalism, others did not see any problems, arguing that we are increasingly becoming used to the presence of robots in our everyday lives.

A focus group interview conducted among the participants of the Robotex International festival also indicated that "It seems so delicate, yes. Even the wind can take it away."

Question 6: Do you think that there are any potential barriers when using image recognition software (i.e., the robot's ability to detect and identify insects) to monitor biodiversity?

Here, respondents were asked to consider what barriers they might see towards utilising image recognition software to monitor biodiversity. Respondents were able to select multiple answers in a non-prioritized order.

An interesting finding here is that almost every answer received the same amount of attention from the respondents, which indicates that there are many equally important barriers that will have to be considered when developing robotic technology that makes use of image recognition software and will be used in public areas, see the distribution below:



Once again, it can be argued that there is a general fear of this kind of robotic technology contributing to a society where mass monitoring becomes widespread. One respondent argues that if such technology is to be used in public spaces, then:

"The software and hardware should be open source. The data collected should be publicly available and easy to access."

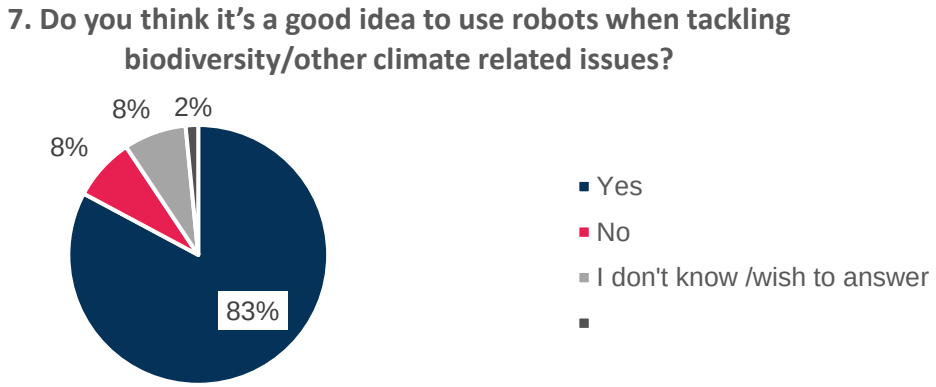
This sentiment echoes the often-mentioned call for transparency of technological solutions, a type of argument that is often used in discussions on new robotic technology as an arbiter for increasing trust resting on the notion that the more can be known about a certain thing and how it works, the more likely people will be to accept and trust it.

Apart from the worry concerning surveillance and monitoring in public spaces, there was some concern about the robot's ability to sufficiently capture the necessary and relevant data. Here, one respondent mentioned the physical dimensions of the robot as something to be considered. Namely, that the area the robot is currently able to investigate might be too narrowly defined and that for example increasing by the height the robot might be able to discover and monitor even more interesting biodiversity.

Another worry is whether the software is adequately able to detect specific types of insects without mistaking them for other, similar looking insects and that this might cause problems regarding data collection and analyses.

Question 7: Do you think it's a good idea to use robots when tackling biodiversity/other climate related issues?

The final question sought to uncover the feelings that respondents have towards the use of robotics in matters concerning climate and biodiversity. Respondents had the option to answer either, 'Yes', 'No' or 'I don't know' as well as an option to elaborate on their answer. The answers to this question were overwhelmingly positive with 83% of the respondents answering 'Yes'. 8% answered 'No' and 'I don't know'.[12]



Some respondents also used this opportunity to elaborate on why they either thought it to be a good idea or not to utilise robots for this kind of purpose. Respondents highlighted several possible upshots of a wider adoption of the STING robot. One respondent mentions that even though technology might not be the answer to everything, robots can play an important part in addressing climate issues:

"I don't believe in techosolutionism [sic][13], but I do think that robots and AI, used intelligently, can multiply our positive impacts on global issues"

Others mention the vast amount of data that can effectively be collected and processed by robots and the fact that robots can potentially work 24 hours a day and can be more enduring than humans. Furthermore, there seems to be a general optimism towards the endeavour and even though the solution or others like it will not be able to solve all the many problems related to climate, nature, and biodiversity, they can be very excellent starting points.

[12] The remaining 2% did not answer.

[13] Techno-solutionism is often referred to as the belief that all problems can be solved by technology, or that applying technological solutions will change society for the better.

5 Use of the Results

The main objective of the Robotics4EU is to ensure a widespread adoption of (AI-based) robots in healthcare, inspection and maintenance of infrastructure, agri-food, and agile production. The results of Task 4.2 accumulated with the results from Task 4.1 can help bring synergies through the project by providing important perspectives from citizens for the future development of robotic solutions.
In this chapter, we will reflect on how the knowledge gained from the online consultations can be used within the Robotics4EU project and beyond.

5.1 Inspire companies to see the potential in engaging citizens and potentially do further societal engagement

One of the main objectives of this activity has been to inform and inspire the participating companies and projects to see how citizen engagement can be valuable in the ongoing development of robotics. Therefor, we hope that the results will be used by the participating companies as input to their further development of robotics. The results varied quite a lot depending on the questions asked and they can therefore also be used in different ways, for example they can:

- Give indications that can help validate business ideas and solutions both in the early stages of development and at later stages of development.
- Indicate areas that might be problematic or cause barriers for future implementation and adaptation of the robot.
- Indicate where further testing and development needs to be done.
- Give concrete suggestions for design changes to improve the robot.
- Inspire to do further exploration of opportunities or challenges that might otherwise have been overseen.

After the publication of this report, The Robotics4EU project will reach out to some of the participating companies to evaluate how they have made use of the results.

As previously mentioned, there are multiple incentives to why citizens and societal actors should be involved in the discussion of new robot technology and there are also multiple ways and approaches to doing soand the citizen engagement activity presented in this report is just of many applicable methodologies. In addition to the companies using the results, we also hope that the results will inspire them to further explore how they can utilize engagement of societal actors to increase the responsibility of their technologies and ensure a good adaption of it in society. Additionally, we hope that the results can be used by robotics developers, who did not participate, to consider how they can improve their engagement with society.

5.2 Using the results to inform the next citizen engagement activity

The next engagement activity in the project is the task 4.3 co-creation workshops. In the Robotics4EU co-creation workshops, the DBT will facilitate activities that enable productive collaborations between companies and end users to help see their

applications in a societal perspective and get a better understanding of how the societal readiness of their applications can be improved. We will use the learnings and experiences from task 4.2 activity as insights to relevant topics to be included in the co-creation workshop.

5.3 Implement results into the development of the Maturity Assessment Model

One of the main direct objectives of the Robotics4EU project is to develop a responsible robotics maturity assessment model (MAM).

This maturity assessment model will help in assessing and determining the maturity of non-technological (AI-based) aspects of robotics. It will be based on the concepts of technological, societal and AI readiness involving technology, people, and process. A first version of the model has been published in 2021 and is further developed and improved throughout the project time.

The maturity assessment model will be an essential tool for companies by helping them to consider non-technological aspects of robotics (data protection, privacy, cybersecurity, socio-economic issues, legal aspects, ethics, gender) as early as possible in the development phase. To be reliable and useful, this tool must be built, validated and tested together with the companies and citizens who are the end-users of robotics solutions.

The results from the task 4.1 *Citizen Consultations on Wishes and Concerns* along with the results from Task 4.2 *Validating Robotics Business Ideas* produces a variety of indications for requirements to enter the maturity assessment model. The results of this will allow us to confirm and complete the list of requirements of the model. Especially results differentiating from expected results needs to be examined further. An analysis of the results must now be carried out in work package 1 to complete the maturity assessment model. This will involve rewriting certain requirements of the model, adding new requirements or achievement criteria, but potentially also weighting these requirements by taking into account this valuable user feedback.

6 Conclusions

The citizen engagement activity sought to collect concrete feedback from citizens on current robotics solutions that are under development and showcased an example of how citizens can contribute to the validation of robotics business ideas. The report presented multiple incentives to why citizens should be involved in the discussion of new robot technology which can be summarized into the three following statements:

1) Citizens may not possess the technical knowledge required to build or control a robot, but they can bring expertise of the social worlds in which new technologies are implemented and can help validate business ideas and highlight areas for improvement and
2) Involving citizens can align solutions with society's expectations and needs. Adopting inclusive approaches early in development can prevent costly mistakes and increase societal acceptance of robot technology.
3) Robotics has the potential to influence major parts of our society therefor considering citizens wishes, needs and fears in the development and regulation of robotics is important for shaping society in a democratic and responsible way.

In total 1045 number of respondents across eleven different surveys answered questions and gave feedback to robots from the following companies, who voluntarily agreed to participate: Lifeline Robotics (DK), Capra Robotics (DK), NAUST Robotics (DK), Graspian (DK), Halodi Robotics (NO), IDMind (PT), RobStruct (DK), Panza Robotics (SK), X-Drive Robots (DK), DARKO (EU) and STING Pollinator (IT).

6.1 Conclusions of the mini-reports

The results were analyzed and presented in eleven different mini-reports each with their own conclusions as presented below:

Lifeline Robotics:

In conclusion, the responses from citizens regarding their perception of a robot swabbing them for COVID-19 were divided, with approximately half expressing positive feelings and the other half expressing negative feelings. Respondents generally agree that clear and comprehensive information on the procedure and safety measures are the most important types of information they would like to receive before being swabbed by a robot. Respondents also expressed concerns about the safety and precision of the robot, as well as mistrust in its responsiveness towards human movement or human feedback. However, many also see the potential for the robot to be useful in situations or places where mass testing is required, such as during pandemics or epidemics. Respondents generally prefer to be tested by a human for safety and ease of communication purposes, but it is also worth mentioning that a significant number also see the benefits of using a robot for testing for precision and efficiency. Overall, further testing and evaluation is needed to address the concerns and build trust among citizens to increase their acceptance and willingness to use the robot.

Capra Robotics:

In conclusion, the results of the robot Butty, a robot designed to pick up cigarette butts show that many respondents generally support the idea of the robot and its function. The appearance of the robot is important for its acceptance by society, with suggestions for changes in color making the functionality of picking up cigarette butts more visual noticeable as well as making the robot more familiar and friendly looking to increase acceptance. Respondents also agreed that the robot seems helpful in relieving humans of a generally unwanted and repetitive job and in filling the gap in the lack of human workforce for monotonous jobs. However, some respondents noted that cigarette butt litter is not prevalent in their neighborhood and that smoking is on the decline, indicating a potential declining need for the technology, however many agreed that the overall function of the robot could be applied in many additional areas. Some respondents raised concerns about the robot's safety and the potential for it to make people not care about littering, with some suggesting that the robot should be designed with safety measures such as sensors and visual indicators. Additionally, it was noted that the acceptance of the robot depends on the context and the need for it in a specific area.

NAUST:

In conclusion, the online consultation revealed that citizens have a positive perception of drones and recognize its versatility as a tool for various purposes such as aerial photography, disaster management, and safety inspection among others. Respondents also highlighted the need for regulation and legislation to ensure that drones are used for beneficial purposes and not misused or abused. Concerns about privacy, security, and safety were identified as the areas that participants were most concerned about regarding the future uses of drone technology. Respondents suggested that designers and developers can make drones look safer and more reliable by equipping them with redundancy features and failsafe mechanisms, providing designated drone spaces and safe areas, and also by implementing software safeguards against cyber threats and hacking. Respondents also emphasized the need for strict safety procedures, legislation, and regulation, communication and transparency, and involving citizens in the development process to ensure societal acceptance and trust of autonomous drones.

Graspian:

In conclusion, the survey suggests that Graspian, a robot with the ability to gently touch an item, has a wide range of potential uses across various industries such as healthcare and agriculture. Respondents also suggested different types of feedback they would like to receive when the robot touches an object, including visual, audio, haptic, and through the nerve system. Additionally, most of the respondents had positive attitudes towards collaborative robots and saw their potential as a tool to tackle labor shortages and free people from manual and repetitive work tasks. However, there were also concerns among some respondents regarding trust in a vulnerable situation and the need for human supervision. Overall, we can conclude that in general the respondents seem to be optimistic towards collaborative robots as long as the human factor remains forefront

and a priority, and that the robot is sufficiently tested and developed under ethical and security regulations.

