



X-Drive Robots

Citizen Survey Results



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Introduction

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.

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 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.

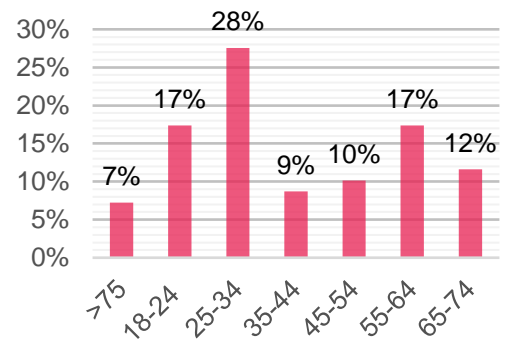
Demographics

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:

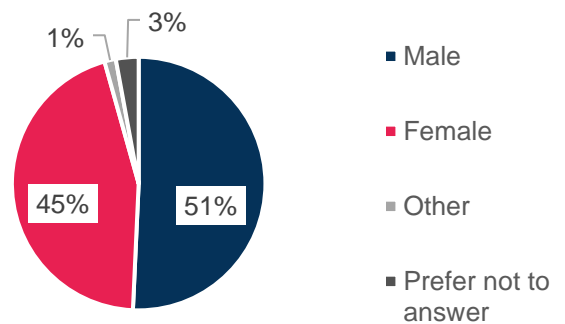
Respondents came mainly from Denmark, making up 29% of the total answers. Lithuania, France and Norway were also quite well represented. Gender distribution was ample, but with slightly more male participants than female.

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:

