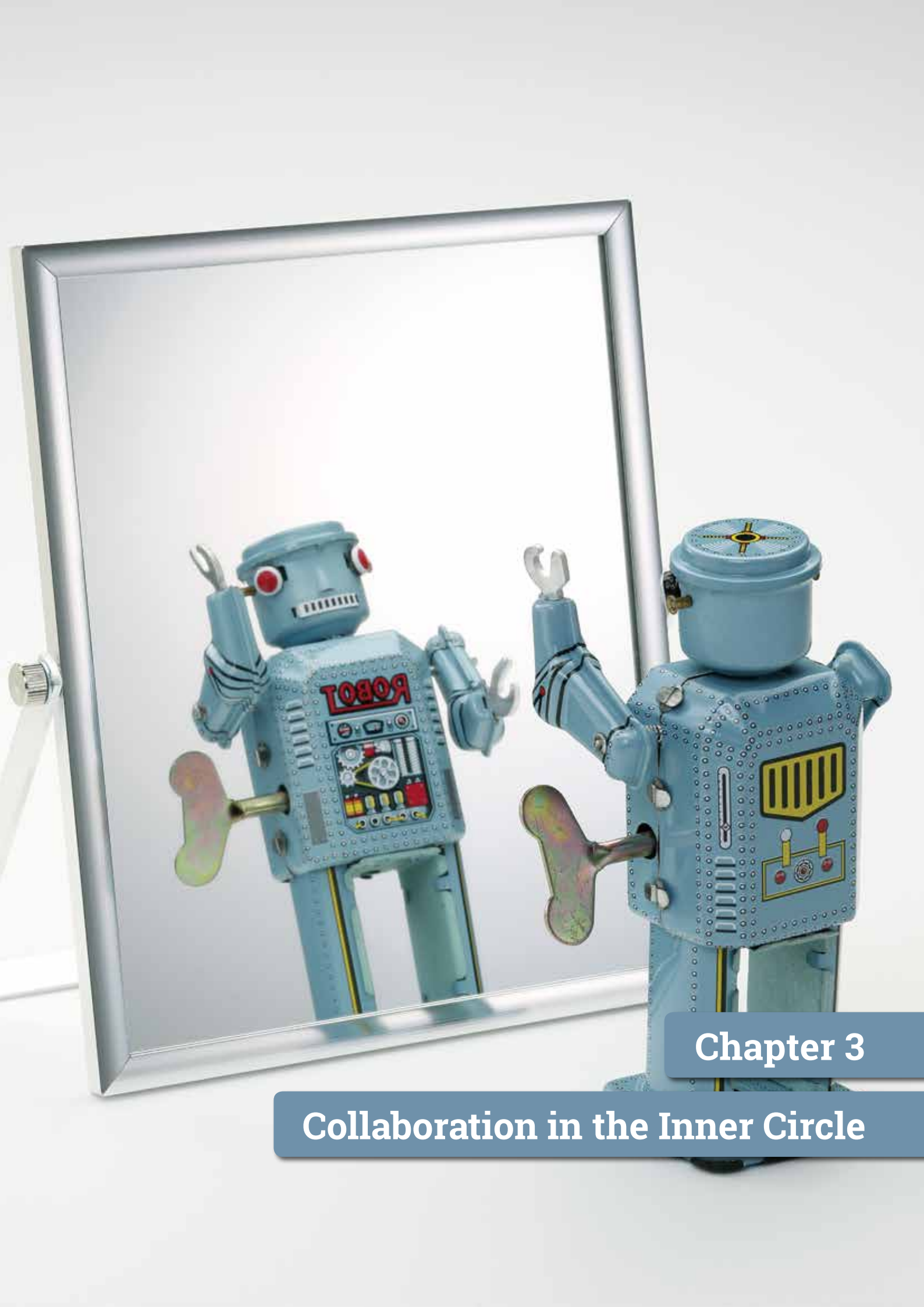


Chapter 3

Collaboration in the Inner Circle

I don't know if that's a typical day really, but perhaps the other thing I should say is, that [our CEO], is going to be at our prime minister's office in a couple of hours' time. So, they're hosting a reception for the tech sector to kind of acknowledge the tech sector's contribution to society and the economy. We are going to be there with a bunch of other AI related startups as well. So, yeah.

(Bran, robot developer, engineer, HERBIE)

◀ Robot developers are often engaged in collaborations with like-minded people.

3. Collaboration in the Inner Circle

You will find here

- An overview of actors involved in existing collaborations with robot developers
- A disambiguation of the term end-user
- Descriptions of different collaboration types and reasons for collaboration within the inner circle of robotics
- An analysis of the gap in collaboration between robot developers and affected stakeholders
- A discussion of potential collaborations with social scientists as intermediaries

You will acquire

- Awareness of who collaborates with whom in robotics and what each stands to gain from these collaborations
- Awareness of the consequences of sidelining or excluding end-users from collaborations
- Awareness of the potential benefits of collaborations with social scientists who are trained to bring affected stakeholder voices into development

In this chapter we take a closer look at the collaborations between the robot developers who enable robots in technical collaborations (primarily engineers) and other robot makers, including other robot developers, application experts (e.g. robot buyers and psychologists), and facilitators (e.g. policy makers or financial contributors). We will examine the gaps arising when end-users and other affected stakeholders are not understood as the people who will eventually be affected by robots. In the subsequent chapters we unfold the consequences of these gaps (e.g. for inclusive design, work, and gender issues). Here, we focus on the robot makers as the key target group of REELER's research, their collaborative learning, and the alignment of motives within three main groupings: among developers themselves, between developers and application experts, and between developers and facilitators (especially funding agencies).

Networks are formed between these groups at for instance conferences, fairs, and seminars. Many times, the people involved in robot development build on previous collaborations and connections to particular funding agencies and application experts. However, REELER has also identified two groups that robot makers do not meet so often and rarely directly *collaborate* with. These are the affected stakeholders and social scientists who could bring new knowledge of the everyday life situations robots will be affecting. We have, as mentioned in the introduction (*see 1.0 Introduction*), seen that end-users form an interesting category as they can be understood in two ways. One understanding of 'end-users' is the same as we have defined in the REELER project: the persons who might actually *use* the robots. However, in several REELER cases, robot makers talk about end-users as the people who *buy* or *invest* in the robots. These persons who act as *spokespersons* are sometimes the closest the robot developers get to actual end-users. Thus, they often only discover very late in the design process how the actual users on the shop floor with hands-on experiences of every day work will be affected by their robots.