Halodi Robotics:

In conclusion, the survey results show that many respondents had a positive opinion of the appearance and design of the robot EVE. However, some respondents expressed dislike for the design, finding it "alienating," "scary," and "daunting." The anthropomorphic look of the robot was seen as a reason for comfort in interaction by some, while others raised concerns about trust and stability. The responses indicate that the look and appearance of the robot are important factors in determining societal acceptance. In terms of functionality, the majority of respondents were comfortable with using EVE in medical situations such as performing deliveries, cleaning tasks, and assisting with reaching and grabbing objects. However, few respondents were comfortable with EVE independently performing complex tasks or administering medicine. Respondents also emphasized the importance of human contact in recovery and vulnerable situations and that the role of robots like EVE should more be seen as an assistive tool to aid healthcare professionals and the healthcare system. In terms of safety and interaction, the majority of respondents were neutral, with some expressing concerns about the robot's stability and lack of human presence. Lastly, the respondents came up with a wide variety of different suggestions for the application areas of the robot EVE, beyond its current use in security, retail, logistics and packaging, and healthcare.

IDMind:

In conclusion, the survey results suggest that there is potential for robots like Harmony to optimize efficiency in the workplace by taking on repetitive tasks and allowing humans to focus on more complex duties. Tasks such as fetching, transporting, and delivering objects and managing and maintaining supplies were commonly suggested. However, there was also a willingness to trust the robot with more sensitive tasks that require precision and safeguarding against errors. The majority of respondents preferred clear and multi-sensory communication from the robot, with an emphasis on inclusivity and accessibility. There was also a divide in opinions regarding the robot's physical appearance, with some preferring it to stand out for safety and accessibility reasons and others preferring it to blend in for trust and acceptance reasons.

Regardless most respondents would not consider the robot as a co-worker they did prefer to work in collaboration with it rather than having it work autonomously. Overall, the survey results suggest a potential for the robot to perform tasks efficiently and improve work processes, but also a need for clear communication and a balance between standing out and blending in for optimal human-robot interactions.

Robstruct:

In conclusion, the citizens surveyed in this study had mostly positive perceptions of the robot, RobStruct, when imagining it as a coworker at a construction site. They saw great potential for the robot to help with physically demanding and repetitive tasks, improving the work conditions for construction workers. However, there were some concerns about the robot's functionality and potential to be in the way on the site. The preferred means of communication with the robot varied, with most respondents preferring voice commands or a physical interface. Respondents also suggested that the robot should be

able to use multiple modes of communication to navigate safely in the unpredictable and loud environment of a construction site. The citizens believed that it would make sense to work alongside the robot in situations where it can relieve humans of repetitive and physically demanding tasks and/or when it can relieve work to allow them to focus on other tasks. However, there were also concerns raised about the implementation of automation in the construction sector, specifically the lack of well-defined responsibility in case of accidents, errors, and flaws, policy issues and the fear of a digital divide. Overall, it seems that further development and real-life testing of the robot would be necessary to fully realize its potential benefits and address any potential barriers to its use on construction sites.

Panza Robotics:

In conclusion, the majority of respondents had a positive impression of the design of the robot, Artaban. Respondents liked the design for being friendly, nonthreatening, and capable of traversing different terrains. However, some respondents had negative impressions of the design, commenting that it looked creepy or mean. The animal-like design of the robot may have contributed to this mixed reaction, with some feeling more accepting of the robot due to its familiar appearance, while others were put off by it. Respondents also provided recommendations for changes in the design of the robot, such as adding rounded shapes to make the robot look more approachable and friendly and improving functionality by using wheels or crawlers instead of legs. Additionally, the majority of respondents did not find the robot to be intimidating, citing the robot's animal-like appearance and "cuteness" as reasons for not finding it intimidating. However, some respondents had recommendations for changes in the design to make the robot less intimidating. When asked about areas or situations where they would prefer not to use robots such as Artaban, the most chosen answer was 'various use in public spaces' indicating a skepticism about the use of robots in public spaces. Lastly, when asked if they would feel safe being near the robot while it is working, the majority of respondents had a positive attitude towards it. Overall, it seems that the design of the robot plays a crucial role in how it is perceived by people, and that a more approachable and friendly design could help to reduce feelings of intimidation, increase social acceptability and make it more user-friendly.

X-drive Robots:

In summary, the survey results indicate that the robot has potential for use in various fields and tasks, with a focus on maintenance and tasks that may be dangerous for humans. Respondents had a broad understanding of the areas in which it would make sense to use the robot, with a majority recognizing the potential of using the robot in relieving humans from repetitive and physically demanding tasks. The results also suggest that there is a general interest in using this type of robot, but that financial costs and further development may be needed for certain applications. Respondents were divided on whether the physical appearance of the robot had any influence on their perception of it, with some believing that as long as the robot can perform its tasks effectively, it doesn't matter. When asked about a specific situation in which they would encounter the robot, many respondents felt safe and comfortable, but some concerns still exist that need to be addressed, such as the robot's size and its ability to communicate its intentions clearly. The survey results also suggest that there is a general

concern about the robot safety, with many respondents believing that developers and companies should be responsible if robots makes mistakes or causes accidents.

DARKO:

In conclusion, the results provide insight into the diverse opinions and expectations of technology among respondents. The results suggest that safety concerns and technological advancement are factors in determining preferences for the robot's movements, with a majority of respondents preferring the robot to adapt to its surroundings and learn human activity patterns for increased safety. The results also show that many respondents would feel safer working alongside a robot that tracks and records the movement of people, but there are also concerns about data protection and technical ability that need to be addressed if doing so. The results also indicate that the addition of humanoid features to a robot does not have a significant impact on the respondents' willingness to interact with the robot or their perception of its trustworthiness. However, the use of both verbal and gestural communication improves the clarity and acceptability of the robot's intentions. The results suggest that the majority of respondents prefer the robot to communicate using a voice and gesture, and that it is important to consider the needs of people with hearing or visual impairments when designing communication for robots. Overall, the survey highlights the importance of considering the diverse perspectives and needs of individuals when developing technology and the need for further testing with real-life interactions to fully understand the impact of the DARKO robot's features on human-robot interactions.

Sting Pollinator:

In summary, the responses suggest that there is a good level of interest among citizens. Respondents noted that the presence of robots in the community could increase interest in nature and biodiversity, and that the technology could assist in fighting climate change. The use of robotic technology was seen as a beneficial way to engage citizens and bring knowledge about important environmental issues to local environments. Respondents also indicated that they were interested in receiving follow-up information about data collected in their local area. Additionally, the majority of respondents see a great potential in robotic solutions to communicate the importance of biodiversity in local communities and to engage with the topic of biodiversity and nature in a meaningful way. However, there were also some concerns about the potential negative consequences of using robots in public areas, such as data collection and privacy concerns, impact on nature and biodiversity, and potential vandalism. Therefore, it is important for developers and policymakers to consider these potential negative consequences when incorporating robots into society to ensure that they are used in a responsible and effective way.

6.2 Potential tendencies

While there are some common themes that appear across the conclusions, the specific applications and uses of the robots being evaluated lead to conclusions that are not directly comparable However, looking across the surveys it appears that the following themes, topics, and worries appeared multiple times and therefore potentially can indicate general tendencies that could be thought of as issues to reflect on in the robotics development:

- **The appearance and design of the robot is an important factor in its societal acceptance.**
  Overall, it is clear that the appearance and design of a robot can greatly impact its acceptance, trustworthiness and usability in various settings. This was recurrent through multiple of the surveys. However, it was also mentioned several times that function is more important than design.

- **Concerns about privacy, security, and safety in regard to collection of data.**
  Robots that collect data of people either deliberately or not deliberately through cameras as sensors should consider data management concerns as several citizens highlight a need for transparency in the use and storage of data.

- **Recognition of the potential for robots to relieve humans of unwanted and repetitive jobs.**
  Citizens are generally positive towards having the robot replacing monotonous, repetitive, and degenerative work. It can also help fill the gap in the lack of human workforce.

- **The importance of clear and comprehensive information on the procedure and safety measures of robots before they are used.**
  Especially for robots that are in physical contact with humans' extra attention should be put on safety aspects and showing/communicating these aspects to the users of the robot to increase trust. It should also highly be considered to have human representation as this has shown to increase a greater trust.

- **Mistrust in robots' responsiveness towards human movement or human feedback.**
  In situations with close or direct human-robot interaction there are significant concerns about the safety and precision of robots, as well as mistrust in their responsiveness towards human movement or human feedback. Respondents would like to feel they have the upper hand and can control or stop the robot if needed. The need for designers and developers to make robots look safer and more reliable by equipping them with redundancy features and failsafe mechanisms.

- **Regulation and safety procedures is expected.**
  The respondent expects strict safety procedures, legislation, and regulation, communication, and transparency. And multiple highlighted involving citizens in the development process to ensure societal acceptance and trust of robots.

- **Regulation and legislation from policymakers.**
  Several mention the need for regulation and legislation to ensure that robots are used for beneficial purposes and not misused or abused.

- **In depth testing within the use-case context.**
  Several suggested further testing with real-life interactions to fully understand the impact of the robot's features on human-robot interactions. Most of the robotic

companies participating in this activity are however aware of this and are already working with such an approach.

- **Robot should indicate its intentions.**
  Several robots received feedback on modes of communication, here it was clear that to navigate safely robots should be able use multiple modes of communication both by visual and audio signals to communicate its intentions.

- **Robots are tools that can help humans but not alternatives to humans.**
  Many respondents emphasized the importance of perceiving robots as tools or machines, rather than as colleagues or co-workers. They indicated that direct collaboration with robots is acceptable and interesting as long as it serves a clear and meaningful purpose.

6.3 Reflection of what outcomes the methodology can bring

Reflecting on the results of the eleven mini reports it appears that following a similar methodology can give companies one or more of the following outcomes:

- Help validate business ideas and solutions both in the early stages of development and at later stages of development.
- Indicate areas that might be problematic or cause barriers for future implementation and adaptation of the robot.
- Indicate where further testing and development needs to be done.
- Give concrete suggestions for design changes to improve the robot.
- Inspire to do further exploration of opportunities or challenges that might otherwise have been overseen.

Here it is important to mention that the outcomes and how they can potentially be used by the companies varied a great deal. We can also conclude that the methodology had its challenges such as engaging a broad variety of citizens to participate in online surveys and keeping their attention span, here special attention should be put on reaching the younger and older generations and people without a higher education as they are difficult to engage. This should all be considered as learnings to improve on.

In addition to help validate business ideas the learnings from the report will also give inputs to the development of a maturity assessment model in the Robitcs4EU project. The results of the citizen consultation (from D4.1 and D4.2) will transfer into the work in work package 1 and allow us to confirm and complete the list of requirements of the model, to review the description of each of these requirements and, more particularly, to potentially weight the requirements that appear to be the most important in the eyes of the citizens, future users of the robotic solutions.

7 Appendix

Overview of Appendixes

- **Appendix 1: Example of mail sent to companies.**
- **Appendix 2: Partner manual sent to companies.**
- **Appendix 3: PowerPoint used at online meetings for introduction to the companies.**
- **Appendix 4: Template for companies to fill out.**
- **Appendix 5: All consultations as they were presented on Engagesuite platform.**

7.1 Appendix 1: Example of mail sent to companies

Dear company,

I'm contacting you from the Danish Board of Technology regarding an EU funded project called Robotics4EU which we are currently working on.

We are writing to you because we are very interested in the inspection robots you are developing. We have been looking at the [Insert] robot and we have also seen on your website that you have other inspection robotic solutions/systems under development.

We were wondering if you would consider participating in an activity in our project Robotics4EU where you will be able to get citizen feedback on one of the robots. This will be a completely free service for you as it is part of an EU funded project.

