APPENDIXES OF THE THESIS REPORT:

FACILITATING MUTUAL LEARNING IN LIVING LABS VIA DEVELOPING PROFESSIONAL IDENTITY OF KNOWLEDGEABILITY IN DAILY COMMUNICATION

A case study on a living lab of sustainable medical instruments

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An electronic version of this thesis is available at http://repository.tudelft.nl/.

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Appendix A - Protocol of semi-structured interviews

INTERVIEW INVITATION FORMAT:

I am Weiwei Liu, and right now I am graduating from TU Delft in the master Science Communication. For my thesis, I want to learn how can a communication perspective facilitate the process of medical innovations. In this context, I choose Living Lab Medical Delta Instruments as a case study, and that's why I was introduced about you by Steven Flipse, the supervisor of my thesis.
I wonder if it is possible to interview you, about your interpretation and your experience in this living lab context. The interview will be no more than 1 hour. I fully understand that you might be very busy at this moment, and if you are available for this interview, please let me know your preferred time.

Thanks in advance!

Best regards,
Weiwei Liu

Dear Friends,
Weiwei, a bright student of us is investigating if the type of projects that we are all working on can be clustered in a future "Living Lab" entity that is potentially owned and directed by a consortium of academia, industrials and other partners.
Weiwei likes to have an interview with you of approximately 45 minutes to see if partners like you can benefit from a new structure in terms of efficiency and use of a very broad network.

INTERVIEW PROTOCOL:

Good morning/afternoon,
I am Weiwei, and right now I am graduating from TU Delft in the master Science Communication. Since I studied biology during my bachelor time, the field of healthcare always intrigues me. And it is at that time, I realised that the problems in healthcare is not just the responsibility of practitioners and medical technologists. But also, these questions inspire many social science researches to explore how to facilitate the process of medical innovations. So, in this context, I choose Tim's lab as a case study, and that's why I was introduced to you by Tim.
The focus of my research is concerning the interaction between people with different perspectives, and through the interaction, how do people's identities display and reshape in a living lab context. Thus, in the following moment I will ask you about your interpretation and your experience in this collaboration.
Before we start, can I record our conversation? The record is just for my analysis and I will ensure the anonymity in my final report.

Clusters of questions	With questions	Notes
Professional identity (identity of own practice)	1. What's your daily work/responsibility in your own organisation? 2. What's the role of medical delta in this living lab context	Institutional frame
	3. What is the expertise/professional competence that you provide in this collaboration with Tim?	Self-understanding as a service provider
Identity of knowledgeability	4. Why did you want to collaborate with Tim's lab? 5. What can you benefit from this collaboration?	Motivation

	6. How did you know him and started collaborating with him?	
	7. What would be a meaningful partnership according to you? 8. What is the common ground between you and Tim, which can serve as the foundation of collaboration? On what basis do you convince that they are the right people to collaborate? (to what extent do you think you are address the same issue?)	Common ground/Similarity
	9. How do you work with Tim right now? What's your interaction?	Engagement
Identification	10. What do you think that you achieve together by your collaboration with Tim (with his broad network)? (What can be the potential advantages of this living lab network compared with your current network?)	Imagination
	11. Have you experienced some differences (mindset, working ways, emphases) during the collaboration with Tim, compared with your work in your organisation? 12. How do you deal with these differences? Or how do you coordinate/align with other actors?	Alignment

Last general question, is there any important question that we didn't address before? Or anything else you would like to mention?

I think I have all the answers of my questions, thank you so much for your kindness and valuable opinions. I will transcribe this interview and send it back to you for reviewing. Thank you for your time, and have a nice day. Good bye.

Appendix B – Transcripts of interviews

Coordinator of living lab, professor at TU Delft (2020/05/27)

I: Yeah, first I want to introduce my research focus. So that will be on the human interaction. So how to help people will construct their identity in the living lab context. Just as you, uh, as our meeting last time. I feel like yeah, you, you have the problem, like, it's hard to attract the right partner for say, yeah, so I think create an identity to clearly represent ourselves. It's a good way to attract the right partner. So, so in this interview, I will ask you about your interpretation and your experience in the living lab context Yeah.

Interviewee: Okay. Regarding this because you, you pick out one of the problems that we have, right? That's correct. Okay, you chose this problem because it is only one of the problems. The other problem is that we don't have the facilities. We don't have the people; we don't have the correct type of entity in order to facilitate that kind of deals with partners. But okay. I think that's clear. So I tried to say there's no the only problem we have, maybe it's the smallest problem. Okay. Okay. Let's start then.

I: Yeah. So because you have already answered many questions last year in the course, high-tech innovation marketing. So today, I would like to confirm some with you and ask more detailed questions. Yeah, so please, correct me if I'm not precise enough.

Interviewee: Yeah of course.

I: So yeah, um, for me, for my understanding with the, your living lab is a research lab and with your personal network and ideally with the network of medical Delta, and living lab can become like a knowledge hub of sustainable surgery. And, yeah, so I wonder now your daily work in this living lab is as a professor in TU Delft, and coordinator of the living lab. And I wonder if your business and, and your company is also involved in this living lab?

Interviewee: Yeah. Yeah, yeah, that's a problem. So you have all my partners, and my PhDs that they are coming out of the partners, they're all entangled, let's say. They're, they're working all together in those living labs. And the living lab is not necessarily now and specifically in Delft, but it's also in in inside the companies itself. But that's not a thing I'm struggling with. It is not all in one location. Yeah. So I become very aware that the living lab is not a single location, a single entity, but it is. Yeah, it's not even the place. It's a cloud to where all the...

I: It's more like an abstract network?

Interviewee: Yeah, and that makes it so complex. Because what I also learned now, it that, there are also serious money flows. There are very commercial entities working together with academics that cannot facilitate any Yeah, let's say they're not allowed to support any activity that leads to commercialization. So huge, uh yeah, set of conflict of interest. Let's say, issues around conflict of interest.

I: Yeah. So it's like the funding that should be supposed to support the academic research but not commercialization?

Interviewee: Yeah, I don't know. That's the thing, because now you see the partners they want to invest in the consortium, but they also want to invest in that… they only do that if there are also production line and if also products are rolling out, which is an activity that fits not TU Delft anymore, but more, uh of the non-academic partners that are part of the living lab, let's say. So, if you create a consortium with academics, non-academics, and you want to be of interest for the partners that are trying to uh… for the clients let's say, the companies would like to try, would like to

find a solution for the problem. The problem is always that I want to Yeah, I want to or if it link to, relate to the fact that I want to earn money.

So then you get, I don't know what, what is the best to do. Because then if you create consortium and investment is needed, where does the money go? Because it's not possible to, to send it to TU Delft and then somehow it is redirected to our living lab, and then the companies are paid from it. It's extremely complex.

I: Can you explain again, the consortium, so it's like your living lab can also do the consortium work?

Interviewee: That's not necessary to work. So we are part of TU Delft academia is partner in the potential consortium with my, uh say Van Straten Medical or other private partners that are doing execution of the work. Let's say. So they invest students that are building production lines within those companies based on our, uh, with my knowledge involved.

I: Yeah okay.

Interviewee: Yeah. And then uh, somebody has to pay for all the expenses and then they want to participate because it is an entity. So, the problems are not that there are no partners, that there is no interest but it is distraction that is now the main problem. So how can we create a living lab that allows real collaboration between all kinds of different partners and allows it to be a little bit more commercial than an academic university is.

Without all those conflicts of interest.

I: Yeah. Or Yeah, you can, like solve the conflicts together. So that you negotiate.

Interviewee: Yeah. And because otherwise you end up in situations that could helping out academia. I find a solution or a problem. In the case of the mouth masks, we created this very fast test setup to see whether those mouth get gaps, uh have the right filter capacity, let's say. I implemented at a location where that is possible, which is one of my partners. Then we validated, I used the data for uh…So we measure like thousands of masks after sterilization total brand-new ones from Asia. Generate, generates a lot of data that you can use them for publications. On the other hand, Yeah, all the people that take in the masks that are doing the processes around it that really test them. They are employees of the company that need to be paid. So this company needs to make a turnover. And therefore, this company needs to, uh, ask for compensation for every test. And that means that if you make an agreement like that, which we did, they now charge around 300 euros, but they earn 100,000 euros a month. And I cannot benefit from it. And the university also doesn't benefit, because there is no structure. Or you see that the company creates a turnover of a million per year in theory. Yeah, we can do the work. It's not what I want. For what kind of consortium do we need in order to make it sustainable for everybody?

I: Yeah, that's a tricky question.

Interviewee: Yeah. That's tricky. And there are many of these kinds of things. So, now we see that Johnson & Johnson strikes, they're all interested to do reprocessing of materials from uh…so that they provide instruments that are very complex that can be used only once, they are disposable. And now they see that it is very interesting to take them apart and to see if you can reuse parts of it or you can still sterilize it or whatever, and they like to invest in such a project.

So, but where do I fit this project?

So it seems now almost undoable to create a consortium with academic and non-academic partners, let them invest in that. So we choose to let them invest directly in the partner company.

And then we thought about, maybe then the living lab or the university has to be paid by uh, yeah, if a project comes out of the school searching goes to TU Delft. And you put the student on it, for example, then you pay a certain fee for the students. Yeah, I don't know if the dean accepts it.

So what we need, we need an entity that can just use work on itself and has the…it is the existence of this entity, this living lab is basically backed up by the dean, and they allow us to with our academic knowledge to help industry to make better products.

I: Yeah. So I want I also want to talk about your professional competence. Yes, last year, you also said, the assets you can bring to the living lab is expertise in sustainable surgeon and I wonder if there is more in your professional competence for example, your, your network with uh, with hospitals. Your network with EAES….

Interviewee: Yes, of course. that so you, yes itself is also a huge, huge entity. It has thousands of surgeons involved and it links the knowledge pool to my, to the living lab then you get, yeah you have a lot of knowledge and support for certain projects.

I: So maybe it's just, maybe you can also be the broker role in the middle. It's like introduce, for example, introduce the right surgeon or right partner company to another industry. So the consortium work...?