In REELER's analysis for this chapter, we begin by acknowledging that the collaborative learning sought after is expected to take place *between very different* groups. On the one hand, the people who enable, design, make, develop and implement robots: 'robot makers'. On the other hand, the various people whose work or lives are affected by robots, whom we term 'affected stakeholders'. What separates the two groups in our

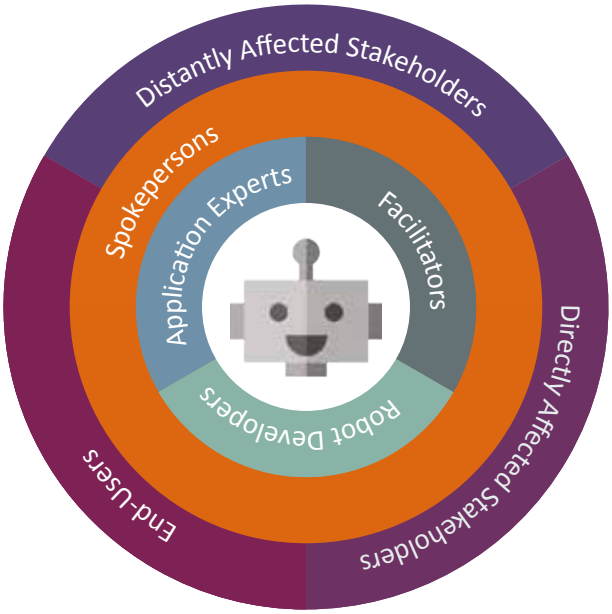


Figure 3.1: Collaboration with spokespersons (e.g., company owners) is often the closest robot developers get to actual end-user collaboration.

analysis is that the robot makers (which include powerful investors) consistently collaborate and learn from each other, whereas the people in the second group, the affected stakeholders are not directly included as *collaboration partners* in any of our 11 case studies (but may be used as test persons or included in decision making as in our two best-case scenarios). It is perfectly natural and logical that we stick to learning and collaborating with people we already know. As already noted (*see 1.0 Introduction*), from an anthropological point of view it is a common thing for humans to form normative bubbles where they feel at home with like-minded people. However, throughout this publication, the REELER material shows that the robot makers have something to gain by leaving the inner circle of robotics.

This chapter has six main sections identifying present day collaborations:

1. An overview of the actors involved in present-day collaborations as they have emerged in our ethnographic research.
2. A description of the technical collaborations between robot developers.
3. A description of the collaborations between robot developers and application experts. (It may be a robot buyer who functions both as application expert and as a 'spokesperson' for the end-users.)
4. A description of robot developers' collaborations with facilitators, like funding agencies, policy makers, and robot buyers, all of whom may act as funding facilitators – but also other 'helpers' such as lawyers and media people in PR and marketing.
5. A discussion of the identified 'gap' in collaboration between robot developers and end-users, directly- and distantly affected stakeholders (who may be otherwise represented by 'spokespersons').
6. A discussion on robot developers' lack of collaboration with social scientists as intermediaries (instead relying on robot buyers as 'spokespersons').
7. A discussion of the problems arising when robot developers try to leave the 'bubble'.

3.1 Overview of collaborators

Figure 3.2: Inner circle of robot makers

REELER research shows that robot makers have plenty of experience with collaborative learning. In fact, the field of robotics is already filled with interdisciplinary collaborations. REELER's Human Proximity Model (*see Introduction 1.0*) has an 'inner circle' around the robot, persons we collectively call *robot makers* (*see Figure 3.2*). The people found in this 'bubble' around the robot are the people we have identified as those who collaborate, learn from each other, and share motives around the enabling of the actual robotic machines: *developers* (mostly engineers), *facilitators* (for instance funding agencies, buyers of robots, and politicians) and *application experts* (people called in to help with the robot's specialized tasks, like a medical devices company explaining how existing physical aids are used for manually turning patients in the bed).

It is a finding across REELER's cases that no matter what type of robot we have looked at in our empirical research there is close collaboration among the people in the inner circle who meet each other on a regular basis at robot fairs, conferences and events. REELER data also shows that the persons who are going to operate the robot, work next to it, or who will be otherwise affected by it, rarely take part in these collaborations. They are not considered application experts, who can give advice whether a robot should be developed at all, or how and where to implement robots. Knowledge about people (e.g., on the shop floor for industrial robots) is developed in the robot projects when robots are tested on end-users and for most of the time these tests take place in laboratories and thus in environments far from the confusing and complex everyday life, where the robots eventually are meant to be implemented.

Furthermore, not least in robot projects receiving public funding from EU but also on national levels, there can also be close connections between developers, financing agencies and policy makers. The robot developers, i.e. the people with the technical expertise, can be CEOs and/or owner of companies or take up other managerial functions with the role to develop whole robots or parts of robots. They often work in close proximity to and collaborate with the robot facilitators. Facilitators are not just politicians and funding agencies, but also people hired by a robot company to help facilitate the

uptake of robots through media imagery (*see 8.0 Imaginaries*), or lawyers who help with legal issues. Robot developers, especially CEO's, develop good skills in collaborating closely with the funding agencies facilitating robots through for instance EU-financed funding, national funds and private funds. These funding agencies, REELER's data shows, often play an important part in the lives and work of the robot developers and thus have a lot of ethical responsibility for what kinds of robots are developed. The European Commission funding schemes we looked at never explicitly called for a direct collaboration with end-users and/or affected stakeholders – and it is by some considered a bad idea to involve end-users and other affected stakeholders in the early design phases, as it may hamper innovation.[1]

However, close collaboration between the robot makers without collaboration with affected stakeholders creates a gap in the common knowledge and common language (*see Introduction 1.0*) between those who collaborate to create the robot and the knowledge of those who will be affected by the robots in their daily lives. Though end-users are included in design processes it is primarily as test persons late in the design processes. REELER has several examples where robots are developed in close collaboration with end users (understood as users not application experts) at the later stages of design work – and where all kinds of new and unforeseen issues come up when the robots are tested (e.g. ATOM, REGAIN SPECTRUS, WIPER and OTTO). In other cases, the end-users are assumed to be, for instance, 'normal workers' (*see 5.0 Inclusive Design*) and in most cases the directly affected stakeholders are overlooked in design processes. Even when robot developers go through a lot of trouble to identify the right end-users, the complex richness of the everyday life situations are overwhelming when robots are eventually implemented in real life situations (*see 7.0 Learning in Practice)*. The directly affected stakeholders, the nurses or physiotherapists close to patients, or teachers close to children, can be drawn into projects to give advice (as in the above mentioned cases), but in general neither the directly affected stakeholders, nor the end-users, are seen as the people with important expertise in the application area or sector particular to the robot under development. This role is left to the buyers of robots, often considered the actual 'end-users' by robot makers (*see 1.0 Introduction*).

The reason this 'gap' is a problem is because of the closed nature of the culture in the robotic bubble. Each of us is equipped, by our experiences, with particular tools for engaging with the world; when people have a shared set of tools, we call this culture. What we find is that persons within the robotic bubble are often working from a shared set of experiences. In spite of diversity in for instance education (engineers, economists, lawyers) found within the culture of collaborators, it is easy to see, for instance at fairs and conferences, that there are also huge similarities within the group. Most are male, white and between 30-50 years of age. They have a higher education, good salaries, and work prospects in the future and aligned motives for creating new robots. All of this create good conditions for collaboration based on a common knowledge and language (in spite of possible internal disagreements). In this respect they may differ substantially from most of the stakeholders who eventually will be affected by the robots in *their* everyday lives. These stakeholders are a diverse group with no common language around robotics and no relatively aligned motives that bind them together. They are, as we show many places in this publication, often without higher education, they may fear losing their jobs and also have little knowledge about the robots that will affect their lives.

3.2 Technical collaboration with other robot developers

In their daily work, robot developers first of all collaborate with other robot developers (within their own spheres of interest and type of robots). It can be software engineers working with hardware engineers for instance. It is in this inner circle closest to the actual design of the robot that we find a common (technical) language and common motives of developing robots. Robot developers share with each other the goal to design robots, and they share a technical language of how to do it. In many cases the robots develop out of a small group of (male) colleagues who work closely together.

The engineers working in different companies may be competitors, but they understand each other's motives for competing. They may disagree on issues but basically, they work towards the same goals. They share an understanding of what robots are really like; that is as machines instead of the media representations of robots (*see 8.0 Imaginaries*) and all the problems tied to making machinery work. Where the general public see the autonomous and humanoid robot shell the engineers see all kinds of wires, connectors and software.