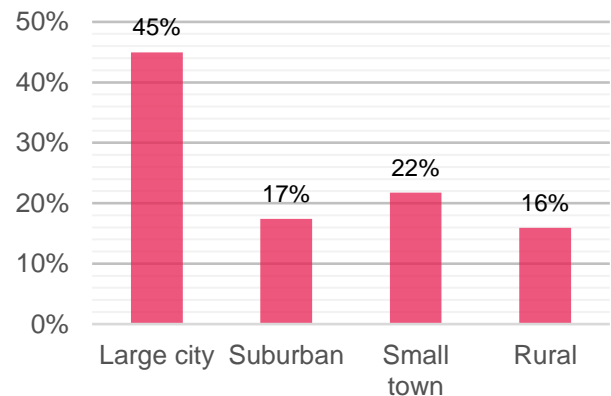
Age Group



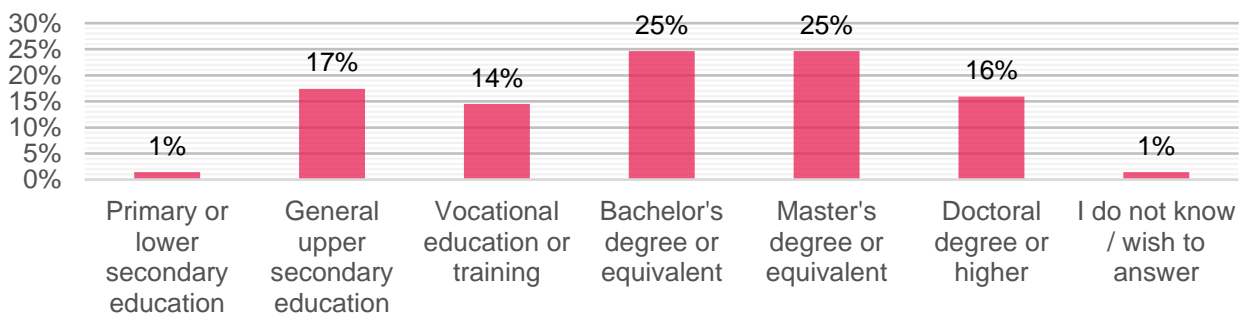
Gender



Area of residence



Education



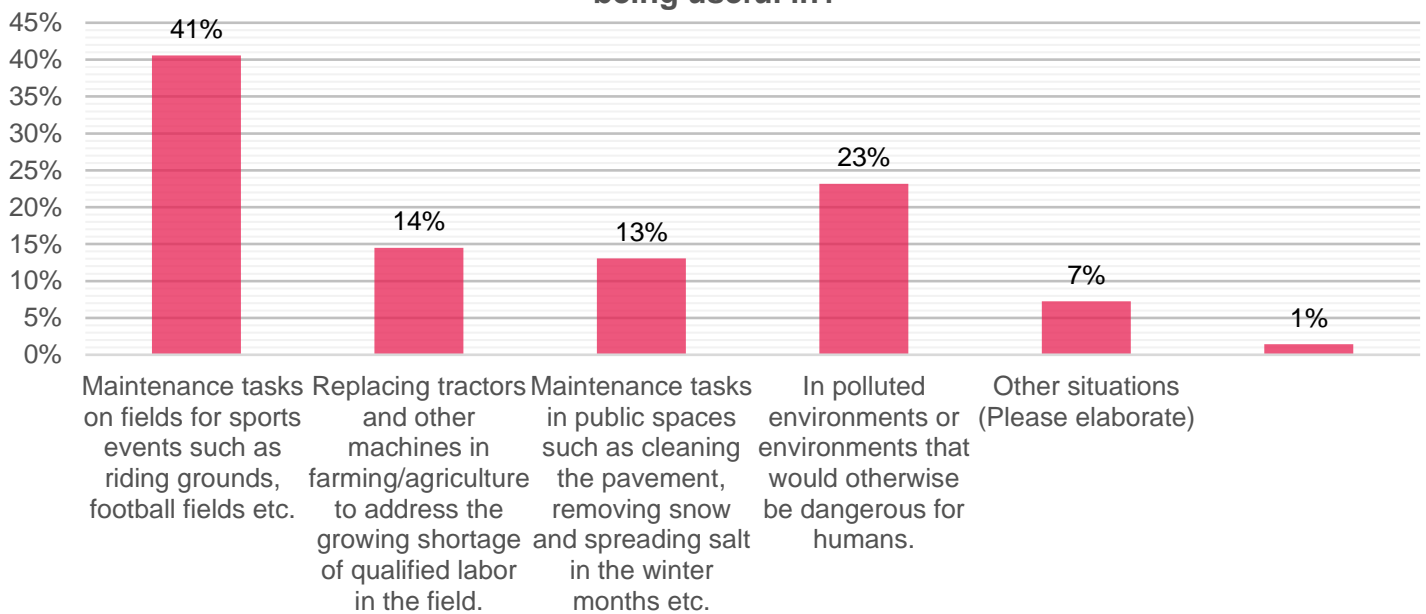
These specific demographics may influence the answers and tendencies described in the report. However, when reading through the responses it is important to be aware that these results are not statistically representative, but indications of people's individual opinions which can be used as valuable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

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:

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



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 the areas mentioned would be suitable for a robot of this type.