Short Description of the Opportunity

At Robotics4EU we are working to engage citizens in the development of robots. We believe in the value of co-creation and in involving the citizens at a very early stage to ensure a higher acceptance of robotic solutions in society. We would like to show citizens across Europe a range of robotic solution and get their feedback. The feedback will both be aimed at assessing the societal readiness of the robot and aimed at providing concrete feedback on questions posed by the developers.

Therefore, we are looking for robotic solutions with artificial intelligence in these areas:

- Healthcare
- Agile production
- Inspection and Maintenance
- Agri-food

We were thinking [insert] could be relevant for the inspection area but if you see any opportunities within the other areas, please let us know.

As a partner in this activity, we would like to arrange a meeting with you to explain the steps in the activity and our expectations from you as a partner. After this first meeting, we will need you to provide us with:

1. Video material of the robot (computer generated images are fine)
2. Some photos of the robot
3. A short, written description of the robot and its purpose
4. Fill in a template with a list of questions you would like the citizens to answer (we will provide you with examples)
5. A one-hour meeting with us to set up the content together

The consultation will be tailored to your specific robot, and we won't need much from you other than a few hours of your time to answer some questions and to send us some material we can use to present the robot.

We hope you are the right person to contact – otherwise please connect us with the relevant person in your organization.

We would love to set up an online meeting where we can discuss it further if you are interested. I can also send you some more written material for you to go through if you are interested.

Let me know if this could be to any interest of you.

Best regards,

7.2 Appendix 2: Partner manual sent to companies

Setting

Robotics4EU is a 3-year-long project funded under the European Union's Horizon 2020 research and innovation programme. The project aims to ensure a more widespread adoption of (AI-based) robotics in 4 key areas:

- HEALTHCARE
- INSPECTION AND MAINTENANCE OF INFRASTRUCTURE
- AGRI-FOOD
- AGILE PRODUCTION

The project will create and empower the EU-wide responsible robotics community, representing robotics innovators from companies and academia in the four application areas, as well as citizens/users and policy/decision makers. This will be done by:

- RAISING AWARENESS ABOUT NON-TECHNOLOGICAL ASPECTS OF ROBOTICS BY ORGANISING COMMUNITY BUILDING AND CO-CREATION EVENTS BRINGING TOGETHER THE ROBOTICS COMMUNITY AND CITIZENS.
- ADVOCATING FOR THE RESPONSIBLE ROBOTICS AMONG ALL STAKEHOLDERS' GROUPS.
- DEVELOPING A RESPONSIBLE ROBOTICS MATURITY ASSESSMENT MODEL AND BRINGING THE PROJECT RESULTS TO THE STANDARDIZATION BODIES.

Development of new technologies, including robotics solutions, are rapidly changing society and transforming the way we live and work. While such developments will undoubtedly bring about numerous positive improvements to society and to our overall quality of life, they can also result in unforeseen negative impacts on society that may have far-reaching and unpredictable social consequences.

Because of the rapid development of new technologies, such as robotics and AI, it is important that a public dialog is engaged. We must consider what uses society can justify and where the line should be drawn for what constitutes unethical, dangerous, or simply unacceptable use and development. Having this dialogue is essential to ensure that the full potentials of the technology can be wielded for beneficial purposes, while at the same time addressing and curtailing the negative impacts that might follow as a result of the development and implementation of the technology.

The European population not only indirectly funds a lot of the research in robotics and development of new technologies, but they will with time also live with the technologies that are being developed – both now and in the future. For this reason, citizens should also have a say in how this technology is being developed and be able to provide feedback on current development within the field.

At Robotics4EU we believe in the value of co-creation and in involving the citizens at an early stage to ensure a higher acceptance of robotic solutions in society.

For more information about the Robotics4EU project, visit: https://www.robotics4eu.eu/

Your Involvement

Your role as a partner in this activity will be to provide the following information about your product/solution:

- A SHORT, WRITTEN DESCRIPTION OF THE ROBOT AND ITS PURPOSE.
- A LIST OF QUESTIONS THAT YOU WOULD LIKE THE CITIZENS TO ANSWER (WE CAN PROVIDE YOU WITH EXAMPLES AND INSPIRATION – OR DEVELOP THE QUESTIONS TOGETHER WITH YOU).
- VIDEO MATERIAL OF THE ROBOT (COMPUTER-GENERATED IMAGES ARE FINE).
- PHOTOS OR COMPUTER-GENERATED IMAGES OF THE ROBOT.

The above information is to be added to the template document that you will receive. Based on the provided information, the consultation will be tailored to your specific robot/solution. This means that your company will be able to get the relevant feedback that is needed to further the development of your product.

The Online Citizen Consultation

The aim of this activity is to engage European citizens and to get them to provide feedback on relevant and actual robotic solutions that are currently being conceptualized, designed, developed, or already on the market.

Once you have filled in the template provided to you, The Danish Board of Technology will develop the content for the consultation, based on your input. The questions, text and images/video material will then be uploaded to the online platform, EngageSuite. This is the platform where the consultation will take place. EngageSuite allows us to create survey style online consultations, where participants can provide informed answers to questions based on text, pictures, video etc. The data can then be downloaded and analysed. Once the content of the online consultation has been approved from your side the Danish Board of Technology will distribute the consultation to citizens across Europe to gather feedback on your robotics solution. All answers provided by citizens are anonymous and will be processed in accordance with the Danish GDPR regulation.

Outcome

After the consultation is complete, you will receive a short report with the analysed data. In this report, you will be able to see the answers concerning your specific solution/robot. Based on the distribution of the total number of participating companies in the consultation, it is to be expected that approximately 150 participating citizens will answer questions concerning your specific solution/robot.

Thank You

7.3 Appendix 3: Powerpoint used at online meetings for introduction to the companies

Who are we?

Robotics4EU is composed by **7 organisations from 6 European countries** representing expertise in robotics in four application areas of the project and non -technological aspects of robotics.

The consortium brings together multiple stakeholders from both public and private sector.

The specific activities under the project will create the best complementary cooperation possible, by creating collaboration with the civil society and robotics community and strengthening robotics ecosystem capacities.

Robotics4EU

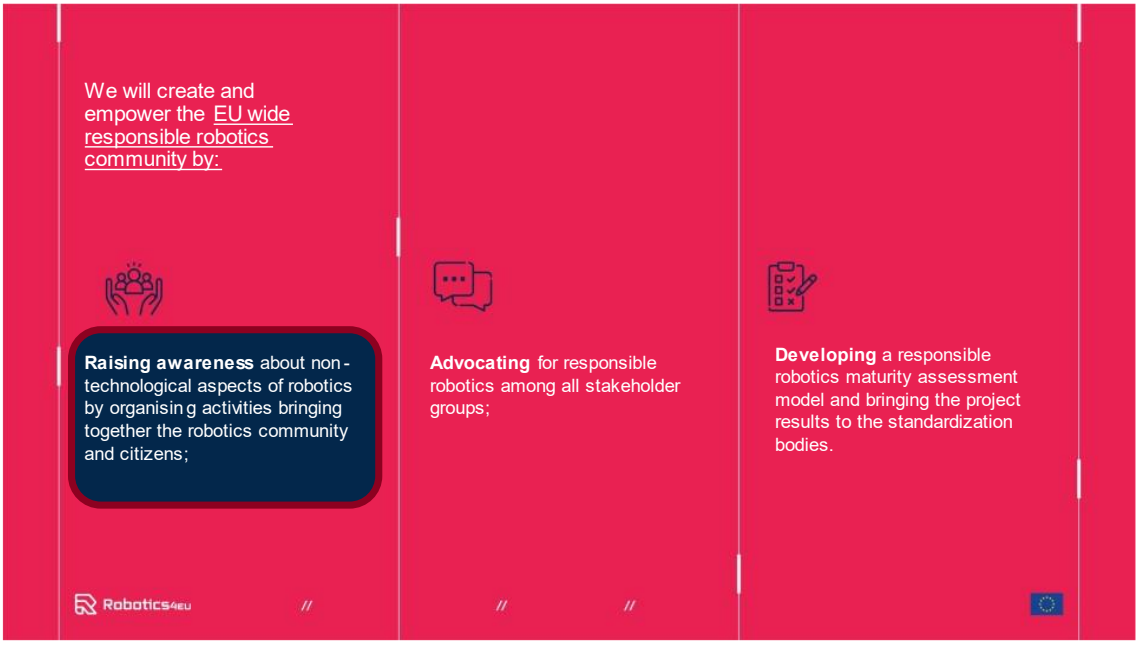
The aim of Robotics4EU.

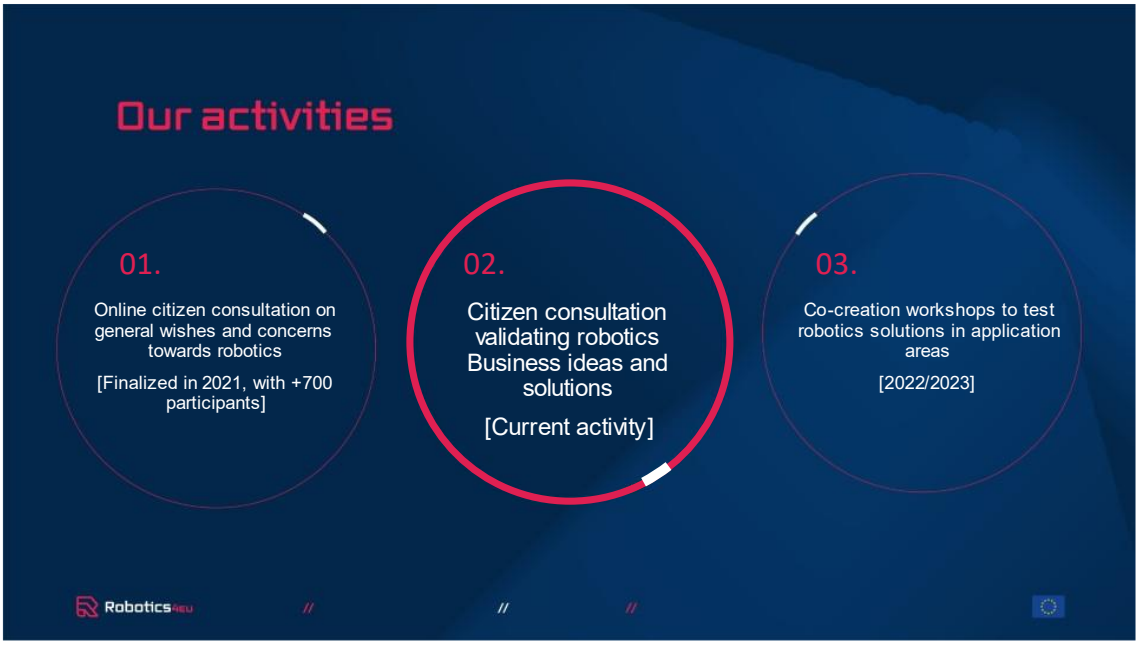
Robotics4EU will ensure a more widespread adoption of (AI based) robots in:

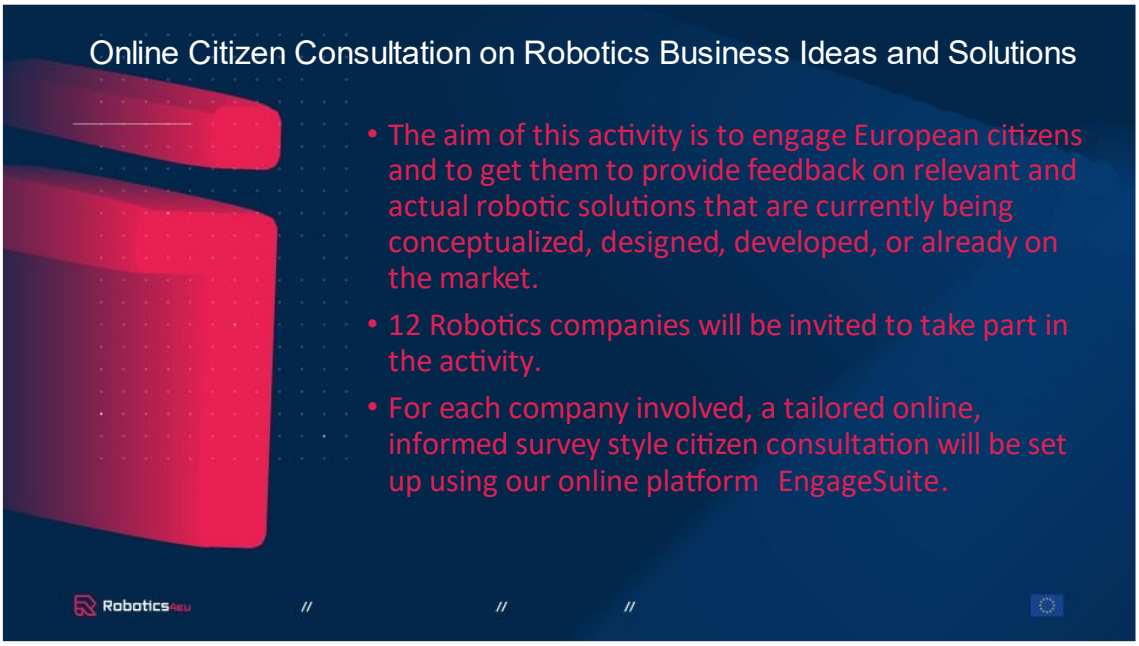
- Healthcare
- Inspection and maintenance of infrastructure
- Agri-food
- Agile production

Robotics4EU


How will
we achieve it?
Robotics4EU


We will create and empower the EU wide responsible robotics community by:
Raising awareness about non-technological aspects of robotics by organising activities bringing together the robotics community and citizens;
Advocating for responsible robotics among all stakeholder groups;
Developing a responsible robotics maturity assessment model and bringing the project results to the standardization bodies.
Robotics4EU


Our activities
01.
Online citizen consultation on general wishes and concerns towards robotics
[Finalized in 2021, with +700 participants]
02.
Citizen consultation validating robotics Business ideas and solutions
[Current activity]
03.
Co-creation workshops to test robotics solutions in application areas
[2022/2023]


Online Citizen Consultation on Robotics Business Ideas and Solutions
• The aim of this activity is to engage European citizens and to get them to provide feedback on relevant and actual robotic solutions that are currently being conceptualized, designed, developed, or already on the market.
• 12 Robotics companies will be invited to take part in the activity.
• For each company involved, a tailored online, informed survey style citizen consultation will be set up using our online platform EngageSuite.

Other companies particpating: https://www.robotics4eu.eu/surveys/

- **Companies having their robotics solutions validated:**
  - **Halodi robots (NO) – Healthcare**
  - https://engagesuite.org/en/dbt/actions/I6GtQj8psTFK/e/PV7g5v_xO9em
  - RobStruct(DK) – Agile production https://engagesuite.org/en/dbt/actions/q2j182j5orxi/e/go2vjUAiVbss
  - Idmind (PT) – Healthcare https://engagesuite.org/en/dbt/actions/0mOwACYs7hGB/e/NpYnZnC_w-KC
  - Panza Robotics (CZ) – Inspection and maintaince https://engagesuite.org/en/dbt/actions/Xt_jcleexueH/e/GVPoSq9nW9iL




The output

- It is to be expected that citizens from countries across Europe will answer questions concerning your specific solution/robot.
- Each company will receive a short report with the analyzed data. In this report, you will be able to see the answers concerning your specific solution/robot.
- Have your robotic business idea or solution showcased through the public report and other project activities.

Your Involvement

Your role as a partner in this activity will be to provide the following information about your product/solution:

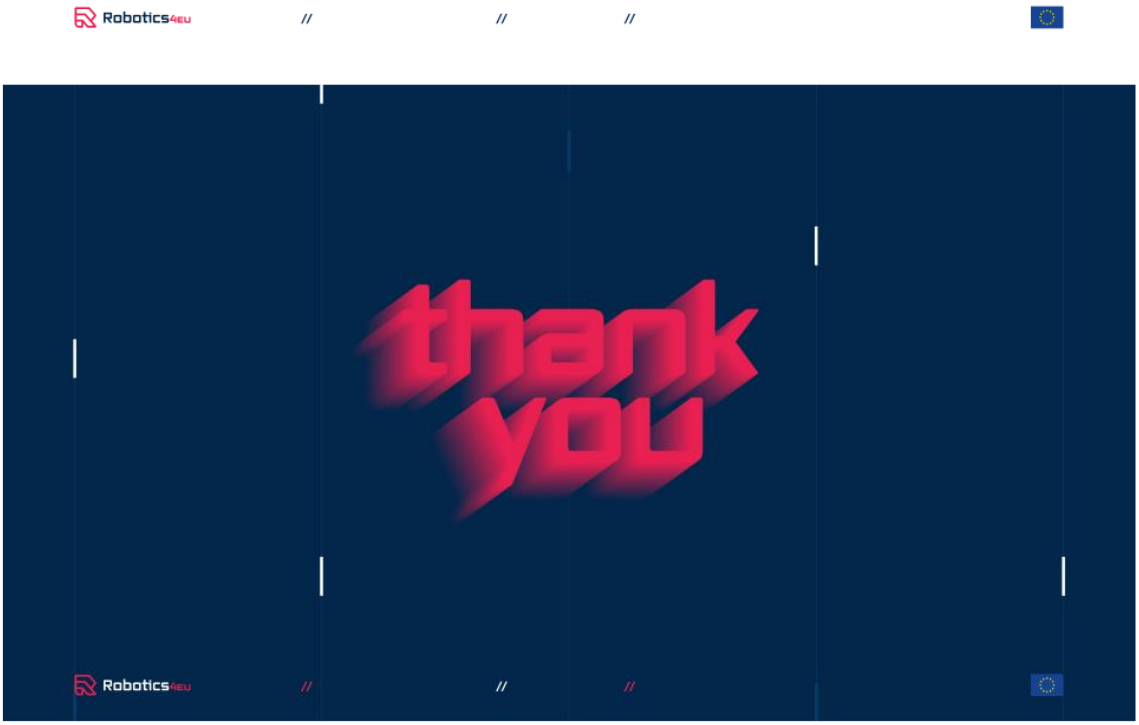
- A SHORT, WRITTEN DESCRIPTION OF THE ROBOT AND ITS PURPOSE.
- VIDEO MATERIAL OF THE ROBOT (COMPUTER-GENERATED IMAGES ARE FINE).
- PHOTOS OR COMPUTER-GENERATED IMAGES OF THE ROBOT.
- A LIST OF QUESTIONS THAT YOU WOULD LIKE THE CITIZENS TO ANSWER (WE CAN PROVIDE YOU WITH EXAMPLES AND INSPIRATION – OR DEVELOP THE QUESTIONS TOGETHER WITH YOU).

The above information is to be added to a template document that you will receive

Process Timeline

The entire activity is planned to run until October 2022 with individual milestones along the way. Your process is estimated to adhere to the following timeline:

- **JULY/AUGUST:** INITIAL START-UP-MEETING/COORDINATION AND PRODUCTION OF CONTENT FOR THE ENGAGESUITE PLATFORM.
- **AUGUST:** IMPLEMENTING AND EDITING THE CONTENT FOR THE CONSULTATION.
- **SEPTEMBER:** THE ONLINE CONSULTATION GOES LIVE.
- **OCTOBER/NOVEMBER/DECEMBER:** ANALYSING OF DATA AND WRITING OF REPORTS.
- **DECEMBER:** YOU WILL RECIEVE A DRAFT REPORT PRESENTING THE RESULTS.



7.4 Appendix 4: Template for companies to fill out

Consultation Template

In this template, you will find the necessary forms that you will need you to fill out to participate in the consultation. There are 4 areas that need to be filled: text, questions, pictures, and video.

1. Text

Please write a short and precise text about your robot/solution in the textbox area below. The text is to be used to introduce the citizens participating in the consultation to your specific robot. Furthermore, the text should be written so that it includes or considers the following descriptions and questions:

1. What is the purpose of the specific robot/solution and what potential problems is the robot aiming to solve?
2. How does the robot work?
3. How will the robot benefit citizens and/or society?

Please fill in the textbox below with the description of your robot while keeping 1-3 above in mind:

2. Questions

Please write the questions that you would like us to include in the consultation. These questions should be based on what feedback you wish to get on your solution/product.

Below, you can add the questions that you wish to ask the participants of the consultation. We do not expect you to provide us with the finalized questions for the consultation here. Rather, this template is intended to be used as inspiration so that we, at the Danish Board of Technology, can finalize the questions and implement them in the online consultation platform, when they have been approved by you. However, if you already have specific questions these can also be added below. Below you can also find questions for inspiration.

In the textbox below, you can add the topics or focus areas you would like to get feedback on. This could be themes such as trust, safety, worries, barriers, feedback on specific features or looks of the robot and so forth. We will use this information for inspiration when creating the citizen consultation:

If you already have specific questions, you can add up to 8 questions in the textboxes below:

QUESTION 1:	
QUESTION 2:	
QUESTION 3:	

QUESTION 4:	
QUESTION 5:	
QUESTION 6:	
QUESTION 7:	
QUESTION 8:	

3. Questions for insipiration

Here you can see some questions that can be used for inspiration

1. Do you think that this type of robot would be beneficial to society?
2. What should the developers of these types of robots be especially aware of?
3. What might some of the barriers towards these types of robots be?
4. Would you like to see more of these types of robots integrated into society?
5. How can robotic developers ensure societal acceptability of their robots?
6. Do you think the views of citizens are important when developing these types of robots?

4. Picture(s)

Here you can add up to 5 images that will be used in the consultation. If needed, you can provide a title and/or comments to the image. Additionally, images can be sent directly to: ahv@tekno.dk mems@tekno.dk or njk@tekno.dk

LINK:	TITLE:	COMMENTS/ELABORATIVE TEXT:
LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**
LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**
LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**

LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**

5. Video(s)

Here you can add video material that can be used in the consultation. The videos can be from either YouTube or Vimeo and will be embedded to the EngageSuite platform. Alternatively, the videos can be sent directly to ahv@tekno.dk using a file sharing service (e.g., WeTransfer) and then uploaded by us to our YouTube channel (videos sent to us can be deleted immediately after the consultation if wanted). Preferably, the videos should be less than 1 minute long. One video is enough, but it is possible to add up to 3 if they are shorter. If needed, you can provide a title and/or comments as well.

LINK:	TITLE:	COMMENTS/ELABORATIVE TEXT:
LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**
LINK:	**TITLE:**	**COMMENTS/ELABORATIVE TEXT:**

7.5 Appendix 5: All consultations as they were presented on Engagesuite platform

Pages including introduction to the activity, consent form, demographical questions and thank you page were more or less the same in all consultations and are therefore only included in the first consultation in the appendix but did appear for each consultation of each robot.

Robotics4EU
Boosting Wider Adoption of Robotics in Europe

Citizen Consultation on Robotics Business Ideas

Welcome to the Robotics4EU citizen consultation on robotics. First of all, thank you for taking your time to help us with the consultation. You are a great help!

The Robotics4EU has a goal of boosting a wider adoption of robotics in Europe.

Your opinion is a key element to the impact of the Robotics4EU project. Your answers will help the company involved improving their products and thereby making them more broadly accepted into society.

In this consultation you will be asked to answer a series of questions regarding robotic solutions from **RobStruct**, which is a Danish company delivering robotics solutions in the agile production area.

The consultation is anonymous, and all data will be processed in accordance with European GDPR regulation.

Enjoy impacting the future of robotics!

follow us on @robotics4eu

contact us info@robotics4eu.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

Robotics4EU
Boosting Wider Adoption of Robotics in Europe

Consent form

Dear participant,

To facilitate this consultation, we will collect information about your:
- Email, age, gender, geographical zone, and level of education

We will collect this data, to make an analysis based on the answers given in the consultation concerning citizens' views on robotics business ideas.