1 We are fully aware that not everyone believes that it is good for an innovation to begin with close collaboration with the end-users and affected stakeholders, and this is discussed in many places in REELER's material (see for instance the chapter on Innovation Economy). We are pointing out that our empirical data shows that projects beginning with end-user collaboration are uncommon, and that this might affect how robots can be made responsibly and ethically. We could also argue that we may find an untapped source for innovation if robot development processes began in collaboration with end-users and directly affected stakeholders.

> *Robots typically are something that attracts most of the attention and then who cares about the rest because the rest, like software, there is nothing really to see. But in reality, just for you to understand, robots are just the tip of the iceberg and then there is software and there are other elements that make together the system, the solution that will deliver value.*
>
> (Felix, robot developer, CEO, WAREHOUSE)

Robot developers invite other professionals into a collaboration of solving ongoing specific problems. The collaborations can be face-to-face working with technical people or other people from disciplines with doctors or psychologists in relation to specific projects or social media.

Robot developers across cases like for instance Franco (BUDDY), Toby (COBOT) and Jørgen (WIPER) participate in collaborative technical platforms like ROS or with robotic hubs to solve specific problems. ROS stand for Robot Operative Systems as a common denominator for software libraries, standards and protocols that help develop robotic applications.

> *And it's [like] everything is in ROS so for us that's very easy to start. So, that's also the reason why in just two months with mainly seven people we did a lot of work.*
>
> (Franco robot developer, BUDDY)

They visit each other – even physically to collaborate on technical issues.

> *We had a couple of people that we had close links with, a couple of machine fitters, also from the robotic hub, that we were in close contact with, and if we had some questions, then we called those people and said, 'we have something we want to show you. Can you come by?' And then we just arranged [it], well, perhaps Wednesday was good, and then they came by and then we showed them what we had made, and then, is that good or bad or what do you think? Then we got some feedback and then we noted what [we could use their comments for]…what part of this is just complaints and what is something that we can actually change?*
>
> (Jørgen, robot developer, WIPER)

Toby is also working on a humanoid robot in close dialogue with colleagues and tells us he often contributes to ROS with new solutions and also gain from his colleagues' contributions to ROS.

In these collaborations the technical developments are the pivotal point for robot development – and this means that technological considerations may overshadow user considerations. Not least because as the technology is the main focus, it is often unclear who the users really are.

Thomas, a robot developer, for instance work with software developers and hardware engineers as well as with a team he names 'user experience people'. They turn out to be mainly design experts who give advice about how the robot should look. Even if he sees the need for collaboration with end-users, the users are brought into his project as test persons. This is also because Thomas and his team, like many other robot developers (see Leeson 2017, Bruun et al. 2015, Blond 2019) begin with the technology – and only gradually finds out how the developed technology can be useful. Here the same technology is attempted to be useful for very different users from nurses to shop assistants.

> *Interviewer: Is the robot now ready for market?*
>
> *Thomas: That's a, that's a big question. Because you have on the one side, the user experience. You have on the other hand, all the applications. And you have the technical point of view. From the technical point of view, I would say we have lots to do. Because we want to get in production. We need to reduce the costs, that's one of the main points why service robots are not running around everywhere, I think. Yeah, from the user experience, we also still have some things left. We have an industrial version, with just a mobile base with a manipulator on top of it, it's the same technology. And we're also working on some kind of medical devices, so we developed a robot that is meant to be helping people learning walking again after a heart attack -so it's the same technology. We have four wheels, a battery, and our vision around it.*
>
> (Thomas, engineer working on a humanoid robot, COBOT)

Later he explains to us, that they also consider it for customer experiences in warehouses.

Thus, he only meets the users' everyday lives when he begins to implement the robot in different places and get responses from different users to a technology already developed.

In the REELER data this multipurpose approach to robot design, starting with an available technology, is not uncommon. You begin a collaboration with technical people, then the facilitators securing funding and then much later the developers draw in spokespersons and application experts representing the humans supposed to benefit from the robot.

STORY FROM THE FIELD:

On the process of developing robots in a social group exploring technology

In this story we follow the process of developing a storage robot, STOREX, from the perspective of a group of Eastern European robot developers.

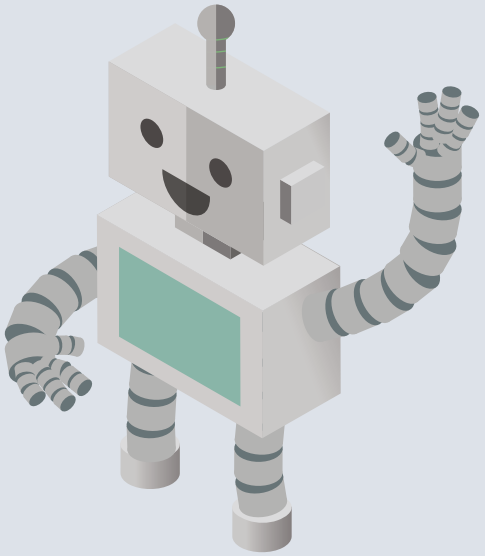
Felix explains how it began as a group of three friends creating a start-up almost as a hobby (also seen in the ATOM case). He joined the group later, but back then the group collaborated with each other without any office or laboratory equipment – and reach out to the technological robotic community to take a closer look at available technologies. They got hold of an advanced robot and scrutinized how it was made.

Felix: So how things started, basically, in 2013 – and again, Anders, who is the CEO, will tell you a little bit more of the history – it all started back in [Easter European country]. So, the people back then were working on the very early prototype. So, most of the start-up started in [this way]. This was not yet in the garage, it was in the apartment, and that was just the idea. Okay, we saw [available transport] robots, and [these robots] were acquired by [a large company] so they're no longer available, and the guys were trying to test and see if it's difficult to make this kind of robot. What does it take to produce this?

This was neither industrial research or university research, but as Felix puts it:

It was probably a hobby. Let's put it this way. (…) It started with people in their own spare time. Again, it was in the apartment and then it moved down to the garage because the robot got bigger. So, by any means, it's not industrial [research]. Really, it's more like a kit made of the components available on the market. But even to understand how you control it, how it moves, what it takes to carry a rack, because you'll see the system is actually about bringing racks to people and racks carrying goods, so this is where it started and this was back in [the Eastern European country].

The idea was to try and see how difficult it is [to make] because, when you look at it, it looks simple. Okay, a robot,



you see many great things when we watch science fiction videos, but in reality, the [guys back then] were trying to understand what does it take to create something like this. So, the point was you can call it research but it was more like a hobby at this stage.

So, the guys realised – and it was a team of three people at the time – yeah, we can make it work. That was the first conclusion. The second was, yeah, if we can make it work, then we have to actually make it more than just a hobby. Then it becomes part of the foundation of a start-up or foundation of the business. So, then the company actually was created in [a Western European country].

Only then they began the next step in collaboration, namely to seek funding opportunities, which they found. Only much later in the process were the end-users supposed to engage with the robot involved.