Interviewee: I think it's always an impact because those, those partners stay… they all…umm, so the industry lots to talk with the surgeons, but surgeons don't want to talk with industry.

I: Ah yeah.

Interviewee: So only being a broker doesn't work, you also have to translate it and you have to explain to each partners why it is necessary that they start talking and collaborating with each other. So what my experience is that, that there are a lot of people that claim that they bridge, they bridge the gap between surgeons and medical specialists and the industry and all the partners. But my experience is that it only can be done if you really start the project and you really be active in it and really make sure that things are being done. Because surgeons they can only talk in industry they Yeah. Receive. But yeah. Also work needs to be done.

I: Yeah.

Interviewee: You can talk about making a project and create something new but yeah, in the end, you need to have the money and the facilities to make it happen.

I: Yeah, okay.

Interviewee: And that is the living lab in my eyes.

I: And so, to what extent you think engaging the living lab is beneficial to you. So not, well, because you're already talking about the benefit to TU Delft. And I wonder what you think would be beneficial to you personally.

Interviewee: ummm, yeah, it's a combination. So if you…uh…really beneficial, right? If those partners start to become available also for high-end, high-tech projects that are of interest of your research line. Then it is helpful. And if that happens, then somehow it pushes yourself as a brand, your research line as a brand in the university. Or, it boosts your, your label, let's say.

I: Yeah.

Interviewee: And then it works.

I: So it is like, how to say, you become famous in this whole area.

Interviewee: Yeah. But it's a very good question. And because if you don't do this right, you can do all the work for everybody. And there's no [???]. You mean, because I have a network, I know who can do what, and I am the guy who does the work or make sure that others do the work. But that is all not beneficial for me. It's only beneficial and I get something out of it. And there's either money or a this, let's say, ummm, not acceptance, but more, …. Let's say boosts my, my tie within university. Yeah so that I become a professional, faster, let's say make it very practical.

I: Yeah accountability in this area?

Interviewee: Yeah. You have to compete with others. And if somehow what you do is important for the university, then it is good for your name. Yeah.

I: So can you tell me more details about what would be a meaningful partner? According to you.

Interviewee: The definition?

I: Yeah.

Interviewee: Well. That's the partner that is uh, really willing to spend time and effort in a project, so not the partner that only wants to put TU Delft logo in their website, but it is one that is willing to Yeah, to also help you in writing the proposal that will also be execution, uh do the execution of some part of the work so that they work on the same level as you are.

I: So it's like they are willing to spend time to have a lot of discussion with you…

Interviewee: Not only discussion, but also that they're willing to open their doors.

And that you really can use the partner as an extension of your living lab. Yeah, I think that's crucial because it, uh, I can only define that now very well because I have some of the companies that work like that. So what happened with the test facilities that we built in another location at the partner, those companies were able to open the doors are able to say: Okay, we give you a room. You can build up your test locations. One of the guys are even doing a PhD with me now. So they work on an academic level. And they're not only in it for branding.

I: Yeah. So what's the common ground between you and other actors? So what's the foundation of this collaboration? And yeah, also can say, what's the basic basis that you think you can convince that they are the right people to collaborate?

Interviewee: Yeah, the problem is always need time to tell. Because If a new partner, the address issue, you really have to figure out what they really want to do, and where they really stand and what they aim for short and long term.

I: So maybe you can already state Yeah, we have this vision we…uh this is our main goal, so if you agree with us, you can come to me.

Interviewee: Yeah, the obvious one, of course, is that they're acting in the same fields. So basically the same as when, when I have to hire an employee, I expect them to bring a portfolio to show them what products they make and what

partners they have and what I want to do to improve their products, let's say, What they, uh if they, uh you have to be able to test if their project fits within the sustainable surgery line.

And that's ideal. So they have to come with a question that I can turn into, let's say, into a project very easily. That within the knowledge field that I have, let's say

I: So it's like, they also need to have some capacity to collaborate. It's like they…

Interviewee: Ah depend of course on the project that they proposed. Because sustainable surgery is broad, but let's say that they have an instrument and it is not sustainable too many parts. It is disposable, and then I want them to bring this. And then I have some questions. Are you willing to, to, to give us all the files to work on? Let's say all the technical drawings. So And what about IP issues? So those are a little bit the standard session, if you start a project and new IP comes out, we need to have format uh typically, let's say we have a format to deal with that. Are they willing to accept that? And also, are they willing to free up some expertise, some people there within the companies to support this project? This question should be answered with a yes.

I: So it's like you said about a contract. So I wonder if there's a space for negotiation or it's just you give them a contract and they, they can only choose, they accept or they don't accept?

Interviewee: Umm, my real my, my experiences that if there is a contract, that if it needs to be changed, it takes half a year, in every occasion that need, need to be changed. So yes, it is possible with the real delay and the regarding…So this kind of projects with potentially new IP that is extremely benefit…beneficial from them. There are no standard contracts for that. So we need to make that. Oh, there's something…We have to ask out technology transfer officer if they can draft let's say a standard contract for us and how we can deal with this. The partners.

I: Yeah. And I will also want to know what's your current interaction between you and other actors. Because for example, I learned currently you have little contact with medical delta and what about with other…other actors for example, people from company or hospitals?

Interviewee: What…what kind of relation I have for them?

I: Yeah, the…what is the interaction between you and other actors?

Interviewee: It depends, highly. But what do you mean? How we communicate? To what means or?

I: Yeah, it's like how you start your collaboration, what's the process of…yeah start a project together.

Interviewee: The process…Yeah I am struggling a little bit for good example because it's so extremely broad. I am, I have to think about the common factors.

So, in case of the specialist, that you often see is that they're interested in my work. And they are interested in publications and that match. So my work, what I'm doing is very close to what they can use. That's why they like sustainable surgery. And therefore they…they're always willing to contribute. And then as a return, they will be, they get a position on the publication as an author. So that's why they're involved on one side of my network, let's say. Industry, obviously, yeah, they have problems. They lose money or their products are not functioning. Therefore they have to put a lot of effort in to sell it. Or they are forced now by the government to make it more sustainable if you don't accept any waste anymore. So there are all kinds of…either…Yeah, they're always forced, either forced by making more money within their own company, or they are forced by the government because they have to deal with one of the problems.

I: It's more like the industry have heavy inno…innovation, pressure?

Interviewee: the innovation pressure, but it is not never out of there. Out of the instrument interest of individual partners. It only happened once. Most of the time, it's only commercially driven.

I: Hmmm, yeah.

Interviewee: And then of course, they see what I'm doing. And then I hope that somehow, I can magically solve the problem for them.

I: And can you? Yeah, what's the experience about that? So how you…how you can solve the problem for them?

Interviewee: If I ask those questions that we just talked about, in addition, yes on everything, green lights. Then I have the capacity to solve it, most of the time we use a student…a graduation student or a bachelor group to explore the problem, and to come up with solutions. And then, yeah, of course, all the support and networking interaction with me and with one of my colleagues that can also benefit. Because if publications are coming out of it, and I'm also willing to put some of my PhDs on it.

I: And yeah, what if the products they…So…Yeah, the product can be a patent, and then who will own the IP?

Interviewee: Yeah, that's a problem. We have those things now. So we have them…uh, one bachelor group work very hard on a…two actually, on two problems that you see at the sterilization department. And the projects were brought in by a collaborating partner, commercial partner. And we now have two very good solutions for that, in that really, really going to save them a lot of money in the future. Then the question is, do we have to apply for a patent and who…who has ownership of this patent?

I: Yeah.

Interviewee: That is an urgent question. Because there was no, before we started this, there are no good regulations for it. If I just say…yeah it is a just bachelor group and we have an external that came from the problem, then, and then the better bachelor group works at the external and then the other IP is for them. Yeah, in this case, it is a partner that works in the living lab. Let's say. They already activated us. I also worked there a lot. There's a lot of interaction with me and actually, some of the solutions are came from myself. And then of course, the bachelor group they were executing it, yeah that changes it a little bit. So I have no idea in a practical way, what is best? If I just let them have the IP and that…yeah they are allowed to patent it for themselves. Or that I go back to my…let's say, my department and tell them to apply for this patent, under their name and then make them do with them. Yeah. I don't know.

I: Yeah. Okay.

Interviewee: If you can solve this kind of stuff, or if you can save it, okay, now, any project that we're going to do that is of interest for the industry. If that is the case, then this is the standard contract that we have for graduation students for bachelor students, and that needs to be signed, otherwise, we're not going to do it. And then everything is already stated in this contract. So you don't have discussion anymore in the end.

I: Yeah. I have no idea about this.

Interviewee: Oh, maybe it is a solution. Yeah because, okay, if we're going to do a graduation or a bachelor project within the living lab, then you need to sign those forms. Otherwise, you're not going to do it.

I: Well, then I am afraid if we're doing so, the industries may feel, it's hard to collaborate with, because you have to sign this strict contract before.

Interviewee: That's possible, that's possible. And then? What happens then?

I: And then we'll lose…

Interviewee: You're not going to do it.

I: Yeah.

Interviewee: And then we don't have cool projects for the students anymore.

I: Yeah.

Interviewee: So this shows that the contracts need to be not that hard and maybe negotiate needs to be able to tailor them to their specific needs.

I: Yeah.

Interviewee: And that is possible uh?

I: Yeah, I think so.

Interviewee: And I don't think we need to have, you know, ummm, everything out of it as university. We just need to have, let's say, some sort of statement in it that if money is…is made, then you want to have 35% of the turnover. Something like that. But at least now there's nothing and now it's everything is under discussion, and you have to start a discussion and the solution is already on the table, and then it's more difficult.

I: Yeah, I think so. Because now I also learned, like, a lot of things in living lab is all about discussion and negotiation. So you really have to spend a lot of time and effort in. yeah, to set up.

Interviewee: Another thing is that if you create a living lab and you…you create fairly dense, let's say collaborations with certain partners, and you're really going to use their space and you're using their systems and their machine shops and you use all for your research line, but they're also making money out of it.

Then it will be a little bit more…more complex.

I: Yeah.