This data will be anonymized immediately after the consultation and your contributions to the analysis will be used for a report which will be published on the Robotics4EU website.

Before we can start the consultation, we need you to agree to the following consent form:

I undertake to preserve the reputation of the project and not take any deliberate action that could undermine the image of the project.

I understand that issues related to confidential information and commercial secrets are regulated by the regulations of Denmark.

I understand that Data Protection Officer, Piia Viks-Binsol, Civitta, Estonia, will process my personal data for the purpose of administrating the Robotics4EU project contact database. Processed data will be saved and kept for up to 3 (three) years after the project ends and then deleted. To cancel consent beforehand, an e-mail must be sent to Piia Viks-Binsol at: *piia.viks-binsol@civitta.com*

I understand that I have the right to cancel my given agreement at any time and in that case, I understand that I lose the opportunity to participate in the project and to receive information about the project activities. I am informed, that in accordance with the rights and in the manner prescribed by Articles 15, 16, 17, 21 of the EU General Data Protection Regulation (GDPR), I have the right:

- To know (to be informed) about the processing of my personal data.
- To get acquainted with my personal data and receive a copy.
- To request my personal data to be deleted or to suspend the processing operations of my personal data, when the data is processed without complying with the provisions of the GDPR and other legal acts regulating the processing of personal data.
- To object with the processing of my personal data. I am informed that if I am unable to resolve the issue with the Data Protection Officer, I can contact the relevant supervisory institution.

Personal data is any information related to an identified or identifiable individual (data subject); a physical individual who can be identified, directly or indirectly, in particular by reference to an identificatory data, e.g., given name and last name, the person's identification number, physical location, IP address or one or more factors specific to his/her physical, physiological, mental, economic, cultural or social identity.

Without expectation of compensation or other renumeration, now or in the future, I hereby give my consent to The Danish Board of Technology, to use written answers in its publications and media activities (including the Internet) for strictly research and dissemination purposes in the context of the project Robotics4EU. This consent includes:

- Permission to use quotes

Processed data will be saved and kept for up to 3 (three) years after the project ends and then deleted.

I allow my personal information to be used in the context of Robotics4EU project in the aforementioned purposes.

☐ Yes

Robotics4EU
Boosting Wider Adoption of Robotics in Europe

Before we get started, we would like to get to know a bit more about you, to better understand who the people answering this consultation are.

What is your age group?

- [ ] 18-24 years old
- [ ] 25-34 years old
- [ ] 35-44 years old
- [ ] 45-54 years old
- [ ] 55-64 years old
- [ ] 65-74 years old
- [ ] 75 years or older

What is your gender?

- [ ] Male
- [ ] Female
- [ ] Other
- [ ] Prefer not to answer

What is your country of residence?

Select your country from the drop-down menu

What is your area of residence?

- [ ] Large city
- [ ] Suburban
- [ ] Small town
- [ ] Rural
- [ ] Other

What is your highest attained level of education?

- [ ] Primary or lower secondary education
- [ ] General upper secondary education
- [ ] Vocational education or training
- [ ] Bachelor's degree or equivalent
- [ ] Master's degree or equivalent
- [ ] Doctoral degree or higher
- [ ] I do not know / wish to answer

We will not share your personal data with anyone and once you have pressed complete at the end of the consultation, your answers will be completely anonymized.

Back Next

Robotics4EU
Boosting Wider Adoption of Robotics in Europe

You are now ready to start

The survey takes approximately 10 min. to complete

We hope you enjoy the survey!

Back Next

ROBSTRUCT

Robstruct is a Danish construction technology startup that develops applications for mobile robots, with the intend of implementing them in the construction industry. Their solution is based on the idea that it is possible to alleviate the pains construction companies experience with regards to worker health, workforce shortage, and sub-optimal productivity.

For example, this type of robot can be connected to a trailer that can help move large and small objects on constructions sites such as bricks, tools, waste etc.

The solution is built on the idea that it is possible to create mobile robots that are intuitive to use and adaptable to their environment and the tasks they are set to perform.

Above: RobStruct robot prototype

Above: RobStruct robot prototype

ROBSTRUCT

At the core of RobStruct's philosophy is the need for improving worker health by alleviating the construction workers from repetitive and physically demanding tasks such as continuous lifting, carrying, and towing.

By eliminating non-value-creating and time-consuming tasks via autonomous executing, RobStruct solutions enable construction staff to focus on actively building. Their solution aims to increase productivity and improve the mental health of workers.

Imagine that you are working at a construction site, and you meet your new coworker. It is a mobile robot capable of helping you with multiple daily tasks. The robot can transport equipment, waste, and a wide array of building materials and it can find its way around the site on its own.

1. Do you think working alongside a robot which is able to move objects could be beneficial and useful at a construction site?

- [ ] Yes
- [ ] No

Why/why not?

2. You have just loaded the trailer attached to the robot with waste, and a specific tool that your human coworker on the opposite side of the construction site needs. How would you prefer to tell the robot what to do?

- [ ] I would prefer that I can call a central command-hub, where a human worker tells the robot where to go to, based on my instructions. (i.e., no direct communication with the robot itself)
- [ ] I would prefer to tell the robot where move by pressing physical buttons on the robot, assigning it to predefined routes.
- [ ] I would prefer that I could communicate with the robot by using voice-commands (such as Siri, Alexa, and Google home)
- [ ] I would prefer to communicate with the robot via hand signals to tell it where to go.
- [ ] I would prefer that the robot only performed predetermined and repetitive tasks, where no communication between the robot and the human workers is needed.
- [ ] I would prefer to communicate with the robot via an app on my phone.
- [ ] Other, please elaborate

Elaborate here

3. Later that day, you encounter a robot delivering materials on a narrow path You are unsure if you should step to the side or if the robot will navigate around you. How would you prefer that the robot communicates its intentions to you?

- [ ] I would prefer that the robot uses visual indicators to tell me where it wants to go (e.g., like blinkers on a car)
- [ ] I would prefer that the robot uses a combination of sound as well as visual indicators.
- [ ] I would prefer that the robot tells me its intentions by using a voice
- [ ] I would prefer that the robot always comes to complete stop when it sees me and only moves again once I have moved past is.
- [ ] Other, please elaborate.

Elaborate here

4. When do you think it would make sense to work alongside a robot such as this?
(Choose up to 3)

- [ ] If it is faster than its human counterpart
- [ ] If it is more reliable than its human counterpart
- [ ] If it is more flexible/dynamic/able to adapt quickly to new situations
- [ ] If it can tell me exactly what it is doing, when and why?
- [ ] If I get more time to focus on other tasks (e.g., building instead of moving waste)
- [ ] If it is more financially viable for the construction company
- [ ] If I can avoid repetitive and physically demanding tasks
- [ ] I would not want to work alongside a robot.
- [ ] Other, please elaborate

Elaborate here

5. What do you see as the largest barrier towards implementing automation in the construction sector?
(Choose up to 3)

- [ ] Displacement of the workforce and a loss of jobs. (Fear of unemployment due to technological advancement)
- [ ] Lack of a well-defined Responsibility in case of accidents, errors, and flaws concerning the robot
- [ ] Becoming too dependent on technology for simple human tasks.
- [ ] Digital divide – discrepancy between workers who are used to digital technology and workers unable to utilize digital technology.
- [ ] Policy issues – Worry that it is difficult to plan and enforce technology-related regulations and laws.
- [ ] Other, please elaborate

Elaborate here

6. Who do you think should be responsible if the robot makes mistakes, or causes accidents?
(Choose the 2 main responsible actors)

- [ ] The developers of the robot (The company that designed, constructed, and programmed the robot)
- [ ] The distributor of the robot.
- [ ] The company that the robot works for.
- [ ] The person who most recently gave instructions to the robot.
- [ ] No one can or should be held fully responsible.
- [ ] Other, please specify

Specify here

Robotics4EU
Boosting Wider Adoption of Robotics in Europe

Thank you!

Thank you for taking part in this consultation on robotics.

We appreciate you taking the time to participate in this activity. Your answers will be analysed and sent to the participating company for their consideration. By answering this survey, you are actively shaping the future of robotics in our society!

Please enter your email adress below

We would like to follow up on the activity and contact you regarding other project activities

Insert Email

Before you go, please fill out the evaluative questions below

Would you be more inclined to be positive towards future robotic solutions if you, or other citizens, have been included in the development of the robotics ideas and applications?

- [ ] Yes
- [ ] No
- [ ] I don't know

Did you participate in the last Robotics4EU citizen dialogue meeting in the fall of 2021?

- [ ] Yes
- [ ] No

When you have entered "Complete" in the pop-up box, your answer has been registered, thank you!

Newsletter:If you want to keep up with our project results and activities, you can subscribe to our newsletter:
Subscription for Robotics4EU Newsletter

Check out the other robots:
X-Drive Robots
Graspian
Capra Robotics
NAUST robotics
Lifeline robotics
Halodi Robotics
Panza robotics
IDmind
DARKO
STING Pollinator

For more information visit our website: www.robotics4eu.eu

For more information about Robstruct, visit their website via the link below:
RobStruct

Back Complete

IDMind's robot for the Harmony EU project is a modular mobile robot, with multiple storage spaces and a robotic arm for the manipulation of small objects. The mobile robot will be implemented in a hospital environment to perform a wide variety of tasks, and on-demand deliveries. It also has multiple features related to interaction tools, communication of intention, aesthetics, and feedback — to be integrated in a natural way in people's day-to-day routines.

Above: Harmony robot prototype - general view (3D drawing). In this image, you can see a general view of the robot with a person (height= 1,80 meters) for scale.

Above: Harmony robot prototype - Simple version (3D drawing). In this image, the robot is in its simplest form, with only front storage, for the delivery of small objects.

LIVING ROBOTICS

Harmony robots will perform tasks which are physically demanding and repetitive for humans, and thereby freeing them to perform other tasks. Additionally, the robots will optimise processes, collaborate with the staff when needed and interact socially.

Above: Harmony robot prototype - two modules version (3D drawing). As it is a modular robot, it can be added another storage space on the back, for the transportation of bigger objects.

Above: Harmony robot prototype - three modules version (robotic arm included) (3D drawing). A robotic arm can be added with a drawer below, so the robot can manipulate small objects and put them inside the drawer moving the objects to another location.

1. What type of tasks would you want a robot like this to perform?

Answer here

2. Regarding the robot's physical appearance, would you prefer that the robot stands out or blends in with the environment?

- ☐ Stand out
- ☐ Blend in
- ☐ I don't know

Elaborate here

3. If you were to work alongside this type of robot, would you see it as a coworker?

- ☐ Yes
- ☐ No
- ☐ I don't know

Why/why not?

4. Would you prefer that the robot is working autonomously (by itself) or in collaboration with you (working together)?

- [ ] Autonomously
- [ ] Collaboratively
- [ ] I don't know

Elaborate here

---

5. If you were a patient or a medical professional, do you think you would enjoy interacting with a robot on a daily basis?

- [ ] Yes
- [ ] No
- [ ] I don't know

Why/why not?

---

6. How would you prefer the robot communicates its intentions to you?

- [ ] I would prefer that the robot uses visual indicators (e.g., like blinkers on a car)
- [ ] I would prefer that the robot communicates via sound
- [ ] I would prefer that the robot communicates by using a combination of visuals and sound
- [ ] I don't know
- [ ] Other, please elaborate

Elaborate here

Carrying out routine tasks, such as area surveillance, condition monitoring of heat, toxicity, chemicals, or predictive maintenance represents a significant part of the costs for almost every municipality or private company. The costs are getting higher if the tasks are performed in potentially hazardous or hard-to-reach areas affected by earthquakes, or places like construction sites, landfill sites, nuclear power plants, oil stations etc.

The solution is to carry out these tasks by using the robot Artaban – a universal multipurpose robotic platform designed to support these types of routine or dangerous operations across various industries. Using Artaban could play a key role in reducing costs, minimizing failure rates, and protecting the health and safety of citizens or employees.