(Based on interview with Felix, robot developer, CEO, WAREHOUSE)

3.3 Collaboration with application experts

Robot developers, or their companies, collaborate with others outside of robotics to explore new ways of technical development– often either driven by or in connection to universities and especially new applications for technology already made. Application experts are in our general definition the people who have an expertise in the areas where the robot is supposed to be applied (*see 1.0 Introduction*). As these areas differ, so do the application experts, but across cases we see that robot developers make a lot of efforts to collaborate with and learn from these experts. They can be psychologists giving advice to engineers on how to design robots so they are not scary or a university expert on farming giving advice on what crops robots are needed for. The way the robot companies define the *experts* called in to help develop robots with the engineers are rarely the people affected (directly or indirectly) by robots in everyday life though they can be called in as end-users to test results. However, sometimes the owners who have power enough to order and eventually buy specific robots are speaking on behalf of the actual end-users.

> *Do you know what, I spoke to a lot of professional workers and shopping mall management companies. For instance, in [my residence country] I had a chat with companies [retailers] or for instance with [a retail company], they own a lot of shopping malls, both of them roughly best forty shopping malls across the [country]. And they became interested and engaged with the idea.*
>
> (Guy, robot developer, WAREHOUSE)

Across our REELER cases, we find that big farm owners, contractors, dairy owners, industrial company owners etc. often represent and speak on behalf of the actual end-users. Robot developers may also, for instance, reach out to communities like hospitals to explore potentials for robot developments. Often but not always universities are involved in collaborations. In these cases, the point of departure for a collaboration is not a problem-space defined by the end-users and affected stakeholders, but often a question of finding expert advice on where to apply an existing robot technology so it becomes helpful in a particular area. This may allow the same technology, with advice from different experts in different application areas, to move from one kind of application to another. We have for instance seen a space type robot become a healthcare robot or an educational robot. Applications of an existing technology can, with the help of application experts, move a robot developed out of shear curiosity and passion into an area where it can find a use, for instance in 'education'. Here new application experts may open for further applications, which then lead to adjustments in the original machinery.

> *They ran a preliminary study and they decided that robotics could be interesting. From that point we start to explore where we were able to apply robotics. At that time, I was doing some studies only related to education and with educational robotics, and then we identified that that technology could apply a lot with children with autism. We started to explore this with the hospital, but after a few months we got the project (funding related to social robots) and an educational robot platform to help children with traumatic brain injury. And like it's how we start this relation, and that was seven years ago.*
>
> (Pedro, robot developer, BUDDY)

However, some robot types are very specialised, e.g. in agriculture, and need application expertise tied to a particular field. Sometimes the robot developers in our REELER cases have collaborated for a long time with the same application experts on the same technology across several projects (e.g. OTTO, REGAIN, SANDY). These collaborations can involve company owners, hospital management, big farm owners as application experts. At other times the robot developers call in application experts from other areas when needed in specific situations. For instance, school teachers, psychologists, medical doctors and physiotherapists are called in to help adjust the design.

However, sometimes application of an existing robot technology takes place because an application expert and a robot designer simply meet and begin talking to each other in an inner circle collaboration (as has also been show in research outside of REELER, e.g. Hasse 2015a).

> *I was involved in research, that's market-close research, ok? Which means I was always very close with the industries, ok? And then, because I worked in the intelligent systems as in the data-processing, data scientist, and robotics. Now, robotics, everything about data-processing, making effective decisions, ok? So, it was quite an accident, I met [xx] that was interested [in my work]. [Following this meeting] they were interested in me come to help developing some intelligent system for them in robotics. Let me say, autonomous robotics.*
>
> (Ali, robot developer, CEO, WAREHOUSE)

Robot developers collaborate with other robot makers in the 'robotic bubble', reading the same literature, attending the same types of conferences, and thus aligning themselves within a shared culture.

3.4 Collaboration with facilitators

To realize the goals/ideas, the robot makers often collaborate with and learn from persons who can ensure funding. This means collaborating with funding agencies, potential buyers and engaged politicians, and it also implies hiring people to help protect and facilitate the uptake of robots. These can be media people, lawyers who protect the interests of robot companies and help make applications, funding agencies, investors, policy makers, national governments, and municipalities. Especially the funding agencies in EU are big players, and some smaller robot companies may feel the pressure, because they are not so visible and powerful in the inner circle. Here lawyers have found a good business as facilitators, that help 'read' the motives of the funding agencies and help with collaborations.

> *I think we can have some nice opportunities, because the European government provides a lot of money in case of European projects. The only problem is that these kinds of projects, ten years ago were really easy to access. Now it has become a business, so now there are persons – lawyers really – that just do this job; to support a big company to achieve the money, to take the money from the European project. And so, the small company does not really have the opportunity to have the kind of economical support.*
>
> (Alessio, Start-up CEO, robot developer, COOP)

Here especially EU's program officers, fund raisers, as well as selected partners are important collaborators expected to yield access to funding.

In fact, getting funding (especially for universities or research institutes) or earning money (private companies) looms so large that it may overshadow getting the right people for the job – as long as they can live up to funding criteria. The funding agencies meet with the robot makers (mostly the technically oriented people) at a number of conferences and meetings, which REELER researchers have also visited. At these conferences and fairs the robot buyers and robot developers not only learn from each other. People from policy and funding agencies are also present. They talk to and learn from the robot developers and the robot developers in their turn learn what motivates the funding agencies and policymakers. Robot developers generally respond when funding agencies place new demands. They also listen to robot buyers. They use a lot of effort and time to align their motives with those of funding agencies and customers – and they often meet physically to discuss details. The 'problem space' to work on is defined in close collaboration between robot makers. EU also create an environment of cross-country collaborations in order to get funding and politics – however these collaborations can be difficult even considering the common language in the inner circle.

Robot developers and their companies also meet and collaborate with policymakers in order to define and keep in line with societal standards – especially EU (ethical) standards. It

is in this last category we find more social science-oriented disciplines visiting the 'inner circle' – for instance people from psychology, medicine and biology, but especially philosophers specialised in robo-ethics (*see 4.0 Ethics Beyond Safety*).

In the REELER data we did not select the cases from who participates in specific robot competition, conferences and receive particular funding, but we see that in all cases funding is a big issue for the robot makers and that conferences, competition and fairs are important to keep up with funding possibilities.[2] At these fairs and conferences robot makers from the inner circle meet and debate their common goals – as we also see in most other areas of technology development.

> *On the one hand, such competitions are such a time sink, because you have to prepare for this contest, you have to write an application, you have to take part in it all. If these are nationwide competitions, then in most cases you have to go somewhere in our country. But the undoubted advantage of this kind of competitions is that in many competitions there are media that try to look for more interesting projects, especially those that win, and this results in the greater solution promotion in the media, ranging from local to nationwide. So, it largely allowed us to build this recognizable brand when it comes to our country.*
>
> (Dominik, robot developer, ATOM)

Apart from the collaborations with other technical people and funding agencies we also find, across almost all cases, that robot makers (or their companies) work in close collaboration with media people as facilitating experts – and here video production of well-functioning robots loom especially large (*see 8.0 Imaginaries*). It came as a surprise to the REELER researchers that robot developer across most cases have such a close collaboration with media people and that their public image matters so much to them, whether they are university based or based in smaller or bigger private companies.

Across many REELER cases the robot companies we study invest a lot of time and money in developing promotion for their robots and ideas through media. There are whole studios specialised in developing media material for the promotion of robots to the public or potential buyers.

> *Yeah [I work], with social media and social relationships of the company with other companies. And then I am the link between the client and the artist.*
>
> (Sam, robot developer and media facilitator, BUDDY)

These facilitators reach out to others in media networks, face-to-face in fairs, competitions and exhibitions or through social media like LinkedIn and Facebook in order to promote and enhance their business. For this reason, they also take part in exhibitions (where social scientists also sometimes contribute), competitions and fairs.