Interviewee: We can say we don't want that. Or you say, Yeah, okay. There's a living lab in it, which is a commercial semi-commercial entity and we, we let those partners, let's say, we have a sharing those…an efficient living lab. Then it becomes really like a commercial entity that also department has a sharing and the commercial partners have sharing, with their own board of directors. It's Yea

I: Yeah. And I wonder what your experience on working with people outside your discipline.

Interviewee: Outside?

I: Yeah, outside.

Interviewee: Outside what?

I: Outside your discipline. so outside any…outside your technical area? So for example, like surgeon where you have different competence, and yeah, so what's your experience about that?

Interviewee: Yeah, I see surgeon, maybe also in the ground. They're not so different in this field. So my experience is that that works very well.

I: Ah okay.

Interviewee: And the industry, um works also very well. And but yeah, but that is that also directly the problem because that means that I am an exception. When I'm gone. The question is, can you really execute a living lab?

Because, yeah, I'm not sure whether there are people like me and how many there are.

I: But have you ever met some…like difference, between you and the people you interact with and how you deal with that different, uh yeah, difference. So, for example, a different way of working and yeah.

Interviewee: Yeah, again, it is all about respect. So those people, they know what you're doing, that's why they approach you. And yeah, and then of course, they experienced that you're working…uh, your workflow and your aim is different from there. And then, yeah, it is very nice if they try to understand it, and they try to benefit from that instead of starting making issue out of it.

And fortunately, the people I work with, they are on such a level that yeah, goes quite well.

But I don’t see a problem directly.

Ah…in evolve from the surgical or the medical or the industry work together, because they are also in the industry you know. The specific industry that I’m working on, they already facilitate surgeons, they already have people, employees that…yeah that they are always in direct contact with surgeons, let’s say. They are all managers. So it is that they all know how those people think. And what they're doing. They're all familiar with it. That's because this is very specific industry.

I: So it’s like they are already know…

Interviewee: Yeah people in JNJ they know how surgeons think and what they are doing and…I am in between because…I…those people already…they know, yeah, they know what to deal with those people. That's no problem.

I: So you also familiar…know how to deal with this.

Interviewee: Yeah, as long as it does in the field to surgery. Yeah, of course. And sometimes you see that you have to deal with other branches within hospitals, for example, people that do all the biomedical and the fibers growth and people are working in, in the biochemical directions. And then they are different slightly but yeah, not exactly. I don't exactly know what you're looking for. For me. Maybe it is a personality thing, but I don't have…I never have problems, only the financial people.

I: Sorry?

Interviewee: Only the economical and financial people. I have problems.

I: With financial people in industries, in companies?

Interviewee: Yeah, sometimes, so the partners that have no idea about technology or development or then they have to approach to you. Things like that. Yeah, it is like saying I have a problem now and you can solve them tomorrow. Those are very typical financial people.

I: And how do you deal with them?

Interviewee: Ignore them.

I: But do you need them? Do you need to collaborate with them?

Interviewee: Of course, if you will…if you are working in a certain context like this, and you create the project and yeah, you need everybody. Yeah. Yeah, it's mainly the inexperienced people that have to deal with a network that this surgical network or development network gets so complex, that they have no idea how it works.

I: Yeah, but if they want to collaborate with you, I think they should…

Interviewee: Those are the people want to collaborate with me. Those are the people that have to do the all the formalities works.

I: What kind of work is that?

Interviewee: If you create a project and everything needs to be…you need investment and it needs to be drafted, you have to make plans for it, need to be approved. You need to go through all kinds of layers within the company. And then of course, every time somebody sees this investment that you need and they have a…they have to say something about it. And if they don't know what you will need in order to create a product or solution, then, of course, you end up in discussions that are never useful for me, yeah so is I need to explain why I need to invest money in something then yeah, to waste my time.

I: But I feel like it's necessary to explain to them otherwise. It's hard to get investment.

Interviewee: Of course, but you are an engineer. And as a…as the owner of the project and the problem, either surgeon or industries have the solution or…or technical team that needs to develop a solution, they also know where they're talking about. So they know what they need and how the timeline looks like. At the end, those are not the people that really have to push the project to the…the companies for approval. So then every time you need to spend time on discussions with people that need to approve it. That's the stuff that this is necessary evil to be done. If you asked me…you know what people do you think difficult to talk with? And those are the type of people.

I: Hmmm, yeah.

And your…uh in the students report I also found now the medical experts are the link between the living lab and companies and…and also is there…so the company approach to…approach the experts and ask for bring them in contact with you and I wonder yeah why not they direct… Why not the company directly contact you?

Interviewee: The last thing is what happened? So the company directly contact me what was the other option? Who was in between?

I: The medical experts. Yeah so…so now I learned in the report is now the company contact the medical experts and experts give to…bring the company to you. So, yeah so now I feel like maybe the medical experts stay closer with the company.

Interviewee: Uhm..I think it both happens. It depends on the type of products and within that discussion, it was that sure since they first approach an industry, if they need something then they say, well, you know, we can put time and effort in that. So, you have to look a little bit further to somebody who can help you and then they end up with me. And then when I develop it and something concrete comes out of it, and it becomes more like products.

Then it becomes also the phase that the…you enter the phase in which it is interesting for the industry. So that happens often and because a surgeon with a problem, it is not necessarily beneficial for the large industry to do something with it because it only costs time and effort to develop it. And for an academia like me, I mean to biomechanical engineering and medical devices. Yeah, it's interesting to develop something new or for example, for my PhDs. It's interesting to develop something, and then to publish about it. So sometimes, you know, we say yes, okay, interesting, let's do something.

And then after that, you go back to the industry and say, Hey, can we do something with it? But on the other hand, yeah, it depending on the problem, of course, you have industries let's say Van Straten Medical, JNJ, they say, we just want to do something. We want to extend our portfolio or now we want to measure in our influence forces, because we think it is important, or we have to do something with sustainability. And then they directly approach us. So it really depends on who has the problem. If it is the surgeon, and often the surgeon goes to the industry, the industry says No way. Maybe go to Tim Horeman and academias and then see if they think it's interesting, or these industry itself has a problem and then they directly go to me. They're not going through surgeons. Makes no sense.

I: Yeah, okay.

Interviewee: So that's a…yeah to clarify a little bit, how it can go.

I: Yeah. And I also noticed that uh…I feel like there is a…I want to know if there is a clear boundary between good and wrong partners. Because you also mentioned, some partners they are wrong? Because they have some…how to say…wrong purpose to contact you. And I wonder if this…if it is possible that these partners can become a right one.

Interviewee: That's a very good question. So, yeah, wrong and right, so the wrong in a sense that their…um…motivation is not good…so they only wanted to have a TU Delft logo, on their website. And then they are happy. I don't think you can change much. The other type of partners, are wrong, they just don't know what to expect from technical universities. So they have no idea how we work, what we are doing, what's the contribution is for academia like us. Umm, so they just walk in they think they can give the problem. And then we are going to solve for them. Because we are all paid out of a big part of money from the government. I think this kind of partners they can be educated, and they can be steered into the right direction. Just by showing them how our process are, let's say, maybe a website, a portal that shows those. You know the workflow, how we can work and who we can put on the projects.

Because often they don't realise that. They don't know that they think people working in a university have plenty of time to work on all kinds of projects for everybody for free. I don't know why they think it, but I also have no clue.

I: Yeah, because in my theories, I also learned, before we collaborate first we need to have some knowledge about your partners…

Interviews: Absolutely. And I think it can be very easy, either a leaflet or a website. You definitely, you strike something here that can be extremely helpful. Let's say at least that's we can give to them, that's how we work. Read it through, this is the website. If you are still interested, maybe the leaflet and the website can also involve at least the six questions that we discuss before. Are you willing to do something with the IP? Are you willing to free up your time? Are you willing to have biweekly meetings? Are you willing to invest money in this project? And if you have that check done, so they know what to expect, they know the basic questions they answer yes. Then it's discussion. Actually that's better.

I: Yeah. Thank you, a lot! I think I finished my questions.

Interviewee: Good.

Engineer in R&D on new medical devices for laparoscopic surgery (2020/06/03)

I: Yeah, so can you tell me about your daily work in your own organization?

Interviewee: Okay, yeah. So we are situated here in Iceland, Reykjavik where we are actually working on a project that actually started in my master thesis. So it's actually been going on for three years now. We started in the Netherlands, when…when I still lived there, and it's on…I don't know if Tim told you what the project is. But it's the development of surgical graspers.

So we started there like within the TU Delft, kind of ecosphere. So, working on campus, and of course, using demo and all the labs and that are available on campus of TU Delft. And then later we started working more within Yes Delft, you know the innovation cluster.

I: Yeah.

Interviewee: So, so the project kind of graduated from TU Delft and became more of an outside innovation project. But we of course, still have ties to the university. And, and then I moved back to Iceland. And now currently we are so working with Reon, my company here in Iceland, Tim's start-up MediShield and Surge-on, and then the University of TU Delft, and the hospital here in Iceland and the hospital in Amsterdam. So that's kind of the network that the project is living in right now. And we try to, we try to kind of split the…split the workload between like where the facilities are…depending on what we need to do at the time. So my daily work is…well it changes because the project goes through like a prototyping phase, then testing phase and then usually like a re-evaluation phase where we kind of check what we did. And then usually we start up like a second iteration of the prototyping. So my daily tasks are…like my most important task is really to kind of coordinate, know what is happening, because it's really important that if I'm making or designing something here, that that we have to coordinate really well with all the partners in the network. So there's not a lot of delays. So we really have to think coordination is the key to make projects that are not all in the same building. Because a lot of time can get wasted if I do something and someone else is in…doing something else that didn't match up. Because it all has to like work seamlessly together.

I: Oh so if I understand right, that this project is really big and it was separated in…in many places. So yeah, everyone works on it a bit…

Interviewee: yeah, yeah. Oh, like my daily tasks are mostly designing. So just CAD SolidWorks designing what we're going to put into manufacturing and, and fabrication. And then the prototypes are made sometimes here in Iceland and some of them are made at TU Delft. And sometimes with our industry partners and we work with a couple of different companies. So for that it's quite important that…that because I do some of the design and then there are two PhD students that also working on it. So, we always need to make sure that we kind of finish everything at the same time. So we can all send it out to a factory to get made.

