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1. Executive summary

This is a white paper as that form is to promote societal development, i.e. a report or guide that helps readers understand an issue, solve a problem, or make a decision. At the same time this is the final report for INBOTS Work Package (WP) 6. The overall objective for WP6 is to promote the uptake of interactive robotics among the general public by identifying in which areas there is a potential to meet societal needs and what is needed to exploit this potential. According to the assignment, this should be accomplished by describing existing best practices and capturing societal values, needs and expectations. The WP have three main tasks:

- To identify gaps and needs related to the current level of understanding of robotics by the public including collection of best practices and key areas where robotics has potential to meet society´s needs. Involvement of end users should be included in this task (T6.1)

- To define a common strategy to increase public awareness about interactive robotics, including transferability of good practice (T6.2).

- To develop specific actions to bring robotics closer to the public and to build a future robotics society including social media, international events, dissemination and communication materials T6.3).

1.1 Disposition of the report

The report is organized in eight sections. In the introduction in section 2, the concepts robots and general public are defined. In sections 3, 4 and 5 the current understanding and available knowledge about social uptake in Europe and worldwide is described including a summary of the result of the assessment of best practices and promising areas for social uptake of robots in Europe. These results are under review in the International Journal of Social Robotics and are expected to be published in 2021.

Section 6 and 7 contains strategic proposals on how to enable social uptake and social awareness of robots among the public, including what we need to know to go from industry as the only target group for robot use, to homes and other everyday environments. These sections includes company perspectives and suggestions on how policymaking can be used to increase the uptake of robots. Section 6 deals with the main purpose for this final report through four questions also followed up and summarized as recommendations in section 8. These questions are:

1. What do we need to know to make it enable citizens to adopt and accept robots in their daily lives, based on the collection of best practices and analysis of their potential?

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2. What do companies need to know to expand their business outside well-known areas, above all to go from focusing on manufacturing to health, education and other support?

3. What do politicians need to do to ensure that there is a functioning ecosystem at the societal level, primarily regulations, standards and policies?

4. We have developed specific actions to bring robotics closer to the public and to build a future robotics society including design workshops, social media, events at international conferences both at place and at webinars. The latter was developed due to the pandemic which made it impossible to meet in person.

Section 7 describes how WP6 worked to build a community and involve citizens in the development of increased use of robots. This includes participation in conferences, initiatives to build networks, blogs and exhibitions.

1.2 Deviations and response to reviewers comments

The Corona pandemic drastically changed the work plans in March 2020, which meant that WP6 quickly switched to digital fora, which is described in section 6. One interruption concerned the plans for promoting diversification of production and marketing towards the public sector together with companies initiated at the project meeting in Madrid in January 2020. For WP6, this meant a shift from completing these plans and instead focusing on creating and enhancing a digital community in the robotic area with networking and several webinars.

Another deviation of plans concerned the idea to visualize and produce video clips of best practices in new robotic applications. This was supposed to take place during the first year but could not be realized because of difficulties of acquiring rights to film products and to organize a common format for filming among the sixteen WP6 project Partners. Instead, a comprehensive evaluation of robot applications collected by the Partners was conducted regarding technology readiness and adoption potential of interactive robots in the field of health in Europe, which is included in section 3.

The reporting responds to the reviewers' comments from the first review in 2019, where the following additions were requested:

1. A more complete description of best practices with the evaluation tool and the result (in numbers) of the evaluation. This is described in section 4 with a detailed figure of the analysis and the result. A paper was written on this subject but it cannot be attached in this report since it is under review for a scientific journal.
2. An explanation why industry is a reference point, while WP6 is about the public. This is explained in the introduction in section 2, that manufacturing is used as a reference point to compare the progress in healthcare, domestic and public domains. However, it should be noted that including manufacturing is according to the objectives of WP6 in the DoW.

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3. A description of the data from design workshops and publications. This is summarized in section 7 as part of building a community and involving citizens. The result is published in 2021 and the reference is included.
4. Any future of design workshops, if they will continue or not. Yes, design workshops will continue in the future being a central part of the research at the Royal Institute of Sweden involving people in the development, design and evaluation of technical artifacts and systems. This is described and references are included in paragraph 7.1.

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2. Introduction

2.1 Definitions of robots

Available robots are characterized by a great diversity. Any definition of interactive robots today shows that robotics is a field undergoing strong development that renders all definitions more or less premature. Relevant organizations, such as IEEE and Robot Industries Association (RIA), have come up with their classifications to provide at least some loose structure when addressing an extremely broad field of robotics) The RIA defines service robots as a new category of robots for use outside manufacturing including anything in agriculture, logistics, cleaning, medicine, customer service, hospitality, personal assistance, and more.[1] This report is using manufacturing and industry as a reference point for the uptake of robots in healthcare, domestic and public domains.

A project-wide definition of interactive robots in INBOTS is robots close to individual users and which work in direct interaction with the individual. The current level of understanding of the potential use of robots outside manufacturing is a number of implemented robots, but above all the visions, expectations and policies that drive this development. Some of the implemented robots are evaluated but the majority are not. As the results from INBOTS have shown, social robots and their role outside industry are still largely a discursive concept with the exception of a few sectors where robots have been implemented and evaluated (Pons 2019). These are surgery, disability support, education and social welfare, described in section 4.

2.2 Definition of the public

General public is possibly an even broader concept that needs to be defined. The mission in WP6 includes manufacturing, healthcare and domestic domains in the general public.[2] This is based on the project's composition of partners with broad expertise in a number of sectors and which in this way can contribute both with existing best practices and robot applications and with proposals on how companies can meet needs in new markets. However, in the work of promoting and exploring the social uptake of interactive robots the general public do not include manufacturing. Manufacturing is used as a reference point only.

From now on in this report, the concept *robots* is used when referring to interactive robots and the concept *social uptake* will be used when referring to the uptake among the general public outside manufacturing.

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[1] https://robots.ieee.org/
http://www.robotics.org/service-robots/what-are-professional-service-robots

[2] See INBOTS project description WP6: Objectives.

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3. Social uptake of robots in Europe and worldwide

The extent of social uptake of interactive robots in Europe is difficult to generalize due to the lack of coherent European statistics and the fragmentation of country-wide statistics. Already in the first INBOTS reporting in 2019, it was stated that the European statistical authority Eurostat has its focus on the presence of robots in industry and that there is a lack of collecting European wide data on any kind of social uptake. To further investigate whether there were national statistics that could offset the lack of Europe-wide statistics on the social uptake of robots, WP6 Partners examined the situation in their own countries in 2020, which is presented below at 6.4.

Eurostat shows that a quarter of European industry uses robots in its operations, more in larger companies and less in small and medium-sized enterprises[3]. The International Federation of Robotics (IFA) and the Robotics Industries Association (RIA) estimates that industrial robots will be a crucial part of the progress of the manufacturing industry for the foreseeable future.[4],[5]

A worldwide comparison shows that in China sales volumes are measured categorized in three types: domestic service robots, medical service robots and public service robots. The statistics show that domestic service robots, including robotic tools and educational robots amount to 62 % of the sales volume; medical service robots including robotic surgery, rehabilitation robots, auxiliary service robots and medical logistic robot amount to 24 %; and public service robots including reception and guide robots, delivery robots and smart security robots amount to 14 % of the sales volume (EO Intelligence 2020). The application of home service robots represented by sweeping robots is relatively mature; Public service robots have been used in retail, catering, government affairs, finance, hospitals and other scenarios, but they have not yet shown an uptake in a large scale; there are high technical barriers in medical service robots. Hence, medical service robot industry is still in its infancy (China Robot Industry Development Report 2019).

For the US, official documents regarding the existence of robots in various sectors or strategies for developing social robots are not available for the last ten years. On behalf of North America, researchers and companies in both the US and Canada are at the forefront of the development and publication of scientific articles on the subject. Taking part of global forecasts the expectations, developed on national levels are high. Transparency Market Reserach, which refers to social robots as artificial intelligence (AI) systems that are developed to interact with humans and other robots, includes social robots for tutoring, telepresence, companionship, and customer engagement in their external information. India is particularly highlighted as a nation in strong growth, especially when it comes to the deployment of social robots for traffic management (TMR 2021).