3.5 Gap in collaboration with affected stakeholders

Robot makers like the above meet, work together with each other and learn from them, and share motives. In all REELER cases, they do involve users to some extent in the design phases but often in a somewhat instrumental way to test equipment. It is here they discover they have designed for particular users with specific body-sizes for instance (*see 5.0 Inclusive Design*).

In terms of power relations, however, it is the robot makers at the inner circle who decide in the end. The users of robots, and sometimes even the directly affected stakeholders, do teach the robot makers a lot but not as *collaborative* partners. Their voices are not heard in relation to what kind of robots to fund and why. End-users often come into the robot makers' space when they have already defined a 'problem space', or found an application for a technology – and developed it, and now need to test it. Robot makers, and especially the engineers, can come close to the users' everyday lives when they test their robots, and they do listen to what they answer when users answer to the specific questions asked– but both questions and robots are defined by the robot makers.

Across case we find robot makers who work in close relation with what they explain to us are end-users in a specified field (construction, warehouse robots, agriculture, health). However, at a closer look the collaboration is with what we name 'spokespersons' such as a manager speaking on behalf of his workers, a farmer speaking on behalf of fruit pickers, a doctor speaking on behalf of patients. Though some reach out to communities outside the robotic 'bubble' or inner circle, it is

2 As it also is for many social scientists and university-based research.

Many affected stakeholders are overlooked in design decision-making processes.

often to find new applications (with adjustments) for existing technologies.

This kind of contact may result in new robots, but sometimes these attempts to collaborate also fail. We have no examples where a robotics project began as collaboration between robot makers and direct end-users or affected stakeholders (e.g., the people who will actually use/work alongside the robot). What robot makers sometimes refer to as users, turn out to be customers (*see 1.0 Introduction*). We have examples in the REELER data where 'users' are only involved by representation, through their managers, employers, healthcare providers as spokespersons - or are simply absent as an identified group. End-users, as identified in most robotic projects as the persons actually working in close proximity to the robot, are used to test and improve the almost finished robots.

End-users are in REELER terms people working directly with the robot. Customers are people who buy and/or implement the robots made by robot makers, but they are rarely *end-users*. However, robot makers often equate customers with 'users' without taking into account they are not the end-users (going to use the robots or work alongside them).

Robot makers rarely collaborate with the direct users of robots like the person working with the robot at the factory, the worker at the farm, the patients who need the robot to receive training or clean a room. Even when they tell us they collaborate with end-users, in reality they work with 'spokespersons' speaking on behalf of end-users (e.g. doctors speak for patients, hospital or hotel managers speak for cleaning staff). These persons have great expertise in their core discipline, but does not necessarily know what it is like to be a patient, a hotel cleaner or a factory worker. Robot makers meet some end-users when they are involved in testing, e.g., but it is not a collaboration so much as 'using users' to adjust the robot. Citizens, patients and other end-users are involved, but not as true collaboration partners, but only to test selected aspects of what it is like to be in physical proximity of the robot. These 'end-users' involved in testing are furthermore often chosen or selected by the spokespersons as when a factory owner is a customer, that speaks on behalf of the workers and point out the workers who should test the robot. When a person outside the robot makers' community asks for a robotic solution, it is often a customer approaching to collaborate. This customer is never the end-user or an affected stakeholder. These customers may therefore not be able to explain how the robot will function in the reality of everyday life of affected stakeholders.

There is a group of great importance for the robot designers, which is most often overlooked. This group we have defined as persons who, on the site of implementation, are indispensable for how the robot functions also in relation to end-users even if they are not using the robot themselves: **directly affected stakeholders**. Once we discovered this group in our

materials, many examples came up: the agriculture robot that has to be rigged and maintained and plugged in to work, the construction site robot that demand somebody clear its path across the construction site, the training robot for home use that is tested on a patient, but forget that it is the husband or wife who has to fetch the robot and rig it onto the patient's body, the nurse who has to make a new routine to avoid collisions with the hospital robot. All directly affected stakeholders are, as the word says, directly affected by robots – and necessary for their success. Yet, they are very often overlooked in the design process studied by REELER.

Finally, we have the **distantly affected stakeholders**. Robot makers in our research seldom try to envision how robots may affect people they do not know and have never met from the outer most distant circle – far from their own human proximity inner circle. Yet the reason we include distant affected stakeholders is because people may be affected by the robots designed, even if they are never near the robot. These people have no voice in how the designs and implementations should take form. They might be fruit pickers, nurses, shop-floor workers or cleaning ladies, or warehouse workers who get new tasks or where it is obvious they will need a new education once the robots take over (REELER researchers have met several of these distantly affected stakeholders, and their voices are heard throughout the chapters of this handbook. They differ for instance from the robot makers by having very little tradition for education and maybe also from difficulties reading). These people may need help to develop new skills to change a work situation (for instance in order to be end-users who collaborate directly with robots). As robots come out of the industrial cage into people's everyday lives, these distantly affected stakeholders are increasingly affected. However, we do not see these distantly affected stakeholders as an issue to be solved by the robot developers alone – and their overall situation is therefore debated in Part II of this publication where we address the more societal issues of robotization. Distantly affected stakeholders may, however, be affected even if they never see a robot. They may be a worker who find a new and more rewarding job, when a robot takes over his or her former tedious work. However, the inner circle of robot makers could still benefit from listening to these people with so much expertise in everyday life issues. They may even get new ideas for innovation (*see 6.0 Innovation Economics*). REELER research shows that even the most distant affected stakeholders have ideas and opinions about robots and their functionality. They do, however, seem notoriously difficult to incorporate into a circle of collaborations – due to, for instance, lack of knowledge about robots, language barriers, educational barriers, fears of job loss, etc.

Why is collaborative learning with all kinds of affected stakeholders a topic that has become important at this point in time in robotics design? One reason could have to do with the robots themselves. As robots are increasingly being integrated into people's everyday lives, it becomes a necessity that robot makers learn to collaborate with those humans who are supposed to let robots of all kinds engage with them in their daily activities. These spaces that previously were occupied by humans and simple machines, are now expected to include robots with artificial intelligence (AI), robots that transform work life and robots that transform human-human relationships. This means that robots are about to change existing workplace environments – often in ways not taken into consideration by the people who enable robots. At least it is the affected stakeholders we interview, who comment on why human-human collaborations cannot be replaced with human-robot 'collaborations' without a loss of social contact.[3]

> *It means a lot at work to talk to one another. It might be that they have some ideas, that they comfort you, or they have some experience. But with robots, no. There are no persons to talk to, and you shut yourself entirely off. You can no longer find solutions to problems, so, it becomes very, very difficult.*
>
> (Elif, cleaning person at a hospital, SPECTRUS)

3.6 Collaboration with social scientists as intermediaries

However, in REELER research we find a need for a more profound way to use social scientists – and those who have a core expertise in studying other people's everyday life in particular. The gap between the robot makers, *including* the spokespersons, and the affected stakeholders consists of a lack of knowledge about the everyday life, needs and values of the people on the shop floor. Where the spokesperson can be an intermediary who speaks on behalf of recipients, this 'speaking' is based on the spokesperson's own experiences, which often are more like the robot makers' reality than the reality of affected stakeholders. Spokespersons can for instance be management level in the same organization where we find the end-users (e.g., the factory owner speaking on behalf of the workers). In this section, we will therefore introduce a new type of intermediaries, we see as useful for both the robot developers, the robot facilitators and the application experts – as well as for affected stakeholders: namely the ***alignment experts***. They are intermediaries who have a core expertise in understanding both the values, needs and practices of affected stakeholders, and understand the economic and technical demands of the robot makers. This type of job function does not exist today, but we propose it to close the gab (*see 12.0 Human Proximity and 13.0 Conclusion*). The task of alignment experts is to work to align motives and values of robot makers and affected stakeholders, based on

3 In the REELER data material we draw conclusions on both what people tell us in the data material, but also from absences and silences. Furthermore, we also note difference through contrasting statements from affected stakeholders and robot makers (see Annex 1 on Methods and Methodology, and Hasse 2019, Hasse and Trentemøller 2009).