I: So what would be the end phase of this project? it will become a marketable product?

Interviewee: So the end phase, as you see now, like without going too detailed into like, how we want to enter the market, because that's can be quite complicated and, and there are really so many strategies. So the end phase is to have a design ready to go through CE certification. We're not sure if we would go through CE certification yet…yet or just have all the documents ready in the design, like semi approved with our consultants. That's what we see. Because

then…then at that point, then it becomes interesting for uh…bigger industry players who might want to either buy out the license or integrate into their product line.

I: Okay.

Interviewee: So it's, it is actually quite the same as just designing in houses…in house with one of the big firms we have, because as you know, there's a lot of regulations. So you can't really, you're not really doing anything new. We have to, we have to document everything, we have to follow all the procedures and…and there's only really one way to like, lock it and get it ready for certification. So the…the new part is really that we are doing good in like this kind of network. And yeah, we really try to utilise our resources like as best as possible.

I: Yeah, that's true. Yeah. And it's also this project…you work with…you start working with Tim?

Interviewee: Yeah. I started with Tim, when I was doing my master thesis.

I: So you're doing your masters so with him as well?

Interviewee: No, I actually did it with…with [???], but I did work on a couple of projects with Tim during my time.

I: Okay, and what's the expertise or professional competence that you bring in…that you provide in this collaboration with Tim.

Interviewee: So, my main thing is, of course, the design aspect itself. I think that would be like my most like regular tasks is CAD design, and especially designing for these types of laparoscopic graspers. And then, like main or main expertise, because we sometimes too have like students take over some of the more regular tasks. My main expertise is…is like designing prototypes that can be fabricated and tested easily. So I have to identify, like we're trying to make a new type of grasper and we want surgeons to test it before. So I need to make sure that we can make prototypes using only what we have access to, because it's very limited. And make sure that that the prototypes will reflect what the end product will be. So…so like, you know, like usually you…like the big companies, they would like design and start like a manufacturing process. They already know what the end product is going to be. So their prototyping phases can be really expensive. We…like if we only want to test like one part of this prototype, maybe a new type of grasper or jaw, or a new type of like a force limiting mechanism. And then we just figure out what we want to test. What is the best way to make a prototype that we want to test that. It's actually very similar to what you just do in academic research.

I: Yeah.

Interviewee: Just playing kind of this…just on our more industry basis. And, and yeah, then it…then it's mainly about being really aware of the fabrication limitations that we have. We don't use injection moulding or some very expensive techniques, usually, like very precise techniques. So why in the end they speak with us? And then of course, is precision machining.

Oh, yeah, that's, that's like the main things that I do like besides…general like grant writing and like all that kind of…more boring stuff.

I: Yeah. Okay. Yeah, if I understand right, it's like, like a PhD in Delft, they can also build a prototype but your work is more industrial base, right?

Interviewee: Yeah. I mean, it's very similar to what you would do in…like in a master or PhD of TU Delft. It's just here that we are like…so like in a PhD you are usually focused on…you have to try to fill in a gap in the literature you have

to try to do new. So what we see is we don't have to do that we already have something new that we are doing. And, and it's even though we do some publications. That's not the main focus. So it's more about like trying to…yeah it's really just moving like PhD and master thesis knowledge to the industry.

I: I guess, you are in the middle…middle part.

Interviewee: Yeah. Yeah. It's, it's sometimes called like, it's called tech transfer here in Iceland, where it's where it's like, kind of industry partners that that kind of move like PhD level knowledge to the industry…trying to figure out like where the market is. And we also like, we're very focused on that. Because even if it's a really good idea, and it's something new it doesn't matter if we cannot, like manufacturer it in a good way, and there is a good market for it. So that's really our main focus is seeing like, it's not always like…like the best technology that gets to the market. There are so many other limiting factors, you have to look at what the market will accept, surgeons for example are not always willing to accept, like the craziest new technology. They've been training on the devices that they know, for 20 years. So we really have to, like have a close ear to the surgeon needs which is like the user needs and like translate that into how we want to move the technology forward.

I: Yeah. And that's it's actually the, the essential idea of living lab, is that, let the end user involved in the early phase of the design.

Interviewee: Yeah.

I: And we talked about the, yeah, in the future Tim's lab will become closer to the concept of living lab. And I want to know what would be a meaningful partnership, according to you.

Interviewee: Sorry what would be the?

I: meaningful partner, according to you.

Interviewee: As a partner to the living labs?

I: Uh, no. as a partner to your own company, or yeah, your own business.

Interviewee: Yeah, like, yeah, so like, Reon is a partner to, you know, Tim's lab? Or you mean…

I: Hmmm, how can Tim's lab become a meaningful partner to you?

Interviewee: Yeah, so, actually, I think it's kind of…it's kind of just how Tim is thinking about it. Because we do have… we of course have relationships with the universities here in Iceland. And actually, the Technical University of Denmark as well. The problem is…so, of course, we are interested in, in new technology and like to see if there is a market for something. And if something can be transferred from academia to industry, yeah, that's the role we see us in. So, normally in when we talk to universities, they have not thought about anything like this at all. So you talk to professors and if they like they might have some good technology that could be useful. But because there have been taken no steps to see if it can't be transferred to industry or fair any like marketers or most often, they are made some concepts or designs that are like so complicated and so high-tech that they're kind of like too much, like you because you don't want to…you just want to take like, like small steps you don't want to already invest in, like, unless it's a really good idea. We're not gonna invest in some super high tech, like, instrument.

I: It's like their ideas stop in the publication, but the result is hard to translate into the real product that can benefit…and be used in the society.

Interviewee: Yeah, and of course there's the main thing is because sometimes what the…like in our case, the user is most often a surgeon or sometimes you know, one of the ER nurses or, or like people who clean the instruments etc. Sometimes what they want is just not what the professors want to research. No. But in Tim's case, because he does have, like he has good relationship with these people. And he usually like already has that in mind. So he's doing things that are publications and it is new technology, it's cutting edge, but nothing like we would say like too risky it's not like it's…I mean, I've seen people working on like nanoscale…trying to make some tiny cables for some futuristic robots, surgical instruments that are like five instrument and one millimetre, diameter casing. I mean, that would be cool. And you can make a prototype that sort of works, but like if we would look into that project you would see that I would need probably 5 to 10 years from taking it over from the university until it is ready for market.

I: Yeah.

Interviewee: It's that is like some companies do that and I mean that like a high budget, but we…and I think most other partners, industry partners were looking into, yeah 3 years to like then…then you really have to start to know if it's kind of work like it's a big markets like super fast but…but if you have three students just add at the concept phase, and yeah, a lot of money to sink into something that you don't work. So, yes, like the university is supposed to do like concepts and really cutting technology but when the…when it graduates and goes to like an industry partner or moves away from the university ecosphere, it has to be viable. Like it has to be at least like tested that it's…it's an idea that can work and something that can be made and used. And and…and like also like with current technology.

I: It is like realistic.

Interviewee: Yeah, because like we have to look at that, even though we can make prototypes with like really…like high grade machines and something really precise mass manufacturing, we are…we still have to use the technology that is available there. You know, slip some high precision machines for micron accuracy. If we want to make a million instruments, then just the market doesn't make sense. It's it, but it's kind of like, it is tricky because it's blurry because you don't want the professors to do market research or, or like something like that. But you also want them to a little bit, you know, think about it.

It is kind of difficult to say where the line is.

I: Yeah. that's why I want now, the people here start, like crossing their boundary to collaborate. So it's like, they stay in their place, but they also know, have an idea what others is doing in the same big…in the same field.

Interviewee: Yeah, yeah.

I: So it's like professors. They can't just stay in their ivory tower to study cool technology. So…they have to…

Interviewee: And it's Well, I mean, they can but that just means that their technology won't get market.

I: Yeah.

Interviewee: It's, yeah, it's a concept that can… It's, but it's a bit new. So I think that's why there's like really no clear steps right now. Like, how it's…how it's best to do it. Because Tim is quite unique in that he already thinks about these things a lot. Most of the stuff he does is already really feasible and, and he has knowledge on manufacturing and application so he can kind of see if…if he's making something that just doesn't make any sense. So, but that's not something that all researchers have, and it's not really something that all researchers should have, but good…should be able to have access to this knowledge in some way. But it's you know, it's tricky to say in what way?

I: Yeah, true. And I wonder, I also wonder how can you benefit from this collaboration with him?

Interviewee: The I mean, the main benefit is, of course, that if you would look…so say if I was going to just start on a new instrument or a new technology, in whatever sector, I mean, any technology always has to go through the research phase.

I: Yeah.

Interviewee: So in a way with this, then, like, a part of the research phase…of the whole kind of R&D concept is done by the university. Yeah. I mean, that is of course saves money for companies. And…but not only that, it's that universities are going to do this research anyway. It's kind of waste to not use…use the research that is going to be done anyway, because most students are going to ease, you know, in either case. So it makes sense, you know, access that research and that knowledge and work with it, instead of just universities do research. And then companies also doing research and you know, the same field.

I: Yeah, yes.

Interviewee: Combine it. Yeah. And it saves a lot of years. I mean, like, we R&D, the research phase, you know, it's at least a year, sometimes two, three years, and then you go to more the design phase, etc. So for companies, it's saves time and money and the main thing companies care about so…

I: But then you also need to pay for the…for example the students, they do research and pay for the university.

Interviewee: Yeah, yeah. And then I mean, that's, that's usually like, sometimes the university will apply for a patent. And then the license the patent or by the patent, sometimes there's other types of deals like companies will pay for, you know, their PhD students' salary. I mean, there's many ways that have been done in that way. And even so, like even if it's I think…even all the money company would pay to the university either licensing a patent or paying for the research with, you know, grants, etc. I think that's still less money than it would take the company to do the whole research phase themselves like you, if you do it, right. So, the I mean, the main thing for companies is of course, you know, saving money or making money so that that's what the interest partners they are looking for.

I: And how do you now work with Tim? It's like do you talk with each other regularly? How often?