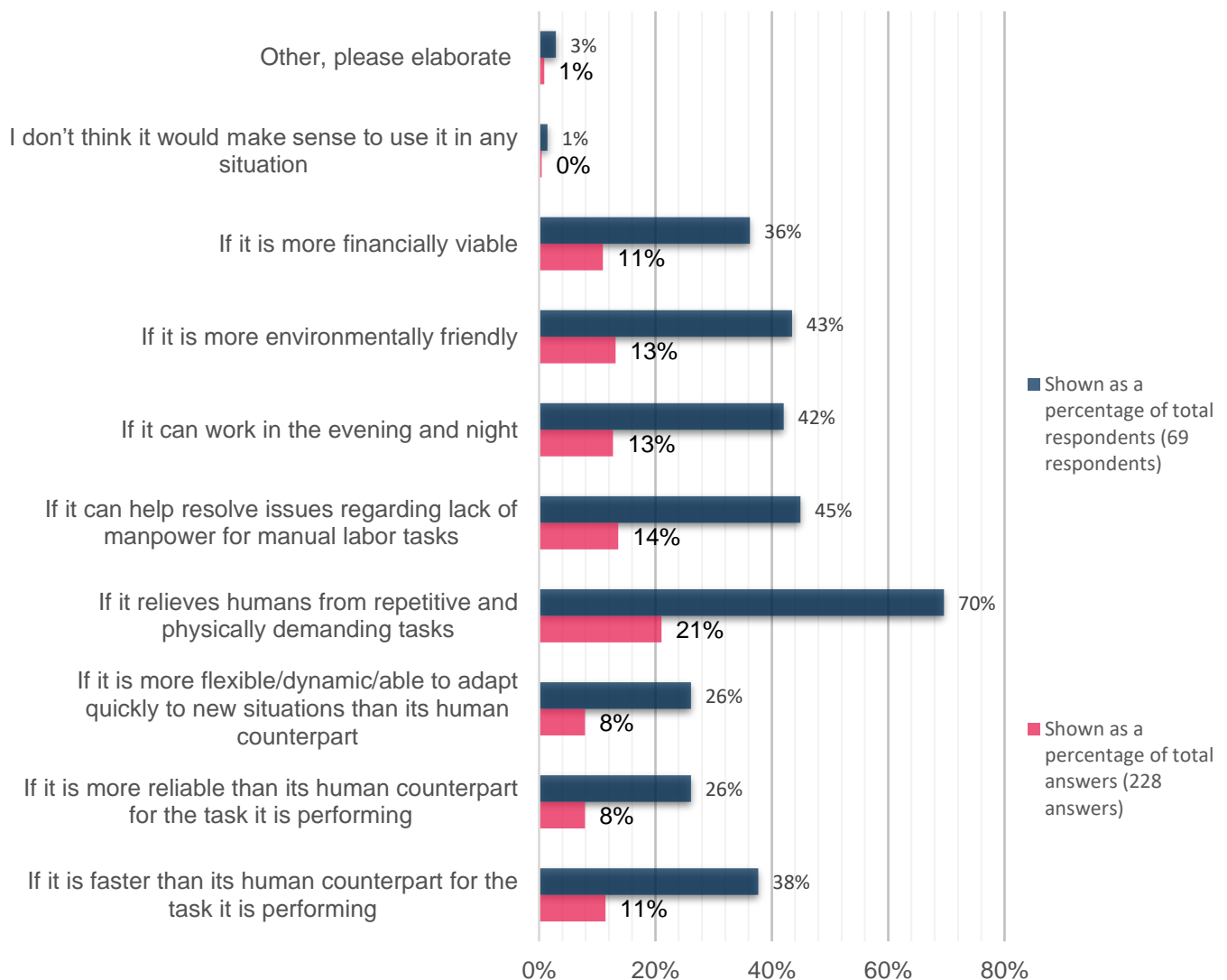
A focus group interview conducted among the participants of the Robotex International festival reveals that "Such machines on the fields do not pose any danger, and I have no great enthusiasm either. There you need machines that do the work."

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:

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



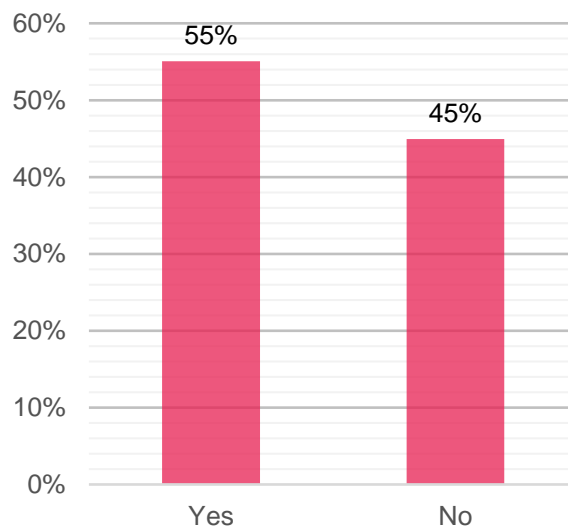
As can be seen, almost every area has received attention, indicating that respondents found all the possible uses of the robot to be something worthwhile to consider. The extra attention to using the robot to relieve humans from repetitive and physically demanding tasks is interesting and points towards 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.