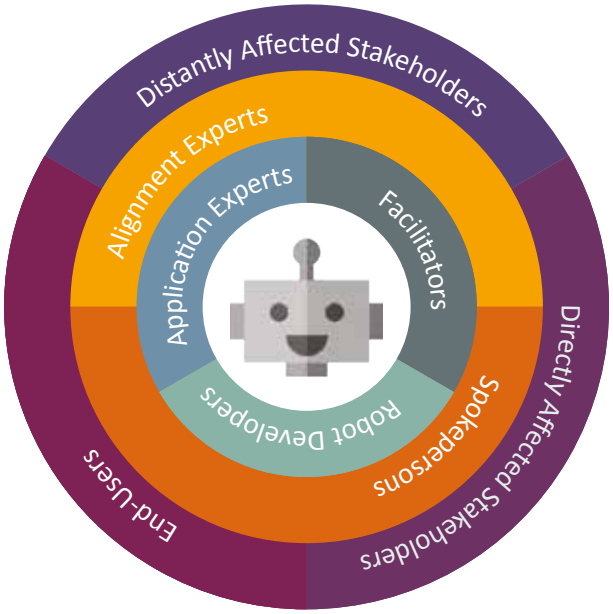


Figure 3.3. Alignment experts can be trained in the social sciences to better understand the needs and motives of both affected stakeholders and robot makers.

empirical knowledge of both. The alignment experts can have a core expertise in Social Sciences or Humanities (SSH) (e.g., an anthropologist or ethicist) but also need knowledge of technology and economy.

We do *not* think we as REELER researchers can live up to this description, yet also through our work we obtained close knowledge of both robot makers' practices and affected stakeholders' life-worlds. REELER researchers achieved some knowledge of the proximity gap and can see possibilities for potential alignment of their separate motives. To that end, REELER has developed and tested experimental tools for collaborative learning (*see the toolbox for engineers and other outreach activities at responsiblerobotics.eu*), which are designed to increase awareness of and attentiveness to other people's motives for collaborating toward a shared goal. Thus, the final Human Proximity Model is a prescriptive model consisting of three rings: the robot makers developing the robot, the affected stakeholders whose work and lives are changing as a result of the development, and the intermediaries who are tasked with translating the needs and values of the two other groups. The subsequent chapters all build on this model of human proximity, toward more responsible, ethical (*collaborative*) learning with robotics.

Why does REELER see it as a problem that robot developers only rarely use social scientists as intermediaries between affected stakeholders and themselves? After all, REELER research shows that robot developers are more than capable of getting knowledge of what users want through a number of other sources. Here is a robot developer pointing to a number of sources they use to get their knowledge of what users' needs are:

> *From client feedback. From fairs and events that we participate in. From feedback from our customer and from our customer department. So not just feedback from the people who bought the robot but what is people asking for when they are interested in our robots, what are they missing, what would they like to see, what is the main thing they are interested on, when they choose to buy a robot, why and what are this interest. As we mostly work with research centres. The other big part is just being quite up to date on the newest research that is being done. And with that we can get an idea of what the community is interested in, and with this we can decide what our next robots should have.*
>
> (Daniel, robot developer, BUDDY)

This is indeed an impressive list, and it covers most of the sources across cases, though each robot type also has their own special approach (not all work so much with research centres as BUDDY for instance). It also shows how much work robot developers need to put into robot facilitation. However, REELER also sees across cases robot makers are not including the people we define as affected stakeholders in collaboration, when the point is to get a thorough and holistic understanding of what matters to those who will be closest to the robots and will be affected in a positive or negative way.

This is also a novel way to make use of social scientists in the technical sciences. Today we do find social scientists involved in around half of REELER's cases, but they are not used to provide deep knowledge about the environments, values and needs of affected stakeholders.

Sometimes social scientists are involved in the role of consultants on markets.

> *So, we hired a couple of consultants last year and we did some due diligence on the market. There is a lot of information.*
>
> (Felix, Robot developer, Storex robot, WAREHOUSE)

In the inner circle of the Human Proximity Model (*see Introduction*), we find also collaborations with social scientists and humanists as they are sometimes brought in as application experts. They are often only loosely connected to the robotics work, but e.g. make surveys or give ethical advice as philos-

ophers. In practice, however, if social scientists are involved, it is often limited to only brief meetings with external experts late in the design phases, typically with the goal to address already selected aspects of end-user needs. This may include hiring only single persons specialised in non-technical subjects (see story on collaboration with social scientists). This also means that social scientists are not involved as partners, but to provide the information that the robot makers have themselves decided is necessary as in the following case where social scientists were involved as the robot developers discovered that hospitals were complex working environments. The robot developers were very happy with the work done by the social scientist though they were never considered partners.

> *Interviewer: And did you collaborate with any social scientists during the process?*
>
> *Samuel: No, I don't think so [as regular partners].*
>
> *Interviewer: Do you have any among the staff?*
>
> *Samuel: I don't think we had any external involved in that but we had some contacts where we sometimes I think ask them about related topics to social science and then, I don't remember specifically what we asked them about but they helped us and that was also their role. If the hospitals couldn't deliver the knowledge or insight we needed, then they would sort of help us by trying to get it from other sources.*
>
> *Interviewer: And could you see any value collaborating with social scientists?*
>
> *Samuel: Yeah, I mean we were a small team back then and definitely we could have used that perspective a bit more in the project, but it's difficult for me to say what it would have changed or what kind of impact it would have had. But I think, the role [the social scientist] had in the project was definitely something that contributed.*
>
> (Samuel, robot developer, SPECTRUS)

However, in some cases, we also find that the funding agencies prioritise projects with diversity – and that can help collaborations with social scientists. In the case of BUDDY there is a close collaboration with psychologists, but their work is still tied to the appearance of the robot and the like – and does not look into why affected stakeholder would need this robot.

> *We don't have social scientists in the company but in several of the European projects we are participating in, we do collaborate with experts in psychology, with social scientists and with other people from that part of the sciences.*
>
> (Robotics company, robot developer, BUDDY)

However, in general social scientists are not part of the inner circle and their potential contributions to robotics are largely unexplored. Sometimes the robot makers are simply unaware of this possibility of collaboration or see it as tied to 'basic research' and not to their type of work.

> *Interviewer: And do you also collaborate with social scientist or for example psychologist?*
>
> *Alph: So, we do industrial application, we don't do deep science. So, we have very advanced applied research, but it's not science.*
>
> *Interviewer: It's industrial development, not research?*
>
> *Alph: Yes. It is applied. If you want it's applied science, but it's not fundamentally research.*
>
> *Interviewer: But do you think it would be useful to collaborate with social scientists or it's not necessary?*
>
> *Alph: Social scientists?*
>
> *Interviewer: Like when you bring the robots—*
>
> *Alph: What is that?*
>
> (Alph, Start-up, robot developer, WAREHOUSE)

In another interview 'social scientists' is simply understood as working with people from another discipline such as biology.