Interviewee: Yeah, I just actually spoke to him just 10 minutes ago. Yeah, we speak quite regularly. You know, either I call him, WhatsApp, email just you know, on the normal communications. We also have meeting that is twice a year with like the whole department that we are working in like the massive lab. So, I used to fly out to the Netherlands at least two times a year sometimes often. Except now.

I: Yeah, true.

Interviewee: And then…but then I'm also in contact with his PhD students that are working on the project. And just actually, just until March, we had one of his students here at the office doing his…

I: Can you repeat the last word?

Interviewee: Yeah, we had one Tim's…one of Tim's students was here in Reon doing his internship. And then he actually just left in March because of Covid. So yeah, we have frequent communication.

It's, it's come more natural for us because we know each other, so it's easy to talk often. And in like, or like other types, like for other, do something with the University of Iceland. There, we just have like set meetings, and it's kind of more

just more like structured. But I do think that it's important. The…like the people who are doing like their day to day job, like the PhD student and the designers of the companies, like they, it's more important that they stay in like really frequent communications. And then it's okay if for example, like the manager of the company, and the professor, they can speak you know, more infrequently, but about like the high-level concept, but it's…it's really important, like I can't stress this enough that the…that the people who are doing the daily tasks, they have to communicate often and that's usually then a researcher or student at the University, and then someone who works at the company.

I: Yeah, and I don't know if I hear clearly. So you mean the manager? The tops? You should? They should? Yeah, you should have more communication on the top level. So the manager and the professor from the university?

Interviewee: No no, so like the manager and professor, they speak, your know depending on the project, maybe once a week, something like that. But I think it's important to also see that, like, usually there's a PhD student working on a project and then on some engineer who works at the company, and they have to speak very often. So they are the ones who have to collaborate to make sure that that everything is being done at the same time. It's, it's a, I think it's important to think of like it's not only just the…you know, the managers and the professors should speak, like, it's important that the students and whoever in the company is working on the project have to be in direct communication.

I: Are these people, for example, an engineer in the company and a PhD student, they can work in the same place? Or if they, yeah, it's like, I feel like the PhDs in a campus and so they have to use internet.

Interviewee: Yeah. They will have to, like we, we, in one project, a different project, but it was two years ago. Then we would usually just communicate, you know, through email, and we would try to use tools like, you know, Asana or Trello. Like these kinds of…

I: Yeah, I know Trello.

Interviewee: So we try to use those tools. And then usually, one of the engineers from the company would come visit the University at least once a month. Oh, but it depends on the project. I mean, this is always…is always an ongoing conversation how it's best to, you know, stay in communications and work, you know, through a distance. Yeah, it's just you just really have to use all tools that you have and…and what people are comfortable with. Yeah. People really hate to use Trello but some people love to use. Like, kind of depends on the team.

I: Yeah. Personally, I don't like Trello, just try once. Yeah, yeah. And have you experienced some difference, for example, on mindset or work ways or different emphasis during the collaboration with Tim, or some? Yeah.

Interviewee: Yeah. Not really, but I think that's because…I was because I did my masters in TU Delft.

So I think I think we're pretty much in line with how the development should be. The main thing that I do here is that of course, universities, for them, they…they care most about publications. Yeah. And the company usually does not care about publications, like it's nice, but it's not their goal. Like they just don't have something that makes money. That's usually how and you can either see that maybe you can look at it as say, you know, a bad thing because that's different emphasis. But it's also quite nice because that means that they're not competing for the same goal.

But yeah, that’s the main difference that I see.

I: Yeah, but I don’t know if… let me try to phrase it…yeah, if the university side, they want to emphasise on the publication, will that influence the direction of this research? Or and if the influence will lead to…yeah…

Interviewee: It will. So what we did in this project, we did not do a lot of publications for like I think the first two years because we are applying for a patent. So once we got the patent, then of course we can do the publications. But for universities and PhD students, especially because they need to pub…have publications frequently.

I: Yeah.

Interviewee: Then it can be kind of tricky. I've seen projects that where…where that there is a bit of an issue, because the PhD student can't graduate without doing publications, but the company is banning them to do publications because well, then, you know, everyone sees the technology, and then they can't patent it. So it is quite delicate. Going for a patent is one solution, because then it is protected. But that doesn't always work. So then in that regard, then it becomes…yeah, and then it really depends on the project, how you're going to solve that. I mean, sometimes you can, you can do publications that are like not disclosing everything. You know, it's not an ideal situation. There's always going to be some compromise on either side.

I: So after you get…you patent it, then you can publish it?

Interviewee: Yeah. So if you have a patent, then you can do any academic publication you want it. You already own all the rights and it's protected. But if…if you publish it before you have a patent, then well, then you've…then you've basically shown all the competitors what your idea is.

I: Yeah.

Interviewee: You cannot apply for a patent on something that you have published prior.

I: So it's like these PhD students they have to wait until the patent is gotten.

Interviewee: Yeah, uh not until we get it, they just have to apply for it. Once they apply for it, then…then it's fine. Okay, but it depends on project like because sometimes the project is not applying for any patents. Sometimes the company just wants to keep it all hidden and it's and yeah, then it's quite difficult. One of my friends was in that situation. I think he couldn't publish anything for, like two or almost three years. Because he was doing research for a big company in Swiss. It was tricky situation.

I: Yeah.

Interviewee: But I mean, it worked out but like that that is really difficult. It's something that really needs to be discussed for beforehand.

I: Yeah, yeah. Okay. Yeah, I think so too.

Interviewee: And usually what happens like so he is…he was a PhD student and, of course University has some agreements with the company etc. So, up to him, it's more of…it's more of an issue with contracts and lawyers, like agree-on. So it's a, it can be a tricky situation if you don't talk about it in the beginning. Yeah.

I: Okay. Okay. So yeah, I think I finished my general questions. So the last one is, is there any important questions that we didn't address before, or anything else you want to add?

Interviewee: No, I think I think like for the concept of living labs, I think it's also really important to think about like the infrastructure. So, so like to make it all work out. Like the PhD students. They have access to the labs at TU Delft. And the industry usually has some different kind of labs. So I think, like in the future, it would be nice to see more like

collaboration of like sharing the…like infrastructure, both machinery, testing labs and equipment. Because I think that could open up the doors to just more generalised research.

I: Yeah.

Interviewee: And then it's always just like the, you know, the question of like, how far should like should academic researcher go? Like before it gets handed to an industry partner? It's…that's I think that's a question that's kind of difficult to answer because I think it really depends. I think I think we want really like I could just depend on each product.

I: Yeah, I think that's that need to be discussed face on each project. Yeah, you can't just say the fix agreement or agreement or contract for every project.

Interviewee: Like…I think all these contracts are always going to be quite like I mean yeah, they can have like the…all the kind of same structure more like the all these like same things that they have to talk about beforehand. Result would be different for each project.

I: Yeah, okay. And I think that's the current idea of Tim's lab. It's like, they want to collaborate with another company in the…in the Netherland and yeah, there will have a different focus for example, the lab in TU Delft, focus on metal. All and the lab in the companies focus on plastic so they can work to use the facility of both to work.

Interviewee: Yeah.

I: Okay, I think I have all the question answers of my question. So, thank you so much for your kindness and opinions. Yeah, no. Thank you. I will, yeah, transcribe this interview and send it back to you for reviewing. And yeah. Okay. Thank you. Have a nice day.

Interviewee: Yeah okay, you too. Bye bye.

Consultant General Surgeon with a focus on endoscopic hernia surgery and paediatric surgery (2020/06/03)

I: Yes, so now can you tell me about your daily work or your responsibility in your own organisation?

Interviewee: I'm a surgeon so I treat patients with surgery. I see patients in the outpatient clinic, do operations on the operating room, small operations on the outpatient operating room. I see people on the ER, that's…well, that's my job.

I: Okay so, can you tell me a little bit about the value or issues your organization address?

Interviewee: Um, what do you mean by that?

I: It's like, for example for Tim he really wants to develop sustainable innovation, sustainable medical instruments. And I think some organisation maybe they'll have some…yeah, values and their identities.

Interviewee: Yeah, well, the values in my hospital…our…that we like to give safe healthcare in an environment, which is also safe but inviting, especially what we do here is the…not so big operations, let's say, day-care operations, short-stay operations, and that is focused on the community around us. So for the big corporations, they have to go a little bit longer. Drive to Rotterdam and the other operation we can do here…we can do here for them so they don't have to travel that far. So we're sort of a community hospital. That's what we like to…this is our identity.

I: Yeah, that’s clear. And…and I wonder what's the expertise or…or professional competence that you provide in this collaboration with Tim?

Interviewee: What…what I provide is the hands-on experience with laparoscopic operation, operating techniques. The hands-on experience with the instruments we use, but also the training you know, I'm…I've been working in surgery now…as a surgeon for about 12 years and no, sorry, 20 years.

I: Oh!

Interviewee: As…so I have a lot of experience, hands-on experience with also with training, training…trainees, residents in surgery, residents in general…general medicine and we call huisarts, so GPs. So I have a broad experience in the day to day workings of laparoscopic surgery…surgery in general. And that's what that's something Tim hasn't got, of course, because he's an engineer. So the collaboration between him and me is very nice and inspiring for us both, I think.

I: Yeah. And actually, that’s exact idea of the living lab. I don't know if you heard about it. But yeah, that's Tim's concept of his future lab. So it's like…the…the essence of the methodology of living lab is to involve user in their early…early phase of the innovation.

Interviewee: Yeah.

I: For…for now, it's the collaboration with surgeon because they designed the instrument. Yeah. And so I want to know how do you involve in interest Tim’s projects? It's like, yeah, yeah. I don't know, how do you involve…

Interviewee: In Tim’s project? Well, of course, he has new ideas, and then we talk about them and try to find out if there’s something which in…in clinic would…would work or would…would benefit surgery. Or that it's just a technical good idea, but then in practice, it wouldn't work or wouldn't be very necessary for our…for our business. So, you know, we talk a lot and then we throw ideas at each other and both times we have brought Tim about something which he is developed or is trying to develop or as in his head. And then we try to figure out how to make that more practical thing or try to find out if we can test it or what is the best way to use it or alter it or so to learn from a discussion about the products he designs and works with.