Above: Artaban seen at a 45-degree angle

Above: Artaban seen from the side

Using smart autonomous robots will become "the new standard" across various industries and will surely have an impact on people as well. The use of autonomous robots will encourage an expansion of knowledge, leaving a growing demand for new skilled workers and new positions in various industries. In addition, there is also environmental and low carbon economy contribution benefits, as Artaban monitors various environments and help to predict dangerous conditions or hazardous situations.

Furthermore, Artaban reduces personal transportation and carbon emissions. It is important to create a more socially sustainable use of robots as it is not the aim to create new technology, which replaces people or cancels jobs. Rather, Panza Robotics are developing (semi) autonomous four-legged robots with embedded sensors to move around people and help them to accomplish their everyday tasks.

Watch a video on Artaban below:

Please answer the following series of questions according to the scale below:

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

It is possible to elaborate your answer in the text field below each question.

1. I like the appearance/design of the robot.

Strongly disagree — Strongly agree

Elaborate here

1.1 If you have any recommendations for changes in the design, please comment them here

Answer here

2. This robot seems intimidating.

Strongly disagree — Strongly agree

Elaborate here

3. By utilizing robots in hazardous areas, work can be made safer for humans. Are there any areas or situations in which you prefer not to use robots such as Artaban?

(Choose up to 3)

- [ ] Military operations
- [ ] Police operations
- [ ] Search and rescue operations
- [ ] Various use in public spaces (situations where the robot could potentially be in close contact with citizens)
- [ ] Perform tasks in potentially hazardous areas
- [ ] Perform tasks in hard-to-reach areas
- [ ] Other, please elaborate

Elaborate here

4. I would feel safe being near this robot while it is working

Strongly disagree — Strongly agree

Elaborate here

5. Artaban is a robot with multiple purposes, such as surveillance, healthcare, waste management and much more. Apart from what you have been shown, what other uses can you think of?

Answer here

6. Do you think robots such as Artaban would be easily accepted by society?

- ☐ Yes
- ☐ No
- ☐ I don't know

Why/why not?

HALODI robotics

Halodi Robotics has developed a service robot called EVE. EVE is a human sized robot platform that can be used for many different purposes. The solution can be utilized in areas such as security, retail, logistics and healthcare performing tasks that would usually be done by humans.

In healthcare, there is an urgent need for innovation and more hands. EVE can work alongside the healthcare professionals in hospitals. As EVE is not limited to a predefined space, but is able to move freely, it can assist healthcare professionals in everyday tasks such as patient hygiene or meal delivery — in both hospital facilities and eventually patient homes.

Above: EVE from Halodi Robotics using its mobility to assist a wheelchair user.

Above: EVE is humanoid in shape and size and can be used for many different purposes.

For Halodi Robotics, the goal is simple: Improving patient care and outcomes with the help of a humanoid robotic assistant. The aim is to create a solution that reduces costs, improves service, and assist healthcare providers. Currently, EVE is controlled remotely by an operator, but in time it will be able to operate autonomously.

Watch a short video about Halodi Robotics below:

Please answer the following series of questions according to the scale below:

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

It is possible to elaborate on your answer in the text field below each question.

1. I like the appearance and design of EVE

Strongly disagree — Strongly agree

Elaborate here

2. In what medical situations, if any, would you be comfortable being assisted by a robotic solution such as EVE?

(Choose up to 3)

- ☐ Food or goods delivery
- ☐ Personal hygiene
- ☐ Cleaning tasks (e.g., cleaning a patient's room and keeping it tidy)
- ☐ Help with medicine (e.g., deliver and dosage of pills)
- ☐ Lifting and transportation/relocation. (e.g., being moved from a bed to a wheelchair, or being transferred in a wheelchair)
- ☐ Help with reaching and grabbing objects
- ☐ Assisting human medical professionals with various tasks (e.g., Rehabilitation exercises)
- ☐ Independently performing complex tasks, such as controlling various monitoring devices, sample collection, or other difficult tasks.
- ☐ Other, please elaborate

Elaborate here

3. I would feel safe being around a robot such as EVE

Strongly disagree — Strongly agree

Elaborate here

4. Can you imagine a future where you would like to interact with this robot, on a daily basis, in different situations?

Strongly disagree — Strongly agree

Elaborate here

5. Currently, EVE is being used to support security guards, as a service robot for retail, for logistics and packaging and in healthcare. Apart from these, what other application areas do you think this type of robot can be used for?

Answer here

6. In the future, if you were to work alongside a robot such as EVE, how do you think you would perceive the robot?

- [ ] I would perceive EVE as a coworker
- [ ] I would perceive EVE as a tool or machine
- [ ] I would perceive EVE as a gadget/gimmick
- [ ] Other, please elaborate

Elaborate here

7. Many foresee a shortage of workers within the healthcare sector. Can you imagine that a robotic solution such as EVE will be able to relieve some of the pressure that the medical professionals are facing? Please elaborate on your answer in your own words.

- [ ] Yes
- [ ] No
- [ ] I don't know

Elaborate here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

Lifeline Robotics

Covid-19 came as a shock to many. Everything was turned upside down and everyone had to adjust to a new life filled with restrictions while trying their best to stay safe and healthy. A robotic solution like the Lifeline swab robot will enable organisations, companies and even nation states to be better prepared for the spread of future pathogens.

The purpose of the Lifeline swab robot is to conduct safe and gentle throat swabs with a high-quality to the sample collected. For example, in conducting a Covid-19 test. The solution works by combining artificial intelligence (AI), machine vision and sensitive robotics into a medical device.

The machine vision provides images to the AI which firstly detects a face, then, the AI detects a mouth on that face, followed by detecting the back of the throat. The AI finishes by finding certain spots on the back of the throat, which marks the areas it targets to collect the best possible swab for that exact throat structure. Then, a calculation is carried out resulting in sensitive robotics movements.

Below: The Lifeline Swab Robot

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

Lifeline Robotics

The solution is fully automatic, meaning that no human personnel is required when a sample is collected. This frees personnel to do more valuable work than repetitive and monotonous swab sampling while shielding them from the danger of infection.

Lifeline Robotics will not be able to stop a viral pathogen from forming but will provide technology that can help the global world be as prepared as possible and detect the threat before it evolves to a full blown, out of control pandemic – a so called early-warning system. Ultimately, the solution will improve health and save lives while securing the economy and minimizing the worry.

Being a medical device means that the product must comply to strict regulations and are of the highest security standard for human safety.

You can watch a short video about Lifeline Robotics below:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

Imagine that you were about to be tested for COVID-19 as you have had a sore throat and been coughing for a while. You have chosen to go to your nearest testing centre as it is most convenient for you. At the testing centre, they have implemented swab robots and it will therefore be your first time being swabbed in your throat by a robot.

1. How would you feel about the situation?

Answer here

---

2. What information would you like before being swabbed by a robot?

Additionally, what is the best way for you to get this information?

Answer here

---

3. What would be your biggest concern regarding being tested by a swab robot?

Additionally, what could be done to minimize this/these concerns?

Answer here

---

4. Which of the following statements do you agree with the most?

- [ ] I would prefer to be swabbed by a robot because I think the sampling would be more precise
- [ ] I would prefer to be swabbed by a human because I think it is safer than a robot
- [ ] I would prefer to be swabbed by a robot because then I would not have to interact/talk with another human
- [ ] I would prefer to be swabbed by a human so I can interact/talk with them
- [ ] I would prefer to be swabbed by a robot because I do not feel that it judges my appearance
- [ ] Other, please specify

Specify here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

5. When would it be a good idea to use a swab robot?

In which situations or places could you imagine a swab robot being placed?

Answer here

---

6. When would it not be a good idea to use a swab robot?

Can you imagine that the robot could be misused or misplaced in certain situations?

Answer here

---

7. Would it be a good idea for travelers to be swabbed before entering a new country?

- [ ] Yes
- [ ] No

Why / why not?

7.1 Would you be willing to let yourself get tested before travelling to other countries? E.g., before travelling by plane.

- [ ] Yes
- [ ] No

Why / why not?

---

8. Imagine that you are the designer of a swab robot, what would the robot look like?

Additionally, what is most important when designing a swab robot?

Answer here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

NAUST Robotics are developing an autonomous drone (i.e., a drone able to fly and move around on its own) equipped with speakers to protect the agricultural fields from birds and wild animals' attacks. The drone will fly over the fields playing deterring noises with the purpose of moving the animals back to natural areas and keep the crops safe.

A landing platform for the drone (drone-in-a-box), that will be initially set in the field, will shelter, and recharge the drone itself. It will also detect the presence of animals either by sound or images, triggering the deployment of the drone to the area affected. The whole system will work autonomously.

Below: the drone-the-box solution at work

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

The solution aims to increase the agricultural yield in agriculture, while avoiding the use of more harming techniques for scaring the fauna and the human-time used to check the status of the fields. It reduces food lost while bringing increased revenue for the farmer. It will result in a lower CO_2 footprint and chemical input usage per unit of food.

Below: A video showcasing the automatic drone solution and images of the NAUST Robotics drone

1. What is your perception of drones and what uses are you aware of?

Answer here

---

2. What potential do you see in drone technology?

Choose up to 3

- [ ] Aerial photography (e.g. for film or jorunalism)
- [ ] Shipping, delivery and cargo transportation
- [ ] Saftey inspection (e.g. of buildings, infrastructure, industrial areas etc.)
- [ ] Law enforcement, security and surveillance
- [ ] Agriculture
- [ ] Disaster managment (e.g. search and rescue, weather monitoring etc.)
- [ ] Private use
- [ ] Other, please specify

Elaborate/specify here

---

3. Are you generally worried about the increasing implementation of drone technology? Please elaborate on your answer in your own words.

- [ ] Yes
- [ ] No

Elaborate here

---

4. Which of the following areas are you most concerned about regarding the future uses of drone technology?

Choose up to 3

- [ ] Safety concerns, such as drones losing control, crashing, or otherwise posing a danger to humans
- [ ] Privacy concerns, such as drones equipped with cameras and fear of surveillance and/or collection of personal data
- [ ] Security concerns, such as drones being hacked, sabotaged, or misdirected (e.g., with the intent to do harm)
- [ ] Noise pollution, such as loud/annoying sounds
- [ ] Visual pollution, such as drones flying around over one's head
- [ ] Local environmental concerns, such as negative impact on wildlife and biodiversity
- [ ] Global environmental concerns, such as negative impact on climate change
- [ ] None of the above
- [ ] Other, please specify

Specify here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

5. What can designers and developers do to make drones look safer and more reliable?

Answer here

---

6. Soon drones may operate completely autonomous. What, in your opinion, should be done to ensure that society will accept and trust autonomous drones?

Answer here

---

7. Drones are increasingly performing activities that involve the use of cameras. How can developers ensure that citizens do not feel that they are being watched or that their personal data is being collected and/or misused?

Answer here

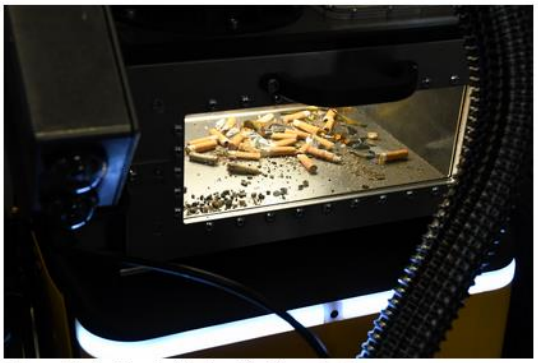
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

CAPRA ROBOTICS
[ONE ROBOT - MULTIPLE APPLICATIONS]

Capra Robotics have created a mobile robot for collecting cigarette butts, primarily for urban areas. Keeping our cities clean is a needed but costly affair. Therefore, municipalities are looking for solutions that are neither too time-consuming, labour-intensive, expensive nor environmentally damaging.