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[3] Eurostat Outlook 21/01/2019: https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/DDN-20190121-1. Showing that 25 % of large enterprises in the EU use robots, 12 % of medium sized enterprises (employing 50-249 persons) and 5 % of small enterprises (employing 10-49 persons). Enterprises more commonly use industrial robots than service robots. Enterprises use service robots mainly for warehouse management systems (44 %) followed by transportation of people and goods (22 %), cleaning or waste disposal tasks, as well as assembly works (21 % each).

[4] https://ifr.org/news/global-industrial-robot-sales-doubled-over-the-past-five-years/

[5] https://www.robotics.org/Industry-Statistics

4. Best practices of robots

WP6 assessed interactive robot applications in order to create an overview of the situation in Europe in terms of technology readiness and adoption potential. The resulting paper is submitted and in review at the International Journal for Social Robots.[6]

The assessment concern health defined in a broad sense. A first investigation presented to the European Commission in 2019 pointed out that compared to industry, transport and logistics, where robots have been used for a long time to streamline production and improve the work environment, there was only fragmented knowledge about the use of robots in healthcare.[7] Although some robots have been established with great success in microsurgery and for people with disabilities, there was a lack of an overview of the health sector in a broad sense and a lack of a discussion about why this was the case. Even in promising fields, such as education and implementation of interactive robots in public places, there is a lack of knowledge about what works and what does not. In this paper, robots that aim to enhance human abilities and quality of life, such as in education, for example, are included.

The collection of best practices was carried out by stakeholders that form the very basis for INBOTS, namely fourteen European universities and research laboratories, six businesses and five facilitators. The research they represent includes robot engineering, use-centered design, affordable design, social human-robot interaction, cognitive science and society and technology studies. To get as close to social uptake as possible and avoid applications that are still at the prototype stage or are far from users and consumers, an inclusion criteria was that the best practices should be high on the Technology Readiness Scale.[8] The highest levels are pre-commercial demonstration system (TRL 7), commercial system launched (TRL 8) and full commercial applications, technology available for consumers (TRL 9). In total 24 best practises were selected out of which the majority reached the upper TRL levels, see figure 1.

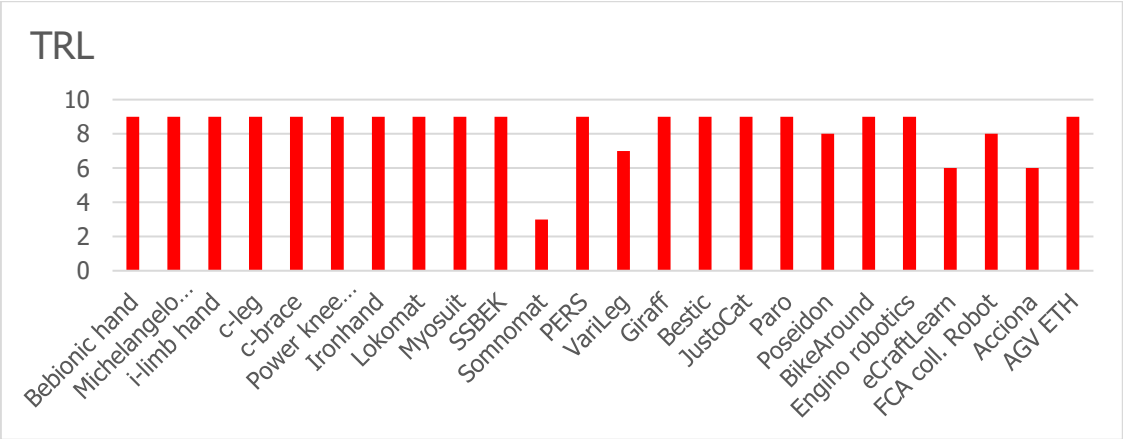


Figure 1. Comparison of TRL values for the 24 robots considered in the evaluation.

[6] Östlund, B., Malvezzi, M., Frennert, S., Funk, M., Gonzalez, Gonsalez-Vargas, J., Moreno, J., Baur, K., Alimisis, D., Thorsteinsson, F., Cepeda, Alonso, A., Fau, G., Haufe, F., Di Pardo, M. Interactive Robots for Health in Europe: Technology Readiness and Adoption potential", In review in the International Journal of Social Robotics February 2021.

[7] See the Report for the first INBOTS review meeting 2019.

[8] Technology Readiness Levels (TRL) Horizon 2020 – Work Programme 2014-2015. General Annexes. Retrieved 2021-02-03.

A tool for analyzing the adoption potential for each best practice was developed based on Rogers' theory of diffusion of innovation (Frennert et al 2020) and with additions regarding the market share. Seven criteria were included in the analysis: market demand: usefulness; relative advantage over previous solutions; feasibility in practice; attractiveness; novelty; and level of the producer's confidence about your marketing.

Figure 2 illustrates the result of the analysis for each best practice. The diagram show the rate of the criteria measured. A represents the demand; B represents usefulness; C represents relative advantage; D represents feasibility; E represents attractiveness; F represents novelty; and G represents level of confidence.

The result show that the majority of robot solutions are dedicated to individual rehabilitation or frailty and stress. Fewer solutions are developed for managing welfare services or public healthcare. The results show that while they are technology ready, most of the applications had a low score for demand. To enhance social uptake, a more initiated discussion and more studies on the connections between technology readiness and adoption and use are suggested. Applications being available to users does not mean they have an advantage over current solutions. The result also point at the fact that acceptance of robots is heavily dependent on the impact of regulations as part of the welfare and healthcare sectors in Europe.