> *Interviewer: So, do you, (not necessarily just in this project, but in other projects), do you collaborate with social scientists or could you imagine yourself collaborating [with them]?*
>
> *Edgar: I mean, we haven't done it within the company but then in my previous lab when I was at university, we collaborated a lot with biologists. But specifically, I cannot imagine right now how to work with that person.*
>
> (Edgar, robot developer, SPECTRUS)

Sometimes the areas of expertise associated with social scientists may involve safety-related domains or any areas that involve non-engineering subjects and engagement of end-users. Also, social scientists are often viewed as persons who simply deal with the 'social' aspect of the design and use of robots. Such an approach does not allow fully exploring the benefits that would come from collaborations with social scientists and in a way that their contribution would actually inform the design process for the benefit of both affected stakeholders and robot makers if they were included in the collaborative learning in the early design phases.

Though some robot makers in the REELER data are more advanced in their collaborations with social scientists in attempts to reach out to other communities (e.g. hospitals), the focus is on collaboration between the public, industry (market) and university to implement, test or evolve the existing technology – not collaboration with citizens, patients, etc. building on insights into what motivates them.

The role of alignment experts thus seems to be a topic for further studies. *Alignment experts* do not just speak on behalf of affected stakeholders, like the spokespersons or help with already defined questions. They make studies to align the motives and values of robot makers and affected stakeholders, based on empirical knowledge of both.

STORY FROM THE FIELD:

On collaboration with social scientists

Across REELER cases, we have three examples of social scientists, who were actually hired by robot companies and thus considered part of the team of robot developers. In one case a male philosopher was part of the core team developing at robot (HERBIE). In two other cases two female sociologists/anthropologists were hired (SPECTRUS and COBOT) in both cases by rather big companies. In both of these latter cases the social scientists had felt it a bit lonely at times, and also had to some extent to define their own positions. But in both cases, they had also been rewarded over time because the robot developers grew increasingly positive of their work. In the following story we take a closer look at the social scientist in the SPECTRUS case.

She was one of the few female employees in the organisation and the only person with a similar profile so far employed at the company. It is interesting to note that the way she was hired by the company was based on her own initiative. Given her interest in human-robot interaction and usability of technology she approached the company on her own with the offer to work for them. The robot developers in this case realised they did not know, what she could do – and asked her to write her own job application – and was very pleased when they learned what she emphasised. This shows that the knowledge on the side of robot makers in collaborating with persons coming from social sciences to robotics is still rather limited.

In general, her role in the company now is to help organise and run user studies and related workshops, meeting, etc. This is how she is involved with both end-users and the company robot makers. She is also the person who acted a contact person and helped involve the company in the REELER research. In particular in addition to being in charge of user studies, she is also involved in project management and coordination of work between different people. However, as time has passed, and because she is only one person, she feels she gets less time to do the important work with affected stakeholders – and instead is doing a lot of administrative project work.

"My job is also a lot of coordination (…) if we have some project collaborations, but I now these days focus a lot of EU projects, and that's a lot project management. (…) So, my role is kind of in between, trying to tell everyone, when they need to do what."

It is important to note that from her perspective ethical reflection and practices are not really enforced within European projects and it is up to the robotic company whether to pursue ethics or not. This may be difficult for persons with merely technical background.

"I think, it comes from the EU, and then, I think, right now nothing is really forced from the EU, so then it's up to the project and the coordinators. I think it's about pushing and pulling. So, if a developer, for examples, pulls for it, then, then that raises awareness for the ones that are leading the process. If a coordinator now would be interested in that, then he would be pushing for that, both on the EU side, and for the developers. But I think most coordinators, if you take a core robotics projects, the coordinators are very technical, and they don't think about that [ethics]. So, they are not pulling. And I don't think robotic developers are. So, they are not pushing, and the robotics developers are not pulling, I think."

Therefore, Katharina would often see herself as one who has to act as an intermediary who actually brings ethical perspectives to the company.

"I'm working a lot in EU projects, where we also develop technology that goes further in the future. So, when we develop a prototype here, then that takes like a year. And we have a concrete goal, and we want to end up this year with a prototype. But the technologies that we develop in EU projects, they might end up in a product in five years or ten years or something like that and there we are thinking more about the ethical consequences, also because it's necessary. It's standard in EU projects also, and we discuss those [issues of ethics] more [in these projects]. And we have more workshops with other companies or with other partners to actually discuss ethical consequences. Like look at what does this technology bring in five years, how does it have an impact on society, for example.

Interviewer: So, do you think ethics is connected to your particular profile? Is it easier for someone like you? How would you describe that?

It's easier for me, because I've been involved in more workshops and projects like the work you do, and then people point towards these things, and that gets me thinking about "Okay, we don't necessarily, when we do development, think about these things, but we do think about these things." And taking that back, and just, when we discuss things, saying that. And then I think it's a more shared experience."

A successful collaboration and learning related to bringing ethical thinking to the company requires making an

effort and taking interdisciplinary approaches by each party involved.

"I think that [developing one's own ethical guidelines] will become more and more important for engineers as well. Either engineers having that touch, or also anthropologists having a little bit of the engineering aspect."

Though we here find a successful collaboration between a social scientist and robot makers, their motives are not entirely aligned. Katharina sometimes feels lonely, and also that she as a social scientist takes a special concern for ethics. However, EU and their emphasis on ethics also helps her in this work. As the funding agencies call for more ethical robots the social scientists can take on the role of interpreting what that means.

Finally, it is interesting to note that of the few social scientists employed in robot companies we find in REELER, there is an overweight of women (see 11.0 Gender Matters).

(Based on an interview with Katharina, HRI expert, SPECTRUS)

One of the main reasons for a lack of such collaboration with social scientists is a prevalently technical focus of robotics research. This often implies taking a rather narrow perspective on robots seen as technical systems separate from humans which leaves little room for consideration of any factors that lay outside the technical domain. In some cases, robot makers do acknowledge the need and potential benefit from collaborating with social scientists, however, they still do not see it as a must or a priority, at least not yet. However, for some there is a curiosity about learning from social scientists.

Interviewer: Can you imagine collaborating with more social scientists, so artists, or sociologists, or philosophers?

Hugo: Yes, why not. Yes, remember I'm a technician and my kind of thinking is square.

Interviewer: [The way] you are thinking..?

Hugo: Yes, I'm a technician really and for me two plus two is four. So, for me to tag with society, no, maybe not. But sociology or philosophy is very interesting, very good.

(Hugo, robot developer, HERBIE)

Today it is not common that robot makers are actually collaborating with social scientists in developing ideas for projects or involving them in the design process. This seems to be tied to the fact that robots were previously kept in specially built environments like factories, where the contact with humans was limited (as robots were 'caged in' or 'enveloped'). That has changed in later years – and this may be why the robot developers (as well as the whole group of robot makers) increasingly feel a need for closer collaboration with both citizens directly and the social scientists, whose expertise lies in getting to know issues tied to people's everyday lives.

Interviewer: And in the course of your work, the design process, do you ever collaborate with social scientists, or not really?

Pino: Me personally, no.

Marco: No. No, me neither.