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

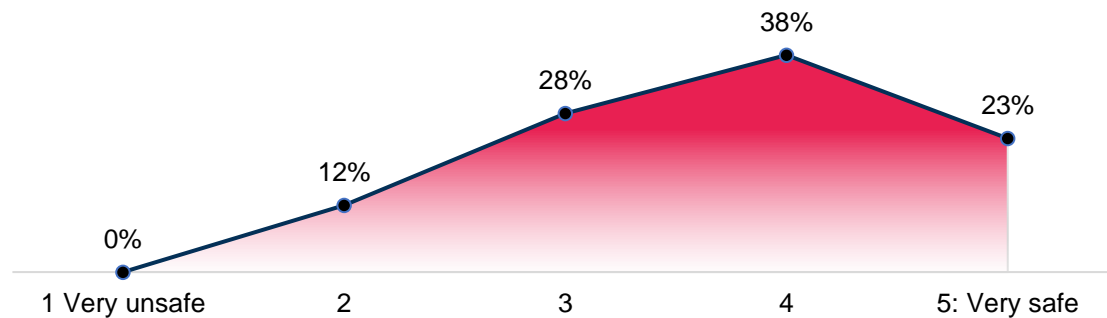


For those that did consider looks to be important, answers were based on a couple of different assumptions. Some emphasised the fact that if the robot is intended to roam and work in various public spaces it should be nice to look at. One respondent mentioned that the looks of robots in general will 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'.

Would you feel safe and comfortable walking next to the Robot?



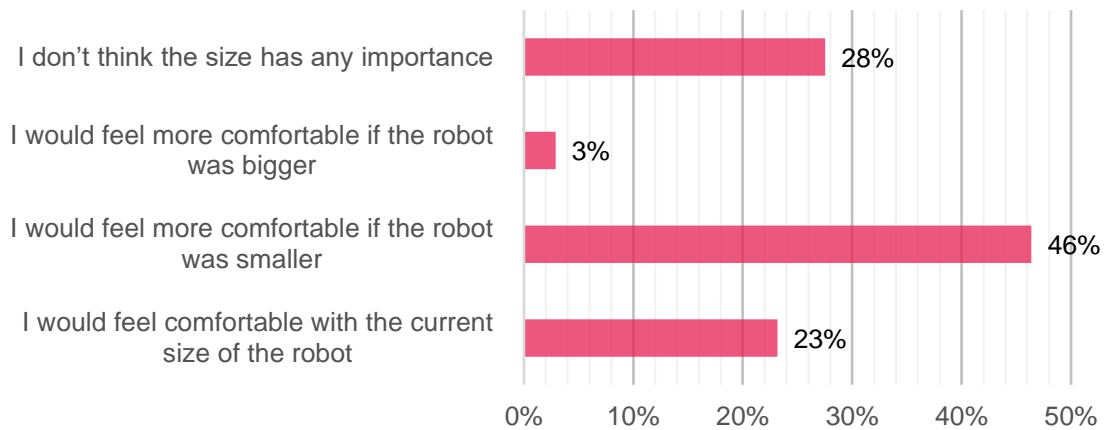
None of the respondents answered that they would feel very unsafe in this situation. On the contrary, many of the respondents answered that they would indeed feel quite safe and comfortable, with 37% placing their answer on the second highest point of the scale, and 23% answered 'very safe'. These answers 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.

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



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.