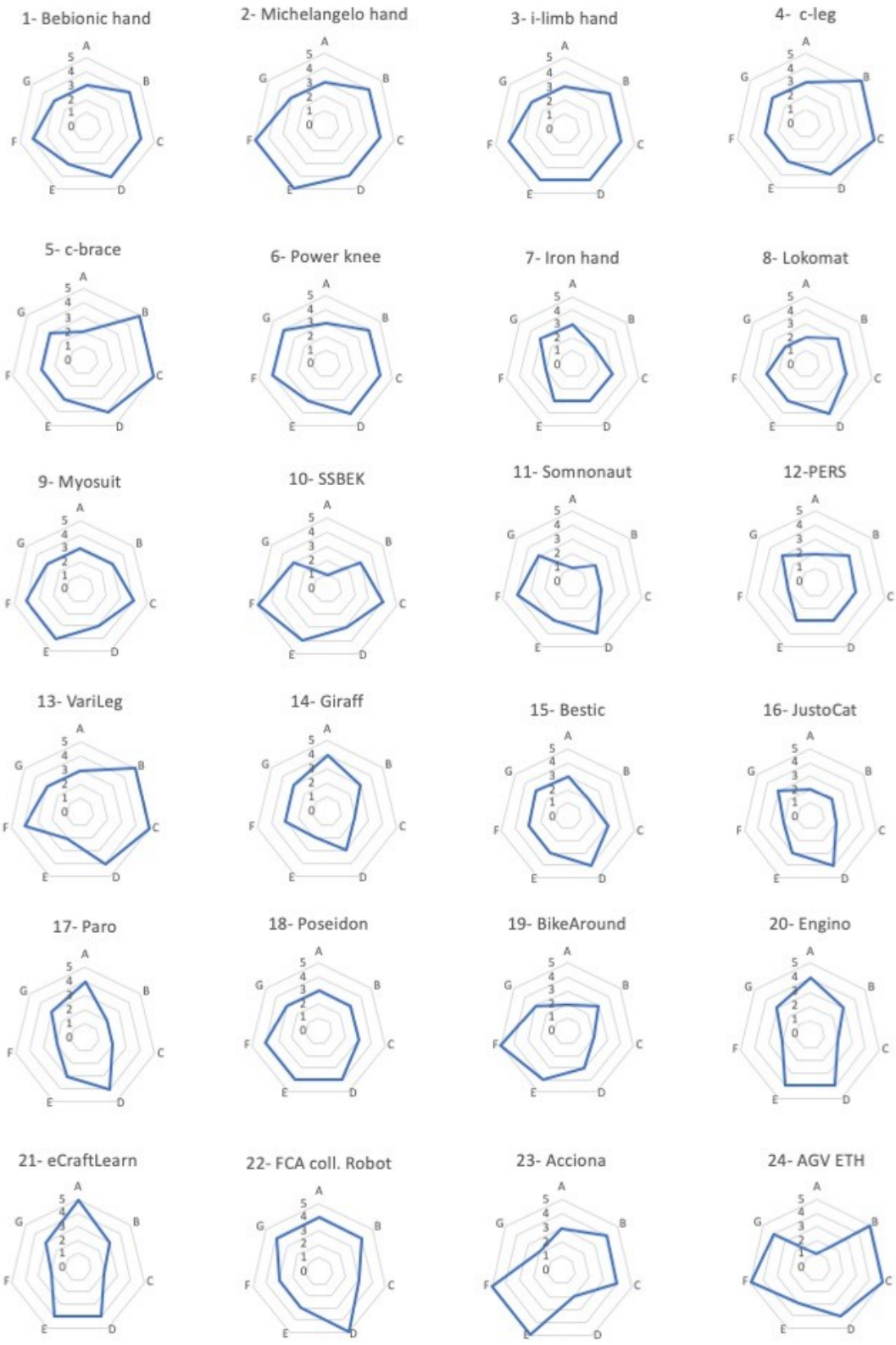


Figure 2. The result of the analysis for each best practice.

5. Promising areas for social uptake of robots

5.1 Industry at the leading edge

The use of robots has reached different stages of maturity in different sectors. Available statistics and best practices show that industries that are at the leading edge include manufacturing, logistics, rescue activities and exoskeletons. Promising areas with a number of applications implemented include support for disabilities, robotized assistance for surgery and education. Other promising areas starting to use interactive robots are health care presented above. Interactive robots at public places for example marketplaces are examples of a potentially promising area with a few single examples.[9]

5.2 Robots in micro surgery

Robots in hospital environments are increasingly common today both for surgery and for transportation. Robots for surgery are commercially available and well established in all surgical subspecialities allowing laprascopic surgery instead of open surgery, for example the da Vinci robot (Beasly 2012). Robots defined as service robots being part of hospital logistics are used for cleaning and deliveries, for example for picking up carts, transport clothes and stock up on medical supplies.

5.3 Educational robots

Education is another research area expected to grow Though the industry of educational technologies has already provided a lot of educational robots for formal and informal learning, a new pedagogical trend, inspired from the maker movement, has recently emerged promoting the incorporation of the making culture in robotics education. This new paradigm ("make your own robot") is expected to give a boost to Do-It-Yourself robots and reduce the demand for ready-made robots. Ongoing research could benefit from longitudinal surveys to examine the long-term impact of the different education solutions on young generation in terms of demystification, familiarization with and acceptance of robots (Alimisis et al 2020). Such a research direction would forthcoming help designers of educational robots to adjust their solutions and products according to the results of the surveys including feedback from educators and learners. A report on robots in education is provided by WP3: Promoting Highly Accessible and Multidisciplinary Education Programs. WP6 contributed to the EDUROBOTICS conference 2020 with a paper on how to enhance teaching about robots in the education of assistant nurses in elderly care (Östlund 2021).

Another important factor for the uptake of robots in school education is the increasing awareness that the robotic technologies we invite children to interact with should be designed in line with sound learning theories and a constructionist/constructivist pedagogy (Alimisis 2020). Robots designed for professionals or enthusiasts when introduced in classrooms may cause difficulties and eventually frustration and discouragement for young learners because they presuppose a domain knowledge and skills that young students or

[9] See the Report for the first INBOTS review meeting 2019.

novices are unlikely to possess. Moreover, the producers of technologies for professionals or hobbyists focus on doing the job fast and at a low cost. They do not care much (nor is it their role) to help users understand how the robot works; this often results in overdesigned technologies which essentially hide how the robot actually works. However, the pedagogical care alone cannot guarantee the design of appropriate robots. Very often, robots for learning offer "less for more" or are not reliable. Putting emphasis on making robots educationally meaningful and engaging should not compromise their reliability or scientific accuracy.

5.4 Robots in social welfare

In social welfare robots are used for administrative matters to support citizens' applications for welfare services for example the SSBTEK owned by The Swedish Association of Local Authorities and Regions. Service robots, sometimes called care robots or social robots, are also provided to patients in care facilities to decrease anxiety, designed as animals, for example Paro or JustoCat (Johansson-Pajala 2020, Shibata 2012). Robots to interact with patients are on the way to be implemented in ordinary homes as the shower robot Poseidon provided by Robotics Care Inc. There is also a range of adaptive robot hands and tele robots, for example the Giraffe robot, but the procurement of these products are still low.

6. Enabling social uptake of robots

Social uptake of robots is accompanied by high expectations of what they can bring to people and businesses in virtually every area of society. So far, the discussion has been about what trends are discernible, what is needed to make them work in human contexts and what challenges we can probably expect based on what robots is coming (Frennert et al 2020, Royakkers & East 2015, Beasly 2012). Some evaluations show that the developments are slow due to lack of knowledge about the context and eco-systems in which robots are supposed to be implemented (van Aerschot & Parvaiainen 2020). Predictions are especially difficult to make since it is about ongoing development and implementations of new technologies and partly in areas where robots have not been used before (Frennert 2019). A clear trend is that robots that have long been used in manufacturing at assembly lines are now being discussed as consumer products and as part of providing care and services to old people at home (Kwak et al 2017).

Hence, the discourse about what robots can bring to the public is under development. Today it concern ethical and political ideas (Toboso et al 2020), trends and potential social effects and suggestions how to evaluate these effects (Frennert et al 2018) and attitudes and expectations of what robots among the public may bring (Toboso et al 2020, Eurobarometer 2012). However, the debate is strongly normative aiming at promoting a wider use of robots in Europe, regulating markets, solving legal and ethical issues, accompanied by high expectations of what they can bring to people and businesses in virtually every area of society (van Aerschot & Parvaiainen 2020, Frennert et al 2020, Royakkers & East 2015, Beasley 2012).

With this background of promising developments but still with a lack of data on social uptake of robots and experiences from industry still dominating the market and the supply of robot applications and not least, the mindset and understanding of what robots can be used for, the most pressing issue must be how to enable social uptake.

Against this background, the main question for this white paper will be how the uptake of social robots can be made possible. The document can help answer this question in four ways:

1. What do we need to know to enable citizens to adopt and accept robots in their daily lives, based on the collection of best practices and analysis of their potential?

2. What do companies need to know to expand their business outside well-known areas, above all to go from focusing on manufacturing to health, education and other support?

3. What do politicians need to do to ensure that there is a functioning ecosystem at the societal level, primarily regulations, standards and policies?

4. We have developed specific actions to bring robotics closer to the public and to build a future robotics society including design workshops, social media, events at international conferences both at place and at webinars. The latter was developed due to the pandemic which made it impossible to meet in person.

6.1 What will enable citizens to adopt and accept robots in daily life?

The main gaps to be closed in order to promote social uptake of robots are first, knowledge, statistics on the uptake and use among Europeans. Second, technological possibilities designed be engineers need to be applied according to available research on what makes technology accepted and rejected and what can we learn from domestication theory when technology is contextualized in situations and environments where people live and work. To achieve this, methods and useful examples of public participation are available today to guarantee social uptake through the design process and that the results lead to good practice.