I: and do you also help…help his project to test the prototype?

Interviewee: Yeah, we do that, with the…with students from the TU and I've done some testing force with medical students. In the past with this box trainer, which is a very nice design. So yeah, that's what we do. I help him in this aspect of his design and then development. Yeah.

I: Yeah. Okay. And as you mentioned, you help him and I wonder what can you gain from this collaboration with him?

Interviewee: Well, first of all, I think it's, it gives me a lot of fun…it is a fun, fun situation in the sense that I've been doing surgery for 20 years now and after 20 years have seen everything about…almost everything there is to see. So new things are always given me energy and new ideas. So that helps me a lot. And the and another side to this collaboration is that I'd like to become PhD. So we're together we're working on PhD project for me. So he helps me with the PhD stuff, the investigations, the writing the articles, new ideas. So we both benefit from collaboration in this…in this way.

I: So, so you also have a PhD in engineering?

Interviewee: No, no, no, I try to I'm working with Tim to do some research and they will, at the end, hope hopefully, give me a PhD grade, so not yet a PhD. I'm just a doctor.

I: Wow, impressive. Yeah, you're learning two skills now.

Interviewee: Yeah. New skills. Feels very nice. And this gives me a lot of energy. So…

I: Ah, yeah.

Interviewee: So with young guys like you, that's also very inspiring and energy-giving. Yeah.

I: Thank you. Yeah. And, yeah, you just thought about you are friend with Tim and can you just elaborate more about what will be a meaningful partnership, according to you.

Interviewee: A minimal partnership and?

I: Meaningful.

Interviewees: Meaningful. Of course, probably…that meaningful would be that we both benefit from the partnership that also creates more than we put it. Like, one and one becomes three, you know.

I: Yeah.

Interviewee: That's…for me is meaningful.

I: And so, what's the common ground between you and Tim? So what can serve as the foundation of this collaboration? Because I can imagine you have both…Yyu have, you have expertise in different ways and but you have must have some foundation to collaborate.

Interviewee: The foundation for me is that I like him a lot. He's a friendly guy, and he's really become a friend. So I think the thing is…the other way around. So yeah, it's a friendship that is a big part of this collaboration.

I: Yeah, okay, Yeah. I think that's also very important. Personal connection. Yeah. Because you just you just mentioned about the one plus one is bigger, like than three. So what do you think? Both of you, what do you think you can achieve together with the collaboration with Tim?

Interviewee: Well, we…how do you call that…ah… well because you know Tim is extremely clever and very professional. He's…he's really one of the top guys I think. But what is always the problem, I think and what I hear around me, sorry, is that is you technicians, you'll, you lack a little bit of the clinical feeling, of course, and so that's what…what I can bring in.

And then what you see is there's an idea develops from a really good technical idea to with the input from the clinicians and clinical ideas develops to extremely good clinical thing or material whatever. Because of this collaboration, you know, when you put two minds together, focus on one thing, it always brings out more. So now, I hope you understand a little bit what I tried to say but very hard to, to tell you exactly what I want to tell you, but well, you know, when you have a good idea in a technical way, they will not say that it would be a very good idea in a clinical way.

I: But just…in the in the real-life way.

Interviewee: Yeah, in a clinic in an operating room, you know, you have, because when you have…as an engineer, you have a very nice idea. And you think, well, this technically very nice solution to a problem. Two things can happen. One there, there is not…this problem doesn't exist. Or to…the thing you think you thought about it, is that…about this new development is that…the clinician thinks that it probably won't work, you know, so and then, when together, you say,

it's technically a good idea, but don't use it for this indication, but do it for another indication and then well, then it becomes a very nice product at the end, because you just, you know, you steer it…steer around and then at the end, it's…it's a good product.

I: Now, it sounds. Well, for me because I doing social science research. I learned like for my responsibilities, I learn theory and…and I also learn what happened in the reality so I hope I can become a tree that my leaves is breathing the...theories in the air so I can grow my root into the deep ground of reality. So it's more like you help Tim to…translate his idea in technology into a good product that will fit in reality.

Interviewee: Exactly, yeah.

I: Okay. That's nice. Yeah. And in this period, in this experience, have you ever experienced any difference. For example, different mindset, different working ways and emphasis during this collaboration with Tim?

Interviewee: Well, the only thing is that sometimes it's very hard to convince him that something which he has thought about a long, long time is not gonna work in practice, you know, when you when you have a very bright idea technically it's probably a bright idea but if it doesn't work in practice, and then you don't have anything…ah then it is not a necessary new invention because nobody wants to buy it or wants to use. So, sometimes that's a little bit I tried to convince him but no always works. But sometimes at the end sometimes he's right. And it still is a good idea. And it still works in practice, but it's the only thing that sometimes is hard but not really.

I: Yeah, I can imagine. Yeah. And yeah, for example, where you found his idea is not maybe not very practical in the reality, how do you deal with this?

Interviewee: I try to…to…to…to guide him or, or the team…or try to guide them in the right direction, or to moulded the idea a little bit so that it becomes a nice, nice invention for the clinic. So, at the moment, we're working on a system where there is moving plateau on which we do technical exercises or exercise…laparoscopic exercises. And they started all with the plateau moving very fast and in very awkward directions. And then I told them but in clinic…in real life that is always a very small movement and not very awkward. And then they scaled it down and now it's clinically it's very interesting. It's an interesting thing. So the idea was good and we had to mould it back to the reality now, it's a very nice technical invention.

I: So it's like you, you find a solution together.

Interviewee: Yeah.

I: It's not just simply reject his idea, but you have…

Interviewee: No, no, no. We try to, to, to, to, to mould it or to…to…to alter it in a way that it will become clinically relevant.

I: Yeah. Okay, and I wonder, what's the frequency you collaborate with each other?

Interviewee: Uh, well, we talk or we WhatsApp about every week, a couple of times. So it's rather intensive. But it's always nice, good.

I: Yeah. Yeah. Okay. I think I finish my questions. I really enjoyed this time.

Interviewee: Okay, thank you very much.

I: Yeah. So last questions is you do think, is there any important questions that we didn't address in this interview or something you want to add?

Interviewee: But maybe you could tell me a little bit more about your idea about the living laboratory? What what…what is your, what is your what's your…What are your thoughts about it?

I: Ah, yes, there was nice. So now the living lab is, yeah, the difficulty of living lab is you…or the benefit, or the potential is you involve a lot of different actors in the, in the network. So it's like every actor well, they have their different expertise and they have different idea or identity themselves in their organisation. But when they join the living lab, maybe this difference will, yeah, will have some tensions in this network. But the tension is exactly the opportunity to achieve something to yeah, to achieve the result is one plus one better, larger than two. So the idea of my research is, how can I help these actors in this network to deal with the tension and make the tension become the benefit…opportunity to benefit from this network. And now, my idea is want to focus on the human interaction and how people display and reshape their identity in this living lab network.

Interviewee: Okay, nice, nice good idea.

I: So what's your idea about the identity thing?

Interviewee: or the identity is important that is always important in research is any size. Of course that you that you as a person gain from it. So it's very important that you explicitly, or make explicit the gain you get from the working together and then probably the enthusiasm will increase. If you can understand what I mean. You say you have to work together. But if there's…there's always one person who doesn't gain anything from it, then he will leave, you know. So try to focus on that everyone involved will benefit from it that it would be very important.

I: Yeah, that's true. Yeah. It's like when, yeah, when we set a, for example agreement or contract, we have to make sure that their interest is separate. So yeah, they can't have conflict of interest. Yeah, I also wonder if the collaboration with Tim also inspire you to reflect on your own…yeah…work.

Interviewee: Yeah, that's true. Yeah. When I you know, when the example I told you about with the movement in the plateau. Now, I looked ahead at the in the operating room, I looked at what I saw as what kind of movement there was. And I didn't…haven't done that for 20 years. So you know, it's sort of in your, in your system. And you don't have a look at it. But when we had to explicitly look at it, it was I saw things I didn't see before. So it's very nice.

I: So it's also the benefit to you. You see things in a different perspective,

Interviewee: In a different perspective. Yes, yes. Yeah, that's true.

I: Yeah. Yeah. That's also I learn from the theory is like when yeah, when we collaborate with people from different discipline. Yeah. also gave us a chance to reflect on ourselves.

Interviewee: Yeah. Exactly. Very nice.

I: Yeah, okay. Thank you.

Interviewee: Thank you very much. And we'll probably talk again, okay.

I: Okay, bye-bye, have a nice day.

Interviewee: You too.

A PhD researcher at TU Delft with a focus on "Circularity for Sustainable Surgery" (2020/06/04)

Interviewee: So you got some questions prepared, right?

I: Yes. So first of all, what's your daily work in your own organization?

Interviewee: I used to be in the management team of a medical company called [ ].

I: Yeah, that's your company, right?

Interviewee: Yeah. It's, it's a family company. So me and my brother are in there. And we have two facilities in the Netherlands and one production facility in Germany. And we have quite a large workshop with the machinery where we manufacture components and specialized instruments but also repair and maintain surgical instruments for both hospitals as well as medical industry. And next to that we manufacture drainage systems in, in Germany, which we export to 26 countries.

I: Okay.

Interviewee: And we did some experiments with recycling waste from the operating room. And we started to collect some stainless-steel instruments and had the melted and made from recycled, recycled, melted material we made a new transport basket for surgical instruments. So it was completely made out of recycled waste.

I: Yeah, so this recycle is just aligned with the idea of Tim's on the recycle and sustainable instrument.

Interviewee: Yes, I…I knew Tim already a couple of years ago because we work together out of one of his companies and yeah, and Tim asked me to have a conversation because I wanted to do more research on the recycling of surgical waste. Yeah, and then he proposed to…for me to do a PhD to mechanical engineering to my mechanical engineering department. So, I started that as an external a PhD candidate. Yeah, one a half years ago or something. So, we are doing now a lot of feasibility studies and experimental study where we have surgical waste collected from hospitals and have reprocess to new raw materials. So it prevents waste coming into the system. But it also prevents to…to use our natural resources which, you know, are diminishing at the moment worldwide, like iron ore and oil. It's, it's getting more scarce.