Fundamentally, robots have the benefit that they tirelessly continue to solve routine tasks. As the world looks today, it also becomes increasingly difficult to get the needed staff for monotonous jobs. Robots could be the next-generation tool for relieving and upgrading the skills of municipal service employees to foremen of robots, while still giving them the ability to solve creative and complex tasks.

Solution seen at a 45 degree angle



Cigarette butts visible inside the robot

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

CAPRA ROBOTICS
[ONE ROBOT - MULTIPLE APPLICATIONS]

The robot is equipped with a camera to find the cigarettes and a vacuum cleaner to remove them. The robot is controlled by an operator, who gives it commands from a provided app. It is estimated that the operator can oversee about 5 robots at any given time. The main goal of this solution is to minimize the amount of microplastics and toxins in urban areas by removing discarded cigarettes from the ground.

The potential for automating monotonous manual services increases daily: the demographic development means that citizens are growing older, while labour shortages are rising to new heights each month. Service tasks still need to be performed and are being distributed on even fewer workers

The robot here is 110 cm long, 43 cm wide, and 85 cm tall and drives at a max speed of 6 km/h.

Solution seen from left side

Solution seen from right side

Robot driving, dynamic shot

Solution in action

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CAPRA ROBOTICS
[ONE ROBOT - MULTIPLE APPLICATIONS]

Please answer the following series of questions by grading them according to the scale below:

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

After grading a question it is possible to elaborate in the textfield below each question.

1. I like the appearance of the robot.

Strongly disagree ○——— Strongly agree

Elaborate here

2. This robot seems helpful.

Strongly disagree ○——— Strongly agree

Elaborate here

3. This robot seems intimidating.

Strongly disagree ○——— Strongly agree

Elaborate here

4. I would feel safe passing this robot on the street.

Strongly disagree ○——— Strongly agree

Elaborate here

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CAPRA ROBOTICS
[ONE ROBOT - MULTIPLE APPLICATIONS]

Please answer the following series of questions by grading them according to the scale below:

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

After grading a question it is possible to elaborate in the textfield below each question.

5. It is a good idea to have robots collecting cigarette butts.

Strongly disagree — Strongly agree

Elaborate here

7. I like the fact that you can see the cigarette butts inside the container

Strongly disagree — Strongly agree

Elaborate here

6. I would like to have this robot in my neighbourhood.

Strongly disagree — Strongly agree

Elaborate here

8. Anything you want to add?

Answer here

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GRASPIAN

Nowadays, robots are using cameras to navigate their surroundings, locating and identifying objects that the robot is handling while avoiding to bump into walls and other obstacles. Cameras are therefore a great help to robots, however sometimes the cameras are struggling because of poor lighting conditions, the camera view being blocked or other problems that take away the eyesight from the robot.

Graspian is adding the sense of touch to robots. By combining input from a camera and touch sensors, we give the robot much improved capability for navigating its surroundings using both visual and tactile sensing.

Think of what it takes to pick up a glass of water on a table in front of you. You see the glass with your eyes, you stretch your arm in the direction of the glass, your fingers will feel the surface and edges of the glass, then you put your hand around the glass to pick it up. Even if you only knew the approximate location of the glass, you would most likely be able to do this task even with your eyes closed. Go ahead and try it.

The Graspian Solution Holding a Tomato

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

GRASPIAN

Just like humans combine visual and tactile sensing, we make robot tools with the sense of touch, so that they are able to handle objects that are otherwise challenging to robots. A challenging object can be either:

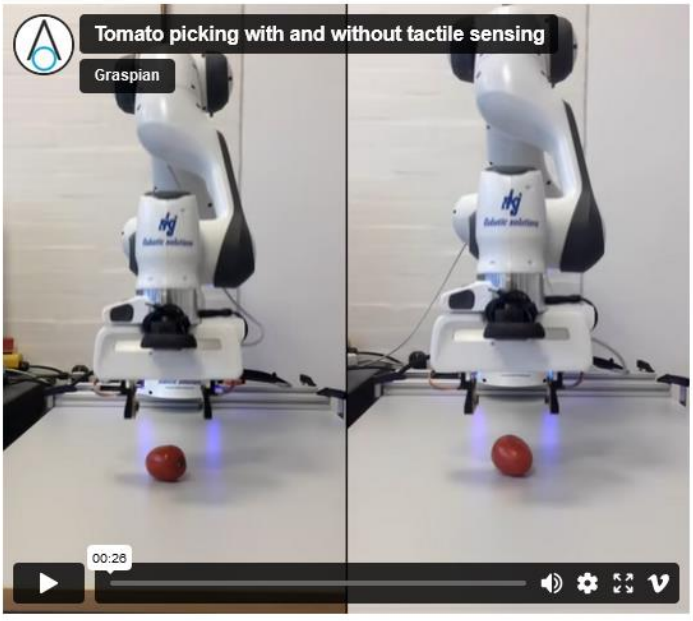
- Being of a fragile material,
- Having a slippery surface,
- Having an irregular shape, or
- Working in a changing environment

We enable a robot to avoid dropping, damaging or bruising of objects. One example of such objects is fruits and berries that require delicate handling.

GRASPIAN

Example: Tomato picking – Picking a fragile object with and without tactile sensors.
Robotic picking of a fragile object, like a tomato, is not easy. This experiment demonstrates how a standard gripper acts with and without tactile feedback to the robot.

On the left side of the demonstration, the tomato is squashed when the gripping tool engages On the right side, the gripper gently detects the tomato, then ensures a central contact point before the gripper locks in and engages with the object.



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GRASPIAN

1. Could you think of some situations where a robot with the ability to gently touch an item could do something that is not possible today?

Answer here

2. Could you think of a better – or more descriptive – name than Tactile robotics.

Answer here

3. If a robot arm acts as your extended limb, how would you like to receive feedback from the robot when it touches an object?

Answer here

4. How can a robot such as this be designed to tell a person in its vicinity that the robot knows what it is doing?

Answer here

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GRASPIAN

5. On a scale from 1-10 how willing would you be to trust a robot such as this in a vulnerable situation (e.g. as a patient)

Not at all — A lot

Elaborate

6. On a scale from 1-10 how willing would you be to trust a robot such as this in a working/collaborating setting

Not at all — A lot

Elaborate here

7. On a scale from 1-10 how willing would you be to trust a robot such as this in a voluntary/playful /entertaining setting

Not at all — A lot

Elaborate here

8. What is your opinion on collaborative robots in general?

E.g. are you concerned about your job being made redundant? Are you concerned about robots taking control?

Answer here

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X-DRIVE ROBOTS

X-drive has developed a robot for pulling tools. A machine that aims at replacing all working situations which involves a person sitting on a tractor, pulling any kind of tool.

The robot is autonomous. That means it drives on a preset route, fulfilling the desired tasks, avoiding obstacles underway, and goes back to the charging station when needed. It is driven by electric motors, and thus is CO_2-neutral, in contrast to regular tractors.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

X-DRIVE ROBOTS

Currently the robot is used to maintain riding arenas by trimming, leveling and drumming the surface. But the company has the ambition to use the robot in many other contexts.

In our society today, we have plenty of jobs that is monotonous, hazardous, and physically demanding. The future vision is that the robot replaces human labour in these scenarios, thereby freeing up manpower and preserving the health of workers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

1. What situations or fields of work could you imagine the robot presented being useful in?

- ☐ Maintenance tasks on fields for sports events such as riding grounds, football fields etc.
- ☐ Replacing tractors and other machines in farming/agriculture to address the growing shortage of qualified labor in the field.
- ☐ Maintenance tasks in public spaces such as cleaning the pavement, removing snow and spreading salt in the winter months etc.
- ☐ In polluted environments or environments that would otherwise be dangerous for humans.
- ☐ Other situations (Please elaborate)

Elaborate here

2. When do you think it would make sense to use a robot like this?

You can select multiple answers

- ☐ If it is faster than its human counterpart for the task it is performing
- ☐ If it is more reliable than its human counterpart for the task it is performing
- ☐ If it is more flexible/dynamic/able to adapt quickly to new situations than its human counterpart
- ☐ If it relieves humans from repetitive and physically demanding tasks
- ☐ If it can help resolve issues regarding lack of manpower for manual labor tasks
- ☐ If it can work in the evening and night
- ☐ If it is more environmentally friendly
- ☐ If it is more financially viable
- ☐ I don't think it would make sense to use it in any situation
- ☐ Other, please elaborate

Elaborate here

3. Does the physical appearance of the robot have any influence on your perception of it?

- ☐ Yes
- ☐ No

If possible, please explain you answer

4. Imagine that you encountered the robot on the sidewalk, cleaning the pavement or at the riding grounds. Would you feel safe and comfortable walking next to the Robot?

Very unsafe ○——— Very safe

Please explain your answer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

5. How important is the robot's size for your perception of it?

- [ ] I would feel comfortable with the current size of the robot
- [ ] I would feel more comfortable if the robot was smaller
- [ ] I would feel more comfortable if the robot was bigger
- [ ] I don't think the size has any importance

6. How would you prefer that the robot communicates its intentions to you?

- [ ] I would prefer that the robot uses visual indicators to tell me where it wants to go (e.g., like blinkers on a car)
- [ ] I would prefer that the robot uses a combination of sound as well as visual indicators.
- [ ] I would prefer that the robot tells me its intentions by using a voice
- [ ] I would prefer that the robot always comes to complete stop when it sees me and only moves again once I have moved past it.
- [ ] Other, please elaborate.

Elaborate here

7. Are there any situations or fields of work you DON'T think a robot such as this should be used in?

Write your answer here

8. Do you imagine this type of robot could pose any risks for the society in the future?

You can select multiple answers

- [ ] I think it could risk stealing a lot of manual labor jobs
- [ ] I think it could risk injuring people or animals (e.g., if a child ran in front of it)
- [ ] I am concerned that public spaces will be overpopulated by robots
- [ ] I am concerned it could be hacked or deliberately used to do harm (e.g., carrying weapons)
- [ ] No, I do not think there are any risks associated with this type of robot
- [ ] Other (please specify)

Elaborate here

9. Who do you think should be responsible if the robot makes mistakes, or causes accidents?

Choose the 2 main responsible actors

- [ ] The developers of the robot (the company that designed, constructed, and programmed the robot)
- [ ] The distributor of the robot.
- [ ] The company that the robot works for.
- [ ] The person who most recently gave instructions to the robot.
- [ ] No one can or should be held fully responsible.
- [ ] Other, please specify

Elaborate here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

"The Robot who wants to be a pollinator" is part of the European Initiative on Pollinators, within the STING project (Science and Technology for Pollinating Insects) by the European Commission.

The robot has been programmed to monitor biodiversity by observing insects and flowers in the field via cameras and sensors. The robot is in the very early stages of development and is what we call a prototype. Currently the robot gets assigned a farmer as its host. The farmer then places the robot in the field where he/she thinks it's worth monitoring biodiversity. But in the future the robot is supposed to navigate by itself in the field.

The results of the robot's monitoring can be used to give researchers insights into the current level of biodiversity in certain areas without them having to spend several days in the field. These results can then be transferred to the farmers helping them to identify how they can improve biodiversity in their fields.

The robot is a rover equipped with two different cameras. One camera is capturing the landscape around the robot and streaming the video to Youtube. The other camera is pointing at flowers, monitoring the visiting insects, and recognizing pre-categorized pollinators through an autonomous insects monitoring system.

The robot will spend all day observing the flowers blooming in the field, and with its camera it captures all the insects visiting the flowers.

In the video below you can see how the robot recognizes insects:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

1. As a citizen could you imagine yourself being interested and curious about the robots' work if you saw it in your neighborhood?

Not interested — Very interested

Elaborate on your answer here:

2. How would you like to communicate with the robot? E.g., if you were to suggest a new place it could monitor or explore

Choose up to 3.