Robots as any other technological applications to be used in a social context, must be worth using in a meaningful way. Applications may well be usable but not "use worthiness", for example, a book may be possible to read but not worth reading (Eftring 1999). The requirements for acceptance of robots in daily life may be higher and at least different compared to the use of robots in working life. Therefore, tests and the study of robots in home environments and other care environments can constitute a higher fence to overcome for researchers and companies that are not used to moving in such contexts. The main difference between a production set and a home environment might be the understanding of routines and meanings embedded, and not always, articulated in both manufacturing and homes. For example, international studies conclude that the automation of work that is possible with artificial intelligence and robots differs between industries and areas depending on how much social sensitivity and contact with people the work requires. In manufacturing and warehouses, it is estimated that about 60% of the work can be automated, but 36% in health care provided in the homes of people. It should be noted that the latter is one of the sectors where robotization is discussed in order to make aid to a growing elderly population more effective (McKinsey 2017, Arntz et al 2016, Frey & Osborne 2013). However, as the figure show, 36 %, this kind of jobs cannot be expected to be automated to the same extent as in manufacturing since having human beings as the work task in itself require a sensitivity that is not required when working only with material factors.

According to the most influential theories and models published, enabling social uptake of new technologies rests on what is already there and which makes users secure and motivated. In its outlook report 2019 Eurostat concludes that ICT is the main enabler to generate innovations and businesses and also leverage socio-economic gains (Eurostat 2019).

One of the most influential models explaining individual acceptance is the Technology Acceptance Model (TAM) initiated for working life studies in the end of 1980s determining the intention to use a system by perceived usefulness and perceived ease of use (Venkatesh 2000). This model mainly proves that the beliefs in what consequences a behavior will have, affect attitudes and in turn actual behaviors. Being criticized for overlooking social and cultural factors the model was expanded in 2003 into a unified theory (UTAUT) merging eight previously published acceptance models such as social cognition, training and

marketing. TAM that was originally developed out of a working life perspective has been widely applied also in other areas such as later life (Venkatesh 2003).

Another widely used theory is the diffusion of innovations that explains the five factors that makes users safe enough to accept new technologies. This is the theoretical framework that made the base for the analytical tool used in the WP6 paper submitted to the International Journal of Social Robots.[10] These are the *Relative advantage,* defined as the "degree to which an innovation is perceived as being better than the idea it supersedes"; *Compatibility*, defined as the "degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters"; *Complexity,* defined as the "degree to which an innovation is perceived as relatively difficult to understand and use" ; *Trialability,* defined as the "degree to which the innovation may be tried and modified"; and *Observability,* defined as the "degree to which the results of the innovation are visible to others"(Frennert et al 2013, Rogers 1995).

A third theory to understand and pave way for acceptance is the domestication theory explaining the adaption process when new technology is brought into the home environment. This domestication process includes four phases: appropriation, objectification, incorporation, and conversion (Berker et al 2006, Silverstone & Hirsch, 1992). Finding out whether technology is domesticated or not require a real-world assessment which will give us an indication if and how robots transforms from being unfamiliar and perhaps frightening into something familiar and part of people's routines and practices.

Responsible research and innovation (RRI) is an approach to research and innovation governance aiming to ensure good practice. Based on the needs for companies to evaluate the degree to which its practices actually align with public benefits of science and technology-based research models and toolkits developed for facilitating the integration of RRI in corporate management is under development (Stahl et al 2017, OECD 2021). A wide definition of RRI is the ambition to achieve a transparent, interactive process between societal actors and innovators with a special focus on ethics, sustainability and societal desirability (Von Schomberg et al 2013). There are also a number of methods and examples of public participation ranging from researchers, activists driving their own agenda and any other groups of citizens wanting social change (European Institute for Public Participation 2021) and global networks and crowdfunding platforms to support public actions (Participedia 2021). Robots as a way to increase interactivity between politicians and citizens and participation in the design of community services are a growing proportion of examples. One longstanding theory in architecture research, Arnsteins ladder of citizen participation, are becoming of use to increase public participation and in a more responsible way. Arnstein's ladder can be categorised into three levels of involvement corresponding to how much influence is given to users (Fischer et al 2021, Arnstein 1969). The highest level represents how users themselves are in control, initiating and driving design to accomplish something. The intermediate level is when people participate as experts on their own life situation, negotiating and collaborating with designers in partnership, being consultants. The lower level corresponds to users functioning more as informants with the ability to comment on already made-up plans or design, or testing prototypes.

[10] Östlund, B., Malvezzi, M., Frennert, S., Funk, M., Gonzalez, Gonsalez-Vargas, J., Moreno, J., Baur, K., Alimisis, D., Thorsteinsson, F., Cepeda, Alonso, A., Fau, G., Haufe, F., Di Pardo, M. Interactive Robots for Health in Europe: Technology Readiness and Adoption potential", In review in the International Journal of Social Robotics February 2021.

In summary, in order to increase the social uptake of robots outside industry, priority must be given to method development that can contextualize technology and provide access to the people who live and work outside laboratories.

6.2 What do companies need to know to invest in new markets for social uptake of robots?

As a result of the successful robotization in the industry, approaches to testing and implementing robots in working life and industrial processes are well known to companies in the robotics industry. How robots should be adapted to everyday life or other sectors such as education, health care or social welfare is still relatively unknown ground for many companies. This emerged at the first workshop with companies.

In 2020, just before the corona pandemic hit Europe, WP6 dedicated a workshop at the annual INBOTS project meeting in Madrid to what companies need to diversify their development and production towards new markets and areas in order to increase the social uptake of robots. The workshop began with Ann-Louise Lindborg from Camanio Care, one of Scandinavia's leading companies in the welfare sector, giving a business perspective on the provision of service robots.

The plan was to follow up on this workshop with examples of diversification and further share knowledge on methods to test products in public settings, such as living labs, home like labs and care accommodations. Unfortunately, this was prevented by the pandemic. Instead WP6 went digital. During the workshop diversification to new markets rendered a big interest but with very few examples. One example discussed during the workshop was the bionic hand, which was originally developed to support workers at assembly lines or other work tasks but is now in demand both by older consumers and in rehabilitation. Instead of markets, procurement of public goods was discussed. Two company reflections below will illustrate the perspectives of the future of educational robot industry and why markets is not enough for companies to diversify and promote social uptake.

To sum up, there is a lack of support for companies that want to develop their business in sectors such as education, health and social welfare. The interest in diversifying their business is great, but there is a lack of knowledge about how to do this and about good examples of diversification. Educational robots are examples of contextualization of robots outside industry and on successful implementation.

6.2.1 The future of educational robot industry

What is the future of educational robots? What is the vision of educational robot industry? In the framework of the INBOTS project, EDUMOTIVA team interviewed Costas Sisamos, founder of Engino.net Ltd, and asked him to share with us his vision on education, robotics, STEM and the future of Engino.

Engino products include multi-award-winning educational robots for children and adults, made from plastic rods and connectors that can create simple and complex designs using

a small number of pieces and equipment. Costas Sisamos, who in 2004 was the coordinator of the Design and Technology Program in Cyprus school education, noted that his pupils found it difficult when they had to build models of robots and realized that he had to find an easier and faster way for this process. That is where the idea for plastic connectors came from. Today, 16 years later, the social, economic, and industrial benefits offered by the company are significant not only for Cyprus but also internationally since Engino robots and toys for children are exported to more than 50 countries. The Engino robots are an excellent educational tool that helps children to develop creativity and design thinking skills, inspiring the inventors of the future. Engino's success story shows what educational robot industries need to be aware of while designing new robots for children:

- Awareness of children's needs and pay attention to their difficulties, preferences and skills.
- Including designers' in their teams to ensure that robots will be suitable for young learners and in line with the current educational trends and learning theories.

6.2.2 Why market is not enough to promote social uptake

There are several reasons that are possibly negatively affecting the social uptake, and these could be related to some questions a potential customer may ask at the time before making the decision of a possible purchase. This is an interview with one of the INBOTS Partners, Antonio Alonso Cepeda at ACCIONA, a company working in infrastructure, energy and sustainability.

From the point of view of a potential customer, a first question for coping with this issue could be: What problem do I have? or What are the needs (challenges) that the company has to face? Depending on the area considered, we may be thinking about: manufacturing problems; activities in polluted work environments, in which people should preferably not work; physical or mental fatigue issues when carrying out work (surgical or manufacturing); skilled labour shortage or assistance difficulties with people suffering physical or psychological limitations.