I: Yeah. And so, this, so in this circular and sustainable living lab, so you'll, join this network as a company partner?

Interviewee: Yeah, or an innovation hub, I think that's a better…better description because we don't want to commercialize too much. We had the discussion earlier to TU Delft, there should be a clear separation between research and the commercial activity. So yeah, we thought Tim and I maybe it's better to name it an innovation hub, but…but a location where we can have students researchers, but also the industry. I mean, we have companies like Johnson and Johnson, who we work with…

I: Yeah.

Interviewee: They really want to offer their dis…complex disposable instruments and see if we can recycle them. And that includes instruments which are used for heart ablation, for your cardiac ablation that it's a catheter which goes into your leg and all goes up through your vein to your heart. With those instruments are single use and they cost 3000 euros per instrument, and they throw it away. But, you know, there's that there's platinum and iridium, which are very costly metals inside that instrument so we can take it out and see if we can reuse them in new disposable catheters for Johnson and Johnson. So those are really motivating projects, which we believe we can further stimulate, if we consider it out of a living lab, for instance.

I: Yeah.

Interviewee: It will get an acceleration.

I: Yeah. And you will, in this in this network, you will play as a researcher?

Interviewee: Yes, solely. Yeah. As a researcher, yes.

Yeah. And I think that counts for the whole team if we were to proceed with this, because there's a…there's a lot we need to find out and we have an idea of making a waste production thread where you have on the one hand, you have a production line and the input in your production line is waste collected from several hospitals who participate, want to participate. And that is through the production line melted, shredded, cleaned, and then used as raw material in a blow molding machine to manufacture new products. So, we have two hospitals who want to participate, we have Johnson and Johnson wants to participate. And we have a waste collection company, one of the largest in Holland, Renewi, who want to participate. So I think together we have a very good network.

I: And together you can, like come up with a better solution to recycle this instrument

Interviewee: And a new solution because there is no solution at the moment to recycle all of those surgical waste. It's brought to a melting up, yeah to burning off and through incinerator goes up in the air. Yeah. And the time will come that we need to reuse our waste simply because costs are increasing of natural resources. And limited available.

I: Yeah. And that will be one big project or it can be several sub-separate project.

Interviewee: I think it will start with one big project maybe that it will be separated later in different projects. But yeah, it could be. But it could be a large project. I mean, I know for sure we need quite some researchers and students to facilitate it to set it up. Yeah, and collected data to find out how we can do this.

I: Yeah. Because I'm curious is like, for me I…I only know that PhD student can only involve in…in one project. I don't know if it's also possible that one PhD student involved in many projects?

Interviewee: I don't know, I don't know. But I know that if we set this up, it should be set up from one project and maybe later it can split up to more but it's…it's really the waste production line. What I consider as the as the project, yeah. So and…and, of course, the whole COVID-19 period, accelerated the need for reusing in this case, facemask.

I: Yeah, that’s true. I learned it.

Interviewee: So that's also what we did. We did quite some experimental and…and feasibility studies on checking if we could sterilize the mouth masks and…and calculate the number of particles which were measured after sterilization. And we did with particle counters and with a laser counting and small particles from 0.3 to one, no, to 5.0 microns. And we found out it was really feasible to…to reuse these masks. So, and then our data was also published in the repository of TU Delft. And our three papers now under review for and three journals amongst which use the journal for hospital infection.

I: And can you tell me what, what do you think you can benefit from this living lab network?

Interviewee: It's the capacity of the partners, you need people who are willing to…you need, you need hospitals who are willing to offer their waste now we have a law not only in the Netherlands but also in the whole of Europe. That's not allowed to collect the waste because it's considered as contaminated as dangerous. So we need a partner in that who has a permit a license to collect it. Which is…is Renewi, the waste processing company. But you also need the

hospitals willing to collect the waste after surgery in special bins on the OR and also locally in the OR make separation of the waste, separated plastic from the paper and stainless steel.

I: Okay, if there's a law there is the then can the hospitals still provide you the waste?

Interviewee: Yes, if we cooperate with the…with Renewi, who have to license for that. But it's also a new setup. That's also what we did with the face masks. Also the authorities did not experience this before. So we said we're going to collect to use face masks and they say under the law, it's considered as waste. And we should know and we consider it as raw material because we're going to reprocess them.

I: Yeah.

Interviewee: Yeah, so I had quite some discussions with the Dutch authorities about this and they made the separate they made a, who do you call it, a special provision for us temporary to do this. So that so that that's also a very important partner in this potential living lab. That's the RIVM, the Dutch Ministry of Health.

They are really on the same line. And actually, we started also a study with RIVM Health Institute and Ministry of Health. On the…to make the lifecycle analysis of the reproaching a face mask so they are very much willing to participate, which is…which is I mean, European Commission, they declared this period as a period to…use to make the economy greener, and specifically for medical devices to be more independent from other countries outside Europe. So we were asked to, to investigate more on this issue. So it's really, you know, connects good together.

I: Yeah.

Interviewee: We have their support. So that's nice.

I: Yeah. And I see, I see, the covid-19, it's a crisis, but it can also become an opportunity to boost in this recycle field.

Interviewee: Yeah, we were really surprised by the opportunity it gave for research and if you look now at all the journals, they all have called for COVID-19 papers.

I: Mm hmm.

Interviewee: And we are publishing like in such a fast pace at the moment.

I: Yeah. True.

Interviewee: Which otherwise would not have been possible.

I: Yeah. Then can you elaborate more about what would be a meaningful partnership according to you?

Interviewee: Minimum partnership?

I: Meaningful.

Interviewee: Oh meaningful. Out of TU Delft or with all the partners.

I: With all the partners.

Interviewee: Okay, if you look to all of the partners. I think that participation, first of all the partnership isn't necessary, but I'm sure that they will participate. And there should be an equal input from all of the partners. That can be in any

kind, but it can also be sponsorship, but it also can be providing knowledge. So one of the three and we only, we only need different four different parties, which are the government authorities and medical industry., hospitals and TU Delft. Yeah, yeah, that that will generate an equilibrium and optimal…optimum. Yeah. Yeah.

I: The participation you mean is the motivation to participate or they just they…yeah involved in this network?

Interviewee: Involvement in this network and all of the partners realize that for the future things have to be changed. We can not consume products, buy them, use them, throw them away. You have to buy them, use them and reuse them, which is the circular economy.

I: Yeah.

Interviewee: We have to go from linear to circular. And companies like Johnson and Johnson they already…from out of the States, United States already put it in their vision to become more sustainable. Of course for these kind of companies, it's also competitive edge. If they do this, they will have an advantage over their competitors. But it's also built up out of intrinsic motivation. Something has to be done.

I: Yeah. So can I say the their own goal of the circular economy is your common ground for…for your foundation…for your collaboration?

Interviewee: Yes, yes.

I: Okay. Then in this collaboration with these four parties, have your experience any differences, for example, in your mindset or in working ways in this collaboration?

Interviewee: No, not yet. We have been cooperating with all these partners throughout the COVID-19 period, as from the safety 17th March and all of them have the same mindset. So, I have not noticed any differences in motivation or input. And the only thing is that what I've noticed is the larger the organization the longer the time is needed to get it off the floor.

I: Okay, hmm, can you repeat?

Interviewee: The only thing with how…if a comp…organization is large…becomes larger, that it takes longer time to get decisions from the organization. There are a lot of zoom meetings, then another committee has to come there and another layer of management has to come there…the SCO.

I: Yeah, the big organizations have this hierarchical structure.

Interviewee: Yeah, yes.

I: But…but I also wonder if they have different emphasizes, for example, like company they will, they want patents or products and university, maybe they will like yeah publish…publication.

Interviewee: But I think if such a living lab should establish them, it's very important to make an agreement with all the parties, the parties and for them to sign upon the agreements we make with regard to patents, intellectual property, but also, until which point we considered the research and from which point we say it's now up to the company to use it commercially. And that's something really it brought me already in some discussions before. The only way to attack this is to make a good agreement.

I: Yeah, yeah. I assume it's not easy to make a good agreement…agreement.

Interviewee: I don't know there are many examples and templates and if we make standard clauses about intellectual property and about the way if we can convert it into earning money or search publishing, I think it's doable.

I: Yeah, okay.

Interviewee: And that’s not a problem.

I: Yeah. Okay. Yeah, I think I finished my questions now. Yeah. So is there any, any important questions that we didn't address before? Or something you want to add?

Interviewee: Let me see. Let me see. No, I think we note here, and you already got the English text for me, right?

I: Yes.

Interviewee: So, that's basically also in there. No, no, no, the only thing is that I made me to add that this is a unique possibility.

I: Sorry?

Interviewee: I think it's a unique possibility to establish this living lab. Yeah. But also for society.

I: Yeah, I think so too. Yeah. And yeah, that's, that's my tasks to see if I can help you to better operate.

Interviewee: Yeah. we and we need this cooperate for everybody. So oh yeah. I think only together we can make this really successful projects, which might last years.

I: Sorry?

Interviewee: which might last for many years and which also could be a potential…it's not only an innovation hub it's also a potential education hub. And for…for bachelor students, master students but also PhDers.

And I think…I think Holland is on the forefront. The WHO already declared that the Netherlands is at the forefront at the moment of sustainable circular methods for medical devices. And we will be mentioned in the year annual reports of the World Health Organization as an example who for…for the rest of the world, so Yeah, it's nice to hear that.

I: I think so too.

Interviewee: Yeah. Good opportunity. Yeah. Yeah.

I: So yeah. So this this whole idea of this circular and sustainable living lab is based on…it's actually genera…yeah, generated during the COVID-19 Period? It's because of the you have a nice collaboration on the masks.

Interviewee: Yes, yes, yes. But also before that, we were already working on that. It's also my research line, together with Tim. So we were already doing experiments with other disposable instruments other than face mask. It made the public awareness, COVID-19 made public awareness a lot bigger, to be more independent, and to reuse our current sources. Yeah

I: So yeah. I think that’s a really big opportunity.

Interviewee: Yes, that’ s that I think too.

I: Yeah. Just like the crisis in Chinese is also…is a combination of crisis, crisis and opportunity. So…

Interviewee: Yes, yes.