- [ ] I would prefer to communicate via a tablet
- [ ] I would prefer to communicate using voice interaction
- [ ] I would prefer communicating via mailbox/email
- [ ] I would prefer to communicate via an app or website
- [ ] I would prefer to be in contact with a person responsible for the robot
- [ ] I do not wish to communicate with the robot
- [ ] Other, please elaborate

Elaborate here:

3. If you have given inputs on a location to the robot, would you then like to receive a follow up on the data collected in your local area?

- [ ] Yes
- [ ] No

Elaborate on your answer here:

4. Could the use of such a robot be an opportunity to communicate the importance of biodiversity in local communities?

For example: Do you think having a robot monitoring biodiversity in your neighborhood would engage you to learn more about the topic of biodiversity?

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5. Imagine that this type of robot will be more present in public and/or private areas in the future. Do you see any negative consequences or impacts of this type of robot which the developers of the robot might not have thought about?

- [ ] Yes
- [ ] No

Elaborate on your answer here:

6. Do you think that there are any potential barriers when using image recognition software (i.e., the robot's ability to detect and identify insects) to monitor biodiversity?

You can select multiple answers

- [ ] I would be worried that the software does not sufficiently capture the diversity of insects (insufficient data collection)
- [ ] I would be worried about the robot recording and collecting data about me without my consent
- [ ] I would be worried about misuse of data (e.g., data breaches, data being sold to 3rd parties, etc.)
- [ ] I would be worried that this type of robot contributes to mass surveillance in our society.
- [ ] I don't think that there are any barriers
- [ ] I don't know / wish to answer
- [ ] Other, please elaborate your answer

Elaborate here:

7. Do you think it's a good idea to use robots when tackling biodiversity/other climate related issues?

- [ ] Yes
- [ ] No
- [ ] I don't know / wish to answer

Elaborate here:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

DARKO
Dynamic Agile Production Robots That Learn and Optimise Knowledge and Operations

DARKO is a European research project that develops new methods for robots that should work efficiently together with people, particularly in logistics and production. An example for the use of the robot would be to have the robot collect parts from boxes on shelves in a warehouse and place them in a tray for delivery to a customer, like a coworker among human staff.

Rendering of a DARKO robot picking from a shelf.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

The central theme for the DARKO robot is efficiency. The robot should navigate efficiently around people – comfortably driving among them in a way that doesn't disturb its coworkers, while still reaching its goals on time. This includes being able to efficiently communicate its intents to the people around it, as well as recognizing their intents. The robot should be energy-efficient – for example, by being able to use low-power computers even for highly complex tasks, and by using newly developed robot arms.

The robot should be efficient at handling objects – which also includes throwing an object into the target tray, rather than driving there to drop the object. Throwing will save both time and energy. The robot should also be easy for anyone to install at a new site – increasing efficiency by reducing the work effort and modifications that might otherwise be needed to adapt the environment for the robot.

Concept drawing of DARKO robots working alongside staff in a warehouse order picking task.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017283

DARKO
Dynamic Agile Production Robots That Learn and Optimise Knowledge and Operations

1. Imagine that you are working alongside this robot. Would you prefer that it always moves on predefined paths (and simply stops when something gets in the way) or that it moves more flexibly, like a person would?

- ☐ I would prefer that it follows predefined paths that are clearly marked on the floor
- ☐ I would prefer that it follows predefined paths, but not necessarily marked on the floor
- ☐ I would prefer that it can plan its own paths and navigate freely, even if that makes it less predictable
- ☐ I don't know / I don't wish to answer

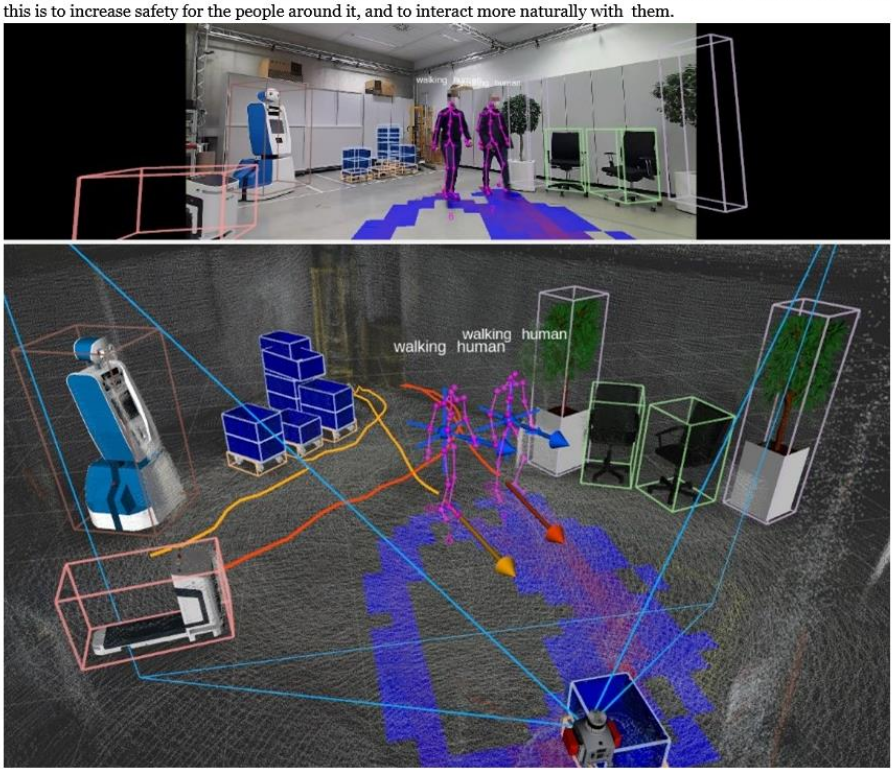
If you can, please explain the reason for your answer:

2. Do you think it would be good if the robot could adapt to its surroundings, for example by learning human activity patterns, and drive a longer path if that causes it to be less in the way of humans?

Very bad idea — Very good idea

o CLEAR

The robot performs tracking through cameras to detect people around it and predict how they will move. The purpose of this is to increase safety for the people around it, and to interact more naturally with them.



3. Would you feel safer/more comfortable working along a robot that tracks the movement of people such as described above, or one that doesn't record the movements of people around it?

- ☐ I would feel safer with the robot tracking/recording movement of people
- ☐ I would feel safer without the robot tracking/recording movement of people
- ☐ I would feel safe either way
- ☐ I wouldn't feel safe around this robot either way
- ☐ I don't know/wish to answer

Elaborate on your answer here:

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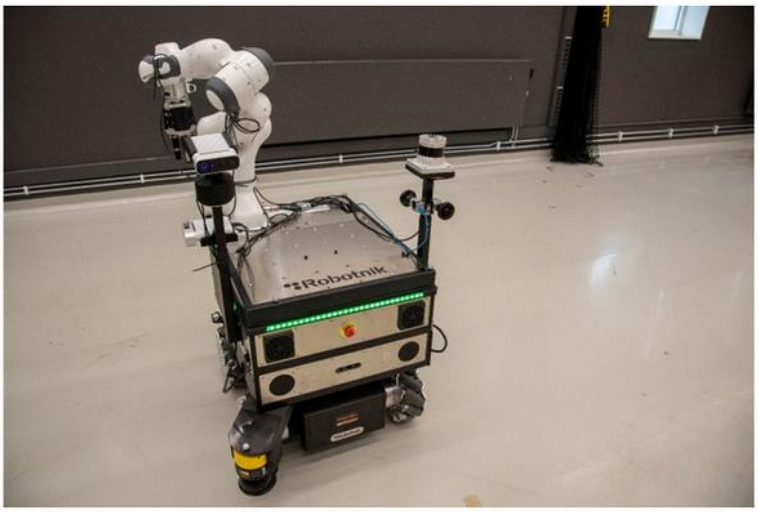
Now for some questions about what you think about interacting with this robot, using different levels of communication.

Below: a picture of the robot's current look:



Looking at the current appearance of the robot we would like for you to give your first indications and impressions on the following statements:

1: I think I will be able to interact well with this robot

Very low expectation — Very high expectation

o CLEAR

2: I would find this robot trustworthy

Strongly Disagree — Strongly Agree

3: I would like to work alongside this robot

Strongly Disagree — Strongly Agree

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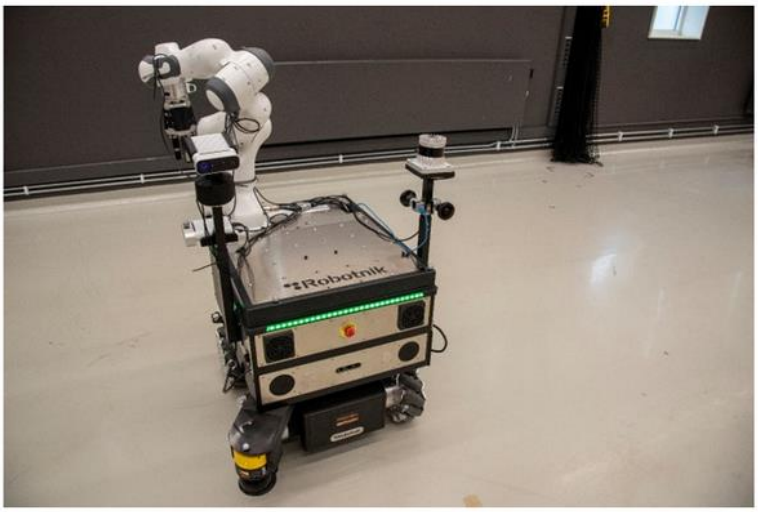

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Strongly Disagree — Strongly Agree

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Strongly Disagree — Strongly Agree

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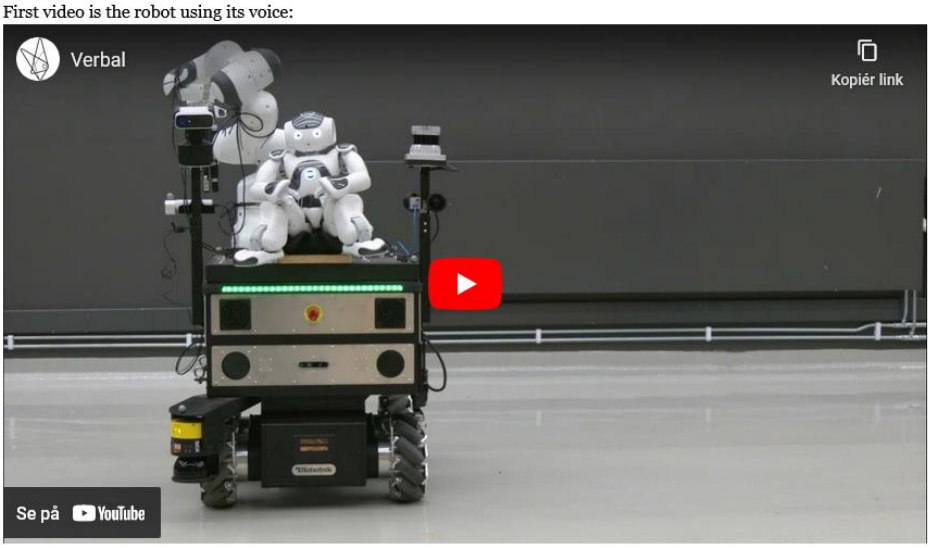
Now we would like you to watch two videos and answer questions related to the videos.

First video is the robot using its voice:



1: The robot communicated its intentions clearly.

Strongly Disagree ○——— Strongly Agree

2: This is an appropriate way to communicate where the robot will go next.

Strongly Disagree ○——— Strongly Agree

The second video is the robot using its voice and giving a gesture:

3: The robot communicated its intentions clearly.

Strongly Disagree ○——— Strongly Agree

3: This is an appropriate way to communicate where the robot will go next.

Strongly Disagree ○——— Strongly Agree

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If you were to work together with this robot, which type of interaction would you prefer, based on the two videos you have seen?

- ☐ Video 1 (Robot used only its voice)
- ☐ Video 2 (Robot used gaze, gestures, and its voice)
- ☐ I don't prefer either (please describe how you then would prefer the robot to interact)

Why would you prefer the chosen interaction Style?

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