The second question could be: Will this robot help me to face my challenge? We frequently attend media presentations of robots. Systems are presented with increasingly humanoid characteristics that tend to empathize with people. The technology and use of AI is showing a promising and advanced future, raising very high expectations for these systems in the next years. We are all aware of the real and objective progress that is taking place in robotics and we predict a very disruptive and amazing future in this sector. Now, when considering the acquisition of a robot to solve a specific activity like the one we had in the previous question, an affirmative or negative answer at this point is the one that is possibly affecting the uptaking decision of the potential buyer.

The third question concerns whether the performance of the robot is competitive (has a good performance) doing a task, or whether this robot can co-work or enhance the capabilities of a worker. In the case of parts manufacturing, an improvement in productivity will be sought (higher production speed or a greater number of working hours). For hazardous environments, the ability to do the job properly and protect workers may suffice. In the field of physical or mental fatigue, it will be necessary to measure in what way this is reduced by quantifying, for example, the number of hours that the new solution allows

to increase the work, or the reduction of errors when performing an activity with respect to the previous situation. Talking about the assistance to people with limitations, it should be evaluated if somehow the robotic solution can provide the care that a person (caregiver) would provide (at some relevant level), or at least define in what specific tasks it could match it or reach a point that would be functionally suitable for these people with limitations.

Once we decide a robotics technical solution could help us to solve our challenges, it should be evaluated the economic viability of this robot for our situation. This analysis is important in terms of profitability for the private sector and sustainability in the public sector, depending on a high procurement competence.

To sum up, some reflections that customers could think about before acquiring a robot could be: First, the design of the robotic solution and its implementation is key. It should be designed and tested jointly, and since the first moment, with people who will use this machine in the future, so that they give the appropriate requirements and the product achieved really helps to improve the situation of similar and new potential customers. Second, the robotic solution selected should achieve a reasonable cost for clients (public or private sector) who acquire it, encouraging potential buyers to test the capabilities of these systems, thanks to reducing the consumer's perception of economic risk by investing in these solutions. Third, it should be possible to achieve economies of scale in the manufacture of robotic solutions, since an important part of the price of robots is given because very few units are manufactured for a specific challenge. In many cases, design costs affect directly in a relevant way the final robot price due to the small number of units manufactured. Fourth and finally, procurement competence in public welfare is key to procure and demand for relevant solutions.

6.3 Policies for the uptake of robots among the general public in Europe

Policies are instruments that can support companies when diversifying and moving out of well-known sectors and markets into new sectors.

6.3.1 National policies

In 2020 and 2021, WP6 made another effort to pave the way for social uptake, namely by dedicating a session at the final conference to bring in experiences of how to use policies when promoting new technologies. Since markets don´t seem to be enough to promote robots for the public or at least not enough to speed up the uptake, policies to be necessary. In preparation for the session, we investigated the existence of national policies country wise in Europe that support social uptake.

These strategies developed by governments authorities in Germany, Greece, France, Iceland, Spain, Switzerland and Sweden are described in detail in Annex 1.

The result show that these strategies mainly concerns industrial developments. Overall societal aspects are included in terms of visions of improved social interactions between citizens and leveling out of regional differences. Concepts of artificial intelligence, cyber and digitalization are used rather than the "social". When the "social" is used it is related to social challenges. However, physical support, enhanced learning, administration and life science and health are mentioned somewhat. To sum up there are expectations of what robotics can bring to the general public among European politicians but the visions have not yet landed in concrete strategies.

6.3.2 Policy labs at European level

Policy labs are a relatively new way of working with policy development in Europe. These policy labs exist today in a handful of member states in EU including groups of actors engaged in developing regulatory frameworks. This cooperation takes place between authorities, business and relevant end users. Characteristic of policy labs is that they strive for a more agile and flexible approach compared to before when regulations and guidelines developed into a more regulatory approach than was desirable.

Policy labs, was presented and discussed at the INBOTS final conference where one session organized by WP6 was dedicated to the use of Policies to promote social uptake of interactive robots. One of the experts in the session was Jakob Hellman, Head of Innovation Management Division at the Swedish Agency for Innovation Systems. He presented five of the challenges that policy labs have to deal with. One challenge is to try to break down existing structures that tend to limit communications between different actors. A second challenge is resistance to change appearing when actors have invested interests and power over existing ways of working and understanding the purpose of the organization. Third, new collaborations between actors form different sectors often take place in pilot projects, which is not enough to see results that develop over time or to create sustainability. Fourth, in order to be solved, problems and issues have to be addressed properly. Last but not least, the focus should be on management change. This was something that characterized the discussion throughout the session at INBOTS final conference. No change takes place without communications and unless the people inside the system are involved.

Another expert in the session, Sylvie Bové from the Research Institutes of Sweden, RISE, emphasized society's need for policies. She pointed to climate change and demographic change that require a discussion on how to use society's resources. She hereby confirmed WP6's results that the issue of social uptake of robots is, like all innovations, an issue beyond the market. Creating the necessary changes requires more than technical solutions. Awareness of changed management must be created inside organizations, not from outside. Achieving change and taking advantage of technological innovations such as robots is simply a matter of mindset.

The session provided many examples of experiences of promoting policies in collaboration with tax agencies, transportation, diagnostics in cancer care and working life to name a few. Björn Arvidsson from STUNS Life Science in Uppsala and Björn-Erik Erlandsson senior adviser with a long experience from MedTech and pharma industry discussed health care.

They pointed out several advantages and disadvantages working with promoting policies in health care systems. In order to achieve less of a push, which is what is usually rewarded in policies that apply to new technologies and more of a pull from within the system, innovations must have a relative advantage. Neither the question of money nor robots replacing human beings belong here. It is about creating trust and lowering the threshold for daring to try something new. For those who are involved in policy development, the most important thing is to understand what the incentives for change are and to have the ability to act. Experience from working with health care organizations points to a feature that is particularly characteristic of this sector, namely its conservative features, which also include issues of hierarchies and the division between the responsibilities of men and women.

In summary, policies to increase the utilization of robotic resources should put change in focus, not separate technological applications. What changes are desirable and how can robots support these changes. These changes must also be based on the system that is subject to change and on the basis of the actors who have interests there and the people who work there.

7 Building a community and involving citizens

WP6 have developed specific actions to bring robotics closer to the public and to build a future robotics society including design workshops, social media, events at international conferences both at place and at webinars.

7.1 Involving citizens

WP6 has benefited from the work of using and developing participatory design methods at KTH in Sweden. This extensive work examining and testing the benefits of involving people in the development, design and evaluation of technical artifacts and systems (Fischer & Östlund 2020 A, Fischer et al 2020 B, Fischer et al 2020 C). In this project, the focus has been on health and nursing and included line managers, frontline care staff, older people and students training to become assistant nurses. Two main contributions were made in this respect.

First, focus groups were conducted with 94 participants aiming at studying care staff and potential care receivers' assumptions, expectations and understandings of care robots (Frennert et al 2020). The focus groups were conducted once for three different selections that consisted of line managers, frontline care staff, older people and students training to become carers. The result show that preconceptions about care robots lead to either rejection or resentment of the technology, or to unrealistically high expectations. Providing hands-on experiences of care robots in work and education settings may be a positive way of enabling frontline care staff and care receivers to gain relevant knowledge. This would also empower these intended users by supporting their ability to differentiate between the actual capabilities of care robots from the visions created by current rhetoric and marketing. Care robots are often portrayed as an exciting new technology for improving care practices. Whether these robots will be accepted and integrated into care work or not, is likely to be affected by the assumptions, expectations and understandings held by potential end users, such as frontline staff and the people that are cared for. This paper describes how the conceptual framework of technological frames was used to identify the nature of care robots, care robots in use and care robot strategy as shared group level assumptions, expectations and understandings of care robots among care staff and potential care receivers. The technological frame of the nature of care robots revealed two complementary components: care robots as a threat to the quality of care, and care robots as substitute for humans and human care, held together by imaginaries of care robots. The technological frame of care robots *in use* revealed aspects of prospective end-users' uncertainty of their ability to handle care robots, and their own perceived lack of competence and knowledge about care robots. In addition, the following potential criteria for successful use of care robots were identified: adequate training, incentives for usage (needs and motives), usability, accessibility and finances. The technological frame of care robot strategy was revealed as believed cost savings and staff reduction. The novelty of the results, and their relevance for science and practice, is derived from the theoretical framework which indicates that adoption of care robots will be dependent on how well

societies succeed in collectively shaping congruent technological frames among different stakeholders and aligning technological development accordingly.