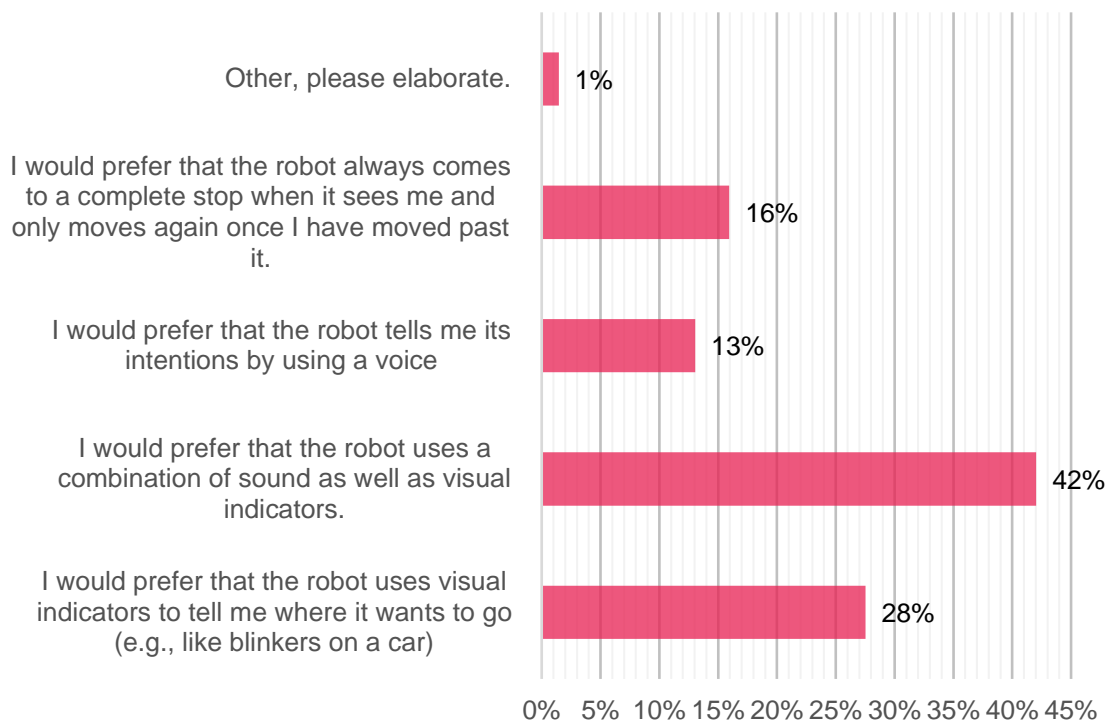
The distribution of answers seems to suggest a tendency to be less positive towards robots that are large in size. There can be many different and equally plausible explanations as to why this might be the case, for many it might be a combination of size and automation that causes them to be withholding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

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



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.

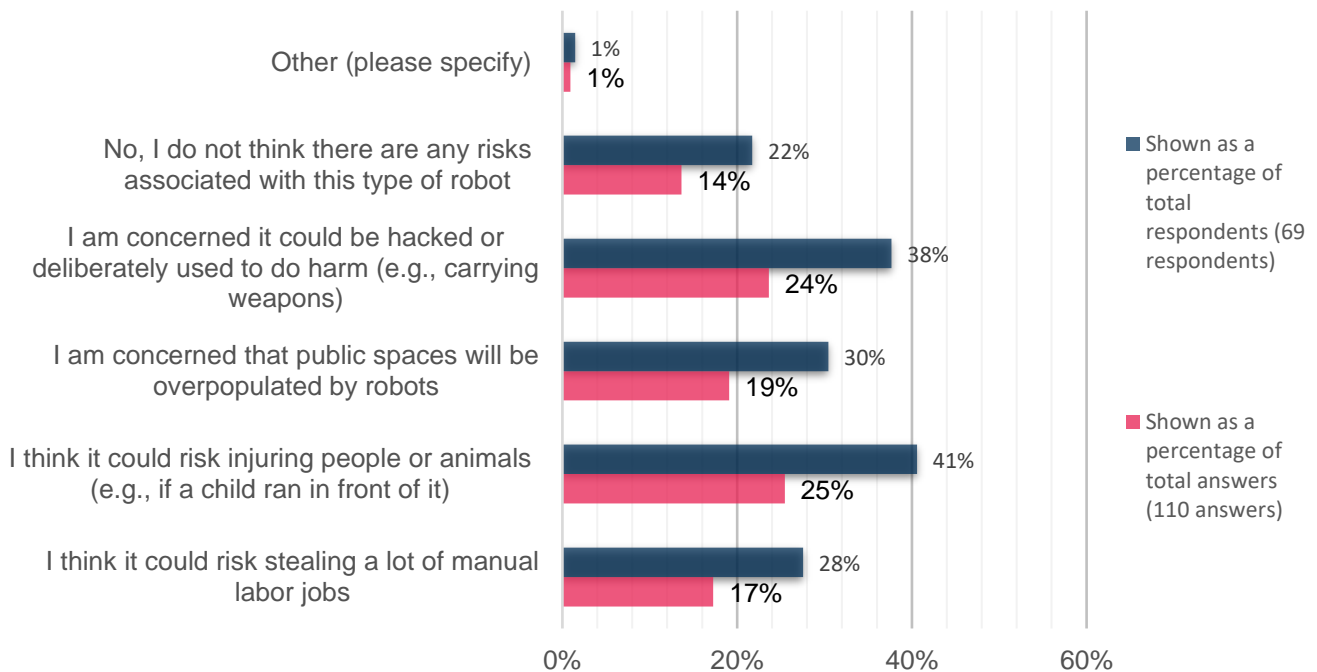
Respondents were also generally against using the robot in situations where it potentially performs worse than its human counterparts or where it is not financially viable. Some situations where respondents considered the robot to be unable to perform on par with humans were mainly areas lacking a plain/fixed 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:

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



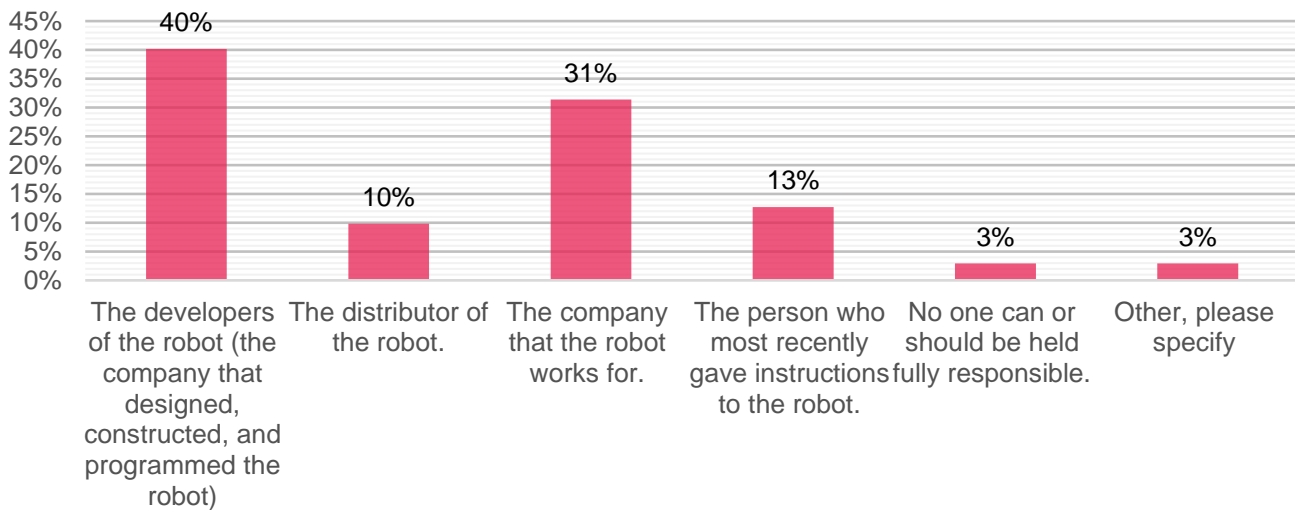
However, even though many did have concerns about risks the robot could pose to society, there were also many that did not think that there are any risks associated with this type of robot and one respondent said that there would be: *“No more risk than with a horse or tractor”*. And as with implementation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

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



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.

Conclusion

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.

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