Interviewer: Why not? I mean, I'm not saying you should, but if you don't, then why not?

Pino: I don't know… Up to now, robots were in general automation and then humans are, let's say, operators. They're quite split. So maybe there was not much interaction between the two and not many maybe ethical issues. Maybe now that robotics is going more into collaborative robotics, meaning that the worker, the operator and the robot are working together, maybe it could be, let's say, more useful to have such kind of feedback.

(Pino and Marco, engineers, robot developers, OTTO)

However, even if there may be a doubt about what a social scientist is, they are considered useful in relation to the users in general.

> *Interviewer: Do you at any stage collaborate with social scientists?*
>
> *Cristiano: No, no, I think, no.*
>
> *Interviewer: No, would it be necessary, or not really?*
>
> *Cristiano: But could be useful for, perhaps for the approach with the user, I don't know. This could be useful, I think.*
>
> (Cristiano, engineer, robot developer, OTTO)

However, if the robots are being designed to be used by people with a technical background the need for social scientists to interpret user-needs dwindles. This is also because the focus is on social scientists as application experts helping with improving design or the psychological factors tied to robots unknown to people without a technical understanding

> *Interviewer: Do you collaborate with social scientists, like psychologists or sociologists, at any point?*
>
> *Carlo: No, not yet.*
>
> *Interviewer: Do you think it would be useful or not really?*
>
> *Carlo: I think not really, because the operators are technician [in the case of the particular robot he works on] so there is no way to interact with the normal people, but only with technicians, specialised technicians, that are going to use our robot. So, I think there is no need to speak with a psychologist or the like…*
>
> (Carlo, robot developer, OTTO)

However, from our point of view in REELER also people with a technical background can be considered affected stakeholders, when they meet a robot that will transform their work life. Here social scientists could have helped understanding present working conditions for the technicians better, thus improving the actual design and uptake of the robot Carlo is working on.

The challenge remaining is finding the right social scientists who would have a good understanding of robots and robot developers' work and could act as a bridge between robotics and ethics and people in everyday lives. In other words, in order to successfully work together, robot makers and social scientists should develop a common framework for how to understand and deal with a given subject, starting from creating a common language in the first place. This means social scientists should not only understand affected stakeholders, but also the work of the robot developers.

> *We need people that understand the problem. Not being scientists or engineers that fully understand the implications and meaning of things, that means that we need a bridge from people who have already been part of [our work], you know, that knows what we're doing. And I guess that's, that's usually… that's usually a problem.*
>
> (Jorge, Head of Laboratory, robot developer, BUDDY)

Here a robot developer points to the problem of the need for a common language, which is not so easy to obtain.

> *Interviewer: Do you find a difference between working with the social scientists and people with a technical background? And if you do, what could that be?*
>
> *Albinus: They are different because of the language they use, [laughs] for sure. And they are different because technical people use generally quantitative, while social people use generally qualitative and they are two different approaches.*
>
> *Interviewer: What difference does it make, do you think, when you work together on a project?*
>
> *Albinus: That when you are working with people with a different background, you need more time, because part of the time is devoted to create a common language, for sure. Because if you are able to start to understand each other, then you can move to work together.*
>
> (Albinus, CEO of a robotics company, robot developer, REGAIN)

This is why REELER research also shows that even though social scientists are needed in the technical sciences, they may

also need a new kind of combined education that prepare them for both studies of people's everyday lives as well as a basic understanding of technical and economic issues (*see 12.0 Human Proximity and 13.0 Conclusion*).

3.7 Concluding remarks on Collaboration in the Inner Circle

Throughout our fieldworks in REELER we find that there is a close physical proximity between the collaborators in the 'inner circle' we have defined in the Human Proximity Model (*see 1.0 Introduction*). Robot makers have shared meeting places as sites for collaboration in the robotics laboratories, at EU events, competitions, fairs and conferences.[4] The people we find to be meeting in these places are mostly white males though we also find examples of female participants and people with other international backgrounds and skin colors. However, the general impression is that the group of males (*see 11.0 Gender Matters)* often appear to share a normative mindset and even backgrounds in higher education, which in our theoretical approach to defining 'collaboration' means that they share important conditions for collaborating. They share to some extent a common language and motives that bind them together. Though they are also competitors they meet regularly at these conferences and seminars to learn from each other about technical developments, political regulations and funding options (*see 1.0 Introduction*).

However, it is not all engineers but only for instance CEO's who mingle with the policymakers from the political institutions and funding agencies and company owners. In REELER some of the cases also began with an identification of an everyday problem through a contact to the end-users or other people affected by the robots, but often collaboration evolved either from groups of robot makers joint in a passion or interest for existing technology, funding possibility etc (*see 2.0 Robot Beginnings*). This already established collaboration between robot makers may also involve spokespersons (e.g. doctors speaking for patients, factory owners speaking for workers) or a mix of the above.

From the perspective of relational agency, robot makers collaborate with each other within a narrow circle that risk reinforce normativity (*see 5.0 Inclusive Design*). In anthropology normativity is something we find within any group of long-term cultural collaborations. On the positive side we see that robot makers, and their agencies, have already developed a solid set of skills in collaborative learning.

On the negative side we see that robot makers mainly include end-users as test-persons and do not collaborate with directly and distantly affected stakeholders – not even through spokespersons. They are for instance directly affected stakeholders identified as people close to the end users, who are supposed to interact with the robots without being intended users themselves. This group of directly affected stakeholders are often overlooked. An example could be an end-user who is going to work with a wearable robot system and needs a close relative (the directly affected stakeholder) to mount the equipment. Or a nurse who gets extra work when a surgical robot (to be operated by the end-user, the surgeon) is introduced in the wards. Or a worker, who loses a colleague, when a robot takes over a job-function. On the positive side, it can be a relative who gets a happier husband or wife because a wearable robot helps a patient to do tasks they could not do before. It can also be the neighbours of an elderly citizen who now gets to socialize more with neighbours because she has robots to help in the garden or house.

Even when the robot makers really try to involve people outside the inner circle, these collaborations are rarely an alignment of motives, but an instrumental use of people's expertise to forward one's predefined goals –e.g., to help solving problems identified by the robot makers themselves or to test robots.

Across all cases a pattern emerges that robots are conceived (*see 2.0 Robot Beginnings*) and developed together with the powerful people in this inner circle. Making robots is not special in how these collaborations come about. Though we have not researched other business and R&D processes we expect it to be pretty common, that there is an inner circle of powerful people working together – and that users are not included as collaborative partners. What makes robots and AI a special case is both the degree of public funding involved in the production of robots, but also that these technologies may have a larger impact than what is usually the outcome of this kind of inner circle collaborations. Also, robots and AI are not necessarily chosen (like being bought on a free market) like for instance a tablet or a dishwasher. Rather, the REELER finding across cases is that there is a gap between who collaborate in close proximity to each other to realise the robot – and those affected stakeholders who are mainly invited in for testing (end-users), or not considered at all (many directly affected stakeholders and distant affected stakeholders) even when these robots and AI will eventually change their lives.

For all of these reasons, and more that are explored in parts Two and Three of this publication, we expect that more social scientists are needed to improve design, and make robot and AI more ethical in the future. However, in order to collaborate with the robot makers in the inner circle, these social scientists need a new education as alignment experts – a perspective we unfold in more detail in part Three (*see 12. Human Proximity and 13.0 Conclusion*).

4 Though robot developers participate in many collaborations with for instance Asian and American countries we have concentrated on European robotics.