Second, a work to integrate robots in the curriculum for assistant nurses working in elderly care was carried out with 49 teachers at the Swedish College of Care and Welfare, VO-COLLEGE. Robots are for sure entering care work but the development remains slow. With this challenge in mind, the key issue is how to educate healthcare professionals in the use of robots. This project included two seminars, two course development meetings and one design workshop aiming at exploring teachers' experiences of technology in care for the elderly work and in teaching technological matters. Being part of the broader framework of digitalization, robots are perhaps one of the most thought-provoking applications and expectations are high of what they can bring to virtually every area of society. Compared with other sectors in society, care is something more than nursing and offers special challenges. The adoption and technology readiness of available robot applications are high but a more thorough contextualization is needed to broaden the uptake. International reports indicate that digitalization has great potential for automating working life, but the differences between sectors is large. The potential for further automation of tasks in industry is large, while the potential is significantly lower in healthcare, actually 36% compared to 60% for manufacturing or 73% for the restaurant sector [3] [4]. Of course, working with people places completely different demands on flexibility and sensitivity. The question of automation here is the use of robots and how they should be organized and used, which are among the key issues for educators in healthcare. Another key question is how to integrate robots in the education of professional care workers. How to make robots part of the curriculum and what is it that future care workers really need to know? Also, can robots be part of teaching care workers, or at what stage will they experience this technology? The result presented at the EDUROBOTICS conference 2021 (Östlund 2021) show that design workshops seem to be a more useful method to generate suggestions on how robots can be better adapted to care work, compared to seminars that brought up broader, though important, questions about care work and the role of assistant nurses and care receivers. The conclusion is that a greater awareness of technology used in care for the elderly is important to contribute to a relevant adaptation of robots and to be able to meet the challenges of an increased demand for care and care professionals. Increased responsibility for this development conveyed in education can help to broaden the view of technology, from being passive recipients of technology to being active co-creators.

7.2 Increasing public awareness in social media

7.2.1. Webinars

WP6 initiated a Nordic chapter of the international community Aging2.0 together with the CeO of Camanio Care, young entrepreneurs and senior organizations. See https://www.aging2.com/ WP6 was responsible for following webinars:

- Challenge your images. Technology is changing but what about our images? June2, 2020. Zoom webinar in collaboration with Digital Futures at KTH.

- Future challenges with digitalization and robots, with Ericsson and Digital Futures at KTH June 3, 2020. Zoom meeting with 26 participants.

- Corona, digitalization and social uptake among older people, June 9, 2020. Zoom meeting with 98 participants.

- Competence and leadership for changes in elderly care, April 15, 2021. Zoom meeting with Microsoft and regional and municipal stakeholders, in all 92 participants.

- Hackathon with seniors and students October 5, 2020.

7.2.2. Digital communication

- **LinkedIn group: Robotics Uptake – The community for Inclusive Robotics**
  We haver created a new group on LinkedIn to put together all the experts form different knowledge domains related to robotics, to keep all the professionals in touch and allow the robotics field keep growing thanks to the collaboration among experts. The group is a place where share the questions and responses to all those issues related with robotics and AI from a non-technical point of view.

- **Youtube: INBOTS Experts opinions about COVID 19 crisis.**
  Due to the COVID-19, we proposed to launch a talks series on how interactive robotics could help solve the problems caused by the pandemic crisis. We invite all partners to participate by asking them to answer questions about their field of research and work in interactive robotics. The talks were published on our youtube channel in short videos. Below is a list of the videos that were released:
  - Our Partner TECNALIA shows how they have adapted their technology to fight Covid 19
    Many organizations are adapting their technology to fight Covid 19, in the specific case of interactive robotics, there are many solutions that can easily be adapted to contribute to overcome this situation. Like TECNALIA, who has the technology to adapt robotic arms to make test to patients allowing healthcare professionals maintain the recommended security distance.
  - Will Covid19 contribute to the acceptance of Interactive Robotics?
    Joost Geeroms, engineer scientist and current post-doctoral researcher at the Vrije Universiteit Brussel (VUB), analyses the impact of interactive robotics in daily life thought their diverse applications and considers the effects on interactive robotics acceptance after considering the benefits of using these technologies during the COVID 19 sanitary crisis.
  - How interactive Robotics can help in the protection against new pandemic
    Dr. Francesca Gallo, Researcher at CRF - WCM Research & Innovation, explains how new robotic technologies can help in the fight and protection against COVID-19 and other future pandemics.
  - Interactive robots can easily be adapted to assist humans during COVID19 crisis like PAL Robotics
    Francesco Ferro, CEO at PAL Robotics explains how they have adapted their technology, interactive robotics, to contribute to the pandemic of

coronavirus by providing service and attendance and being used as a way of control to patients.

- Interactive Robotics & AI might help elderly people during Covid19 lockdown
  Sanna Kuoppamäki, Researcher Ph.D at the KTH Royal Institute of Technology shares her expertise and progress made at BCONNECT@Home project in the use and benefits of using digital technology by elderly people to reduce the isolation feeling during the Covid19 crisis lockdown.
- How can children keep learning about robotics during COVID19 pandemic lockdown?
  Our team member Chrissa Paparasantou from EDUMOTIVA shows how children can keep learning to use and program robots at home with some useful online tools.

- **INBOTS Final Documentary**. This 3rd documentary video on interactive robotics applications and impacts of the INBOTS Project is a complementary continuation of the first and second documentaries. The aim of this third documentary is to present the main conclusions of the INBOTS final white papers and to present the state of the art of the interactive robotics. To do so, we interviewed the leaders of the work packages related to the six INBOTS areas of expertise: entrepreneurship and non-technical support to SMEs, debate on legal, ethics and socio-economic aspects, accessible and multidisciplinary education programs, standardization and benchmarking, regulation and risk management framework and societal and socio-economic uptake.

  Due to the pandemic situation, we have changed the format of interviews and events used in the two previous documentaries. For this documentary, we have set up an online panel discussion around a series of questions. To do so, we brought together, via TEAMS, the leaders of the main activities of INBOTS and recorded their interventions in the panel discussion.

  INBOTS Final Documentary: https://youtu.be/ZJIY6cmwEVg

- **Blog**: another community building activity was initiating the blog: Digitizing Life.

7.2.3. Other events

- Interview with Engino.net: http://inbots.eu/what-is-the-future-of-educational-robots-what-is-the-vision-of-educational-robot-industry/

- Exhibition: Hej Robot! Went digital 2020 on Instagram preparing for its follow up exhibition: Digitopia. In collaboration with the Museum of Work in Sweden. Almost 27000 visitors took part in the exhibition during three months when it opened in October 2019. The main target groups are high school students, schoolchildren of all levels and teachers. The exhibition takes on historical perspective of robot developments with the aim of creating reflection about what to use them for today in homes, at work, in health care, in our bodies, in learning and teaching, social life, city planning and transportations, related to sustainable developments. Visits can be arranged with guided tours or as individual visits. It is set up to create interactions between visitors and robots, for example with Furhat.

- INBOTS Workshop with teachers on the Uptake of Robotics in Education By EDUMOTIVA, December 1, 2018, Athens http://inbots.eu/inbots-workshop-with-teachers-on-the-uptake-of-robotics-in-education/

7.2.4 Conferences

- Event: CYBATHLON 2020 Global Edition organized by ETH Zürich with participation of INBOTS universities University of Twente and ETH Zürich.

- Conference: EDUROBOTICS2021 with the presentation of a paper (Östlund 2021)

- Conference: The International Conference on Gerontechnology, ISG, 2020 with the session "Robotizing care for older people. What should be automated when robots enter home care?" WP6 arranged the session together with Moon Choi Korea Advanced Institute of Science and Technology (KAIST) Korea; Anna Spånt Enbuske Kommunal Sweden; Sanna Kuoppamäki Royal Institute of Technology, KTH; and Björn Fischer Royal Institute of Technology KTH. Published in Östlund et al 2020).

- Event: The Ethics and Privacy Week, arranged by Dublin City University, March 2021. WP6 contributed with the talk: Robotizing the Care sector – a risky business Ethical dilemmas when care rationality meets a technical rationality.

- INBOTS Final Conference May 18-20, 2021. Virtual conference. WP6 organised the session: Policies to Promote Social Uptake of Interactive Robots. The session was chaired by Britt Östlund and included the following experts: Sylvie Bove, RISE Research Institutes of Sweden presenting: Challenges to Promote Innovations; Björn Arvidsson, STUNS Life Science Uppsala presenting: Good examples of promoting new technologies; Jakob Hellman, Swedish Agency for Innovation Systems presenting Experiences from Policy Labs; and Björn-Erik Erlandsson, Senior Advisor presenting: Policies and standards essential in the development and use of robots.

8 Strategic conclusions

The social uptake of robots is at the beginning of its development towards a wider use among the public. To promote this development requires:

8.1 Create and update more thorough knowledge about potential users and areas of use

Knowledge is important in order to make necessary priorities. Today there is a lack of knowledge about areas of use and potential users beyond manufacturing and beyond rhetoric and "wish to be needs". Statistics on uptake, sales volumes and use of robots in society beyond industrial sectors is needed. These statistics should include citizens, meaning all ages, with no upper age limit since the older citizens constitute the fastest growing age groups in the population.

8.2 Go beyond consumer markets

European Institute for Public Participation, EIPP, is a resource with useful and inspiring examples of how to legitimate policy decisions by the active participation of the public. Such resources meet the conclusions of this report, that the market is not enough. Conditions for uptake of robots in promising areas such as education, disabilities and health are very different from individual consumer markets and from using robots in manufacturing. It is a matter of procurement of public goods and welfare services. To explore this potential, the awareness of the context of the use of robotic applications outside manufacturing and traditional working life aspects, needs to be prioritized among researchers and in industry.

8.3 Make use of policy making

Policy labs is a resource in a number of European countries dedicated to developing policies for the sake of societal challenges in cooperation with relevant actors. Robotics is an available resource for meeting challenges such as climate change and demographics but it is also the opportunity for companies interested to broaden their markets. Policies to increase the utilization of robotic resources should put change in focus, not separate technological applications. These changes must be based on the understanding of the system from within that is subject to change and include the people who populate the system.

References

Alimisis D., Loukatos D., Zoulias E., Alimisi R. (2020) The Role of Education for the Social Uptake of Robotics: The Case of the eCraft2Learn Project. In: Pons J. (eds) Inclusive Robotics for a Better Society. INBOTS 2018. Biosystems & Biorobotics, vol 25. Springer, Cham. https://doi-org.focus.lib.kth.se/10.1007/978-3-030-24074-5_30

Arnstein, S.R. A Ladder of Citizen Participation. J. Am. Inst. Plann. 1969, 35, 216–224

Arntz et al (2016) The Risk of Automation for jobs in OECD countries, OECD.

Baur, K., Haufe, F. L., Sigrist, R., Roland, S., Dorfscmid, K., Reiner, R. (2020) The Cybathlon – Bionic Olympics to Benchmark Assistive Technologies. In Pons, J.L. (ed) Inclusive Robotics for a Better Society. Selected Papers from INBOTS Conference 2018, October 16-18, 2018, Pisa, Italy, pp.175-179.

Beasley, R. A. (2012) Medical Robots: Current Systems and Research Directions. Journal of Robotics doi: 10.1155/2012/401613.

Berker, T., Hartmann, M., Punie, Y. & Ward, K. (2006), Domestication of Media and Technology, London: Open University Press.

China Robot Industry Development Report, The Chinese Institute of Electronics, 2019.
Eftring, H. (1999) The Useworthiness of Robots for People with Physical Disabilities. Diss. Lund University, Certec.

EO Intelligence (2020), Report and analysis of the development of China Service Robot Industry, Robot Industry, 2020(4), 83-100.

Eurobarometer (2012) Public Attitudes Towards Robots. Special Barometer 382. Wave EB77.1 – TNS Opinion & Social.

European Institute for Public Participation, EIPP (2021) https://participedia.net/search?query=public%20participation Retrieved 2021706/21.

Eurostat Outlook 21/01/2019: https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/DDN-20190121-1

Fischer, B., Östlund, B., Dalmer, N.K., Rosales, A., Peine, A., Loos, E., Neven., Marshall, B. Co-Design as Learning: The Differences of Learning When Involving Older People in Digitalization in Four Countries. Societies 2021, 11, 66

Fischer A: Fischer, B., Östlund, B. "Technology Development with Older People: The Role of "Unfettered Design"". In Human Aspects of IT for the Aged Population. Technologies, Design and User Experience. *HCII 2020*. Lecture Notes in Computer Science, vol 12207, edited by Q. Gao and J. Zhou, pp. 18-33. Cham: Springer, 2020

Fischer B: Fischer, B., Östlund, B. and Peine, A.. "Of Robots and Humans: Creating User Representations in Practice." *Social Studies of Science* 50, no. 2 (2020): 221–44

Fischer C: Fischer, B.; Peine, A.; Östlund, B. (2020). The Importance of User Involvement: A Systematic Review of Involving Older Users in Technology Design*, The Gerontologist*, Volume 60, Issue 7, 1 October 2020, Pages e513-e523.

Frennert S, Aminoff H & Östlund B (2020) Technological Frames and Care Robots in Eldercare. International Journal of Social Robotics. https://doi.org/10.1007/s12369-020-00641-0

Frennert, S, & Östlund, B. (2018) Narrative Review. Welfare Technologies in Eldercare. Nordic Journal of Science and Technology Studies, Vol.6, No.1.

Frennert A., Forsberg A. & Östlund B. (2013) Elderly People's Perceptions of a Telehealthcare System: Relative Advantage, Compatibility, Complexity and Observability, Journal of Technology in Human Services, 31:3, 218-237.

Frey & Osborne (2013) The future of employment: How suspectible are jobs to computerization? Oxford.

Jachinski, C. (2018) Independent Aging with the Help of Smart technology. Diss. Netherlands: University of Twente.

Johansson-Pajala, RM., Thommes, K., Hoppe, J.A. *et al.* Care Robot Orientation: What, Who and How? Potential Users' Perceptions. *Int J of Soc Robotics* **12,** 1103–1117 (2020). https://doi.org/10.1007/s12369-020-00619-y

McKinsey (2017) A Future that works: Automation, Employment and productivitiy.

OECD (2021) Better policies for better lives. Toolkit. https://www.oecd.org/statistics/good-practice-toolkit/goodpractices/ Retrieved 2021/06/21.

Pons, J.L. (2020) (ed) Inclusive Robotics for a Better Society. Selected Papers from INBOTS Conference 2018, October 16-18, 2018, Pisa, Italy.

Rogers, E. M. *Diffusion of innovations*. New York, NY: The Free Press, 1995

Royakkers L, van Est R (2015) A Literature Review on New Robotics: Automation from Love to War. Int JN of Social Robotics 7: 549-570.

Shibata, T. (2012) Therapeutic Seal Robot as Biofeedback Medical Device: Qualitative and Quantitative Evaluations of Robot Therapy in Dementia Care.Proceedings of IEEE Vol.100 No.8.

Silverstone, R. & Hirsch, E. (Eds.) (1992). Consuming Technologies : Media and information in domestic spaces. London/New York: Routledge.

Stahl, B.C., Obach, M., Yaghmaei, E., Ikonen, V., Chatfield, K., Bren, A. The Responsible Research and Innovation (RRI) Maturity Model: Linking Theory and Practice. Sustainability 2017, 9, 1036; doi:10.3390/su9061036.

TMR, Artificial Intelligence Market Insights, Trends & Growth Outlook. April 2021. Retrieved 2021-04-12 at https://www.transparencymarketresearch.com/latest.htm

Toboso, M., Morte, R., Monasterio, A., Ausin, T., Aparicio, M. & Lopez, D. (2020) Robtics as an Instrument for Social Meditation. In Pons, J.L. (ed) Inclusive Robotics for a Better Society. Selected Papers from INBOTS Conference 2018, October 16-18, 2018, Pisa, Italy, pp.51-58.

Van Aerschot, L, Parvaiainen, J (2020) Robots responding to care needs? A multitasking care robot pursued for 25 years, available products offer simple entertainment and instrumental assistance. Ethics and Information Technology https://doi.org/10.1007/s10676-020-09536-0

Venkatesh, Viswanath, et al. "User acceptance of information technology: Toward a unified view." *MIS quarterly* (2003): 425

Venkatesh, Viswanath, and Fred D. Davis. "A theoretical extension of the technology acceptance model: Four longitudinal field studies." *Management science* 46.2 (2000): 186.; doi:10.1287/mnsc.46.2.186.11926

Von Schomberg, R. A Vision of Responsible Research and Innovation. In Responsible Innovation; Owen, R., Bessant, J., Heintz, M., Eds.; John Wiley & Sons, Ltd.: Hoboken, NJ, USA, 2013; pp. 51–74. ISBN 978-1-118-55142-4.

Östlund, B. Robots entering the care sector. The case of a new curriculum for the education of assistant nurses in Sweden. EDUROBOTICS 2021. In Advances in Intelligent Systems and Computing edited by Malvezzi, M., Alimisis, D., Moro, M. Springer 2021.

Östlund, B., M. Choi, A. Spånt Enbuske, S. Kuoppamäki & B. Fischer (2020). "Robotizing care for older people what should be automated when robots enter home care?". *Gerontechnology*, 19 (Suppl), 1-5, https://doi.org/10.4017/gt.2020.19.s.69883.1

ANNEX 1

Policies countrywise

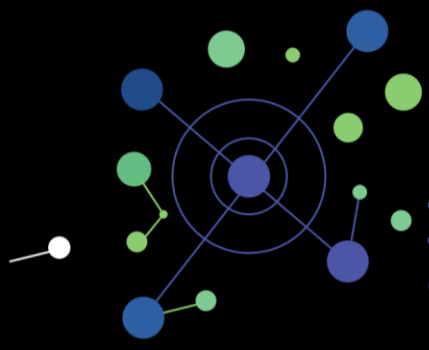
1. Enter your government home page and search for any policy reports, governmental investigations or initiative. These strategies or reports are usually labeled as any of these words: interactive robots, social robots, artificial intelligence, digitization, ICT or IT strategies.
2. Read through the summary or conclusions and try to find out how they expect the social uptake of robots to be realized. Through research? Collaboration between any stakeholders? Other strategies?

National policy report	Strategies	Expectations related to social uptake of robots; how to promote social uptake?
Germany	BMWI (Bundesministerium für Wirtschaft und Energie = Federal Ministry for Economic Affairs and Energy), including a collection of best practice examples, some in research, some in the industry. https://www.bmwi.de/Redaktion/DE/Publikationen/Industrie/industrie-4-0-ki-und-robotik.pdf?__blob=publicationFile&v=4 https://www.bmbf.de/files/Nationale_KI-Strategie.pdf https://www.bmbf.de/upload_filestore/pub/Technik_zum_Menschen_bringen_Forschungsprogramm.pdf https://www.baden-wuerttemberg.de/fileadmin/redaktion/dateien/PDF/200204_Innovationsstrategie_BW_Fortschreibung_2020.pdf	General statements abut also new forms of interaction, physical support, improved learning and adaptation capability of robots. AI and some about service robots in a national KI-strategi and in a research programme provided by the Federal Ministry of Education and Research.
Greece	National Research and Innovation Strategy For Smart Specialization 2014-2020 Robotics including research and development of new generation of robots and supportive	Involvement of the greater part of society. Level out regional differences.

	technologies applied in industry and service delivery, operating in dynamic real world environments with enhanced autonomy, adaptability and safe interaction with humans. National Research & Innovation Strategy for Smart Specialization (RIS3) prioritizing people and society resulting in a high level of quality of life, low environmental footprint and respect for cultural heritage and creativity. http://www.gsrt.gr/Financing/Files/ProPeFiles19/Executive%20Summary-2015-09-17-v04.pdf https://www.athena-innovation.gr/el/robotics_perception_interaction_unit_dm	Developing innovative attitudes, institutions and RTDI links with the society to address social challenges. Support of the extroversion of the innovation system in order to prove to the Greek society the importance, the role and the potential of public RTDI and to develop creativity and innovation culture.
France	Government roadmap called the "New Industrial France" (Nouvelle France Industrielle – NFI) including the main national policies and guidelines toward the use of robotics. https://www.economie.gouv.fr/entreprises/amortissement-exceptionnel-des-robots-industriels-des-pme https://www.bpifrance.fr/ http://www-list.cea.fr/en/media/news/171-media/news/2015/116-february-9-2015-results-of-france-s-first-national-collaborative-robotics-competition https://www.entreprises.gouv.fr/secteurs-professionnels/laureats-du-2eme-concours-national-de-robotique-du-7-mars-2017 https://www.economie.gouv.fr/groupe-travail-france-ia http://www.industrie-dufutur.org/ https://travailemploi.gouv.fr/IMG/pdf/guide_de_prevention_25_aout_2017.pdf https://www.entreprises.gouv.fr/files/files/directions_services/secteurs-	National investments and studies for robotics and potential technology transfer focused on industry including collaborative robots and safety regulations.

	professionnels/industrie/robotique/france-robots-initiatives.pdf	
Iceland	Policy of the Municipal Police force of Reykjavik to the year 2025 (final draft) https://fundur.reykjavik.is/sites/default/files/agenda-items/29_stefna_lrh_til_arsins_2025__lokadrog_7.pdf	Robotic policing with like robocop, p.19
Spain	Ministerio de Ciencia e Innovacion (Ministry of Science and Innovation) https://www.mineco.gob.es/portal/site/mineco/ https://industria.gob.es/es-es/Paginas/Index.aspx http://www.ciencia.gob.es/portal/site/MICINN/ http://www.ciencia.gob.es/stfls/MICINN/Ciencia/Ficheros/Estrategia_Inteligencia_Artificial_IDI.pdf http://www.ciencia.gob.es/stfls/MICINN/Ciencia/Ficheros/Estrategia_Inteligencia_Artificial_IDI.pdf	Artificial Intelligent rather than Robotics specifically. Promote a digital eco-system including the economy, labor market, public administration and education and more not related to social uptake.
Switzerland	Federal Council of the Swiss Government https://www.admin.ch/gov/de/start/bundesrat/politische-agenda/wohlstand/digitalisierung.html https://www.admin.ch/gov/de/start/bundesrat/politische-agenda/wohlstand/infrastruktur.html	Digitalization rather than robots. Promoting digital economy, cyber security, secure digital identities, e-voting and digital education. Expanding needs based transport- and communication infrastructure.
Sweden	Swedish Governments Strategy for a smart industry and neo-industrialization. Swedish Governments National Strategy for Life Science and Health https://www.regeringen.se/regeringens-politik/regeringens-strategiska-samverkansprogram/samverkansprogrammet	Industrial strategy including robots in collaboration with people. Life science and health strategy, mainly about digitalization including structures for collaboration on health data, ethics and safety, welfare technologies,

	-naringslivets-digitala-strukturomvandling/#prioomradends https://www.government.se/information-material/2020/11/swedens-national-life-sciences-strategy/	competence and lifelong learning. Also about demographics and social changes.



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