I: People will turn the crisis into opportunity.

Interviewee: Yeah. Like somebody from the Ministry of Health said, let's not waste a good crisis. Let's make use of it. She said it to me. I don't know two months ago. Let's make opportunity. I'm sorry for the noise in the background.

I: That's fine. Yeah. Look like the noise as a as this dining hall. So yeah.

Interviewee: Exactly. Yeah. So yeah, well, I think we will talk, talk later. Okay, if you need to know anything you have my mobile number. Yeah, my email address, just don't hesitate to contact me.

I: Yeah. Okay.

Interviewee: Well, and good luck.

I: Thank you.

Interviewee: Okay, have a nice day.

I Bye. You too. Bye, bye.

Bioengineer in costumer company (2020/06/05)

I: Yes, so can you first tell me what's your daily work in your own organization?

Interviewee: Yeah, sure. So I'm what we call a bio-engineer or product development engineer.

We in charge of designing and developing instruments and implants for orthopedic, specifically I'm in the hip implant. So, our…our role is to come up with design specifications…find out what the patient needed…find out what the surgeon needed, translating that into design specification.

Call a designer can…can start manufacturing towards designing tool, and then after that, take it through the whole development process of prototyping and then testing and then production, etc. And then finally, regulatory approval and the release. So we really look up to the whole lifecycle of the development to the advancement to the income. I can tell it's launched as we work with a wide range of different…different departments. Because the design is difficult. So, you know, from packaging and microbiology and sterilization to regulatory and labeling, etc. You have to coordinate all of that. But at the same time we have, especially in the early phases, we spend a lot of time with nurses and surgeons or whoever the use is.

So that's fine, that's my role.

I: Okay. So Yeah, this exactly the idea of the living lab. I don't know if you heard about that. So that's the essence of the living lab is they involve user in their early phase of the design. So, so I can imagine that in your work, you also need a lot of communication and coordination with the surgeon.

Interviewee: Yes, and it's really important because whole projects are quite long, you know, anywhere from 3 to 10 years, in that time, surgeons may change their mind, the user requirement may change. So you have to make sure you're in constant contact to make sure that those decisions you've made are still viable, uh, still hold true. Because a lot of the time, you know, you make a decision you take six months to do a prototype by then someone's changed the mind or there's new data that's come out. Or, and then it takes another six months too you've wasted six months in another six months to rectify the problem.

I: Oh, yeah.

Interviewee: So getting surgeon communication is vital. And also…also not just to make sure that you are hitting the right target, but also, we found that with…with our surgeon group, they, they need constant reminding on decisions that have already been taken. They tend to either re-debate an existing decision that's already been made, or they just forgot that they made that decision, and they go for something entirely different. So you have to…

I: Yeah, I'm curious how you deal with this situation…

Interviewee: is difficult I mean, because if you've got a small surgeon group like, three, four surgeons, it's really easy, you just set up a weekly or monthly call. That's really quick. But say for our biggest project at the moment, we've got something like 25 surgeons. Normally we only have…have them all discussing something every six months. So that was the problem, you know, having and trying to find even free time for all of them to be on a call, it's very difficult. So I think project management and etc we use different tools, things like decision log, a weekly or monthly news etc. So just a one-page summary on the decisions that are made. What's happening, where we going, what are the next steps This is a both as a…as a reminder, but also a reference. Because surgeons are busy people who don't want to give them a big PowerPoint presentation or decision, there's something that's a quick reference. And you can see okay, for this instrument, these are the this is the direction, reasonably going. Because this…this and, you know, something that's really, really quick, a nice infographic text style thing for each instrument or each major decision point. So that tends to help, but to be honest, we learned the hard way we have suffered by retracing our steps a lot.

I: So I was wondering during your interaction, do you also like guide the surgeon a little bit like because I can imagine that because, yeah, surgeon they're focused on their work, maybe they don't really think about what will be the future direction for the innovation. So sometimes you also need to teach them.

Interviewee: Yes, that's really true. So they experts in the clinical side of things definitely.

I: Expert in what?

Interviewee: The…in terms of the clinical knowledge, you know, like what the, what the medical side or medical effect of devices. They are experts but like you say they're not always aware of say, different manufacturing techniques, well, limitations of manufacturing techniques and you know, different materials that are available, etc. Or things I don't…so they do need, guiding in that sense. And we…one of the big mistakes we've made, in hindsight is we leave the entire decision to the surgeons, the only one component of the decision. Decision is part-clinical, part-engineering, commercial. Look at all three aspects to make sure that you have a viable product.

But yes, here, whenever you make a decision, really exploring things, you have to both show them what's possible, but also you have to show them what's not possible because a lot of the time, they can say, oh, just do this, just do that. But it takes an enormous amount of effort. And, you know, not only will it delay timelines and costs, but you don't…you don't know if it's great, actually, but they'll be so much risk in your process. And, yeah, so we have to, we have to show them what's possible to make it realistic.

I: Yeah. And I learned right now you have a project, collaborating with Tim, can you…and I wonder in…in this project what would be the expertise that you provide in this project.

Interviewee: So primarily from my point of view, I'm…two things want to make sure that clinically it's effective, by using all experience with, you know, previous techniques, previous instruments and comparing it to what's out there already, understanding the engineering of it so that we can make a good assessment of what they call it effective and then also from a commercial point of view, looking at each…each stage of the process to see how much risk there is, and really there is a commercial benefit. And whether…whether it fits well within what's really on the offering. Sometimes you have a single instrument that is brilliant, but it needs an entire ecosystem to work.

You know, like, for example, everyone was talking about Google Glass and mental reality, brilliant set of instruments, pretty useful. But you need, you need so much data in software engineers involved in a CT scan. So it's very easy to look at one, one instrument, one component. And think, oh, that's this project, look at the whole, the whole ecosystem, really.

So my, my role is to look at merging the engineering side and the chemical side, make sure there's a viable product at the end of the day that we can commercialize. I don't know if that makes sense.

I: Well, Well, I'm not sure if I understand, right, so it's like the researchers in TU Delft they may more focus on the technical part and you will provide them with a more holistic point of view, that is more, involve many perspectives, for example.

Interviewee: Yeah, because making sure something works and making sure that it's…it's commercially successful is a big difference.

I: Yeah.

Interviewee: It's a big difference. Making something work in the lab, making sure it's technically sound. And then taking it to production is also a very big step.

I: Yeah.

Interviewee: It's a very big step, and then making sure that it gets all the regulatory approvals etc. That's another big step. But really, we'd like to confirm those two things. And then the third thing is making sure that we understand the whole ecosystem that the component will need to actually work. Do we have to make a design change on all the instruments for this new instrument to a core implant. [???] is a big in Tim's particular study. It's a…I don't know if you know the details, but basically, we're trying to get the actual force that…of the hip strength trained with the implant in there.

Before we don't actually know what the forces in hip are trained on. So we're trying to…we're trying to get…we're trying to make sure that the force of the operation is similar to what it was before the operation. So that person doesn't feel discomfort and the muscles are not overly stretched, but they're not overly loose as long.

That's a really difficult thing. I mean, so Tim's technical expertise is actually making the sense, make sure it's accurate, making sure that it works on all the different conditions. The surgeon guidelines…so, okay, can I actually use this data? Our perspective is okay, how's that continue to act with all the implants now at the moment? How is it going to interact with the surgical flow at the moment? No surgery at the moment actually gives that data. So if we're giving this data we…from a communication point of view, what are we telling the surgeon? Are you giving them a pass fail? Okay, we just giving them some sort of guidance to translate that to actual direction.

I: Uh, so it's like the surgeon need to learn how to use your innovation.

Interviewee: Yeah, exactly. And sometimes too much information is worse than too little information.

I: Yeah, yeah. I can understand that. Yeah. So…

Interviewee: Some of aspects. And then also from a regulatory point of view, now we've got an electronic device in the hip surgery. That's a whole different level of regulations requirement, sterilization requirements, the shelf life requirements, there was a wall up to be taken into consideration.

I: And the first place why did you want to collaborate with Tim?

Interviewee: it's…I think his idea is brilliant. I think they got the technical expertise to actually make it happen. So they're very appealing to me. They work very fast as well. Yeah, I like the way they design the designs are very efficient, not overly complicated. Or they unnecessarily complicated. but at the same time, they seem to really deserve to make sure that we have something that can actually be pretty effective.

I: Yeah. So it's like, because I learned big company, they also have their R&D department. So…so I wonder if it's for example, cheaper or faster if you have this collaboration with universities.

Interviewee: It is, definitely we use a lot of…we, we have a lot of work going on with universities. It is…it's definitely faster. I don't know if it's cheaper. but very really in R&D do we have the luxury of actually focusing on one project? And you know, for three years and making it work, we have to [???] so it's easier for us to sponsor someone in a Master or PhD just to focus on one thing. And also, a lot of the time we don't have access to the type of equipment that the university will have. Massive, massive investment so it's easy for us to…to borrow the expertise and all the equipment etc in the form of a PhD.

I: And I wonder so like, both partners can…both of you can benefit from this cooperation, for example, PhD will get publication.

Interviewee: Yeah. Okay. No, definitely. And we've been…we've been interacting with universities for 30, 40 years now. Especially to get…to prove any theories, you have also to try harder to make these types of prototypes. Yeah. And as an investigation, like you say, publishing papers, publishing data, this is probably the best way of doing collaboration.

I: So how did you know Tim and start this collaboration with him?

Interviewee: Yeah, that's a good question. I'm not sure how we can…sorry just plug in my charger. I think, I don't know if they approached us or oh, yeah. The surgeon who works with Tim, I believe he had contact with some sales reps. And they got in touch with us. But otherwise our…our need department has to work with Delft university. So that's all we knew about.

I: Okay, so yeah, then I wonder what will be a meaningful partner according to you. So who will be to like, the kind of partner you…you would like to work with?

Interviewee: Good question. I think someone like I said, like someone like Tim's group, because they're really proactive. They look for opportunities to look for solutions. They work they the fastest workers we've seen from all our universities so far and they look for…you know, realistic solution, not something that's going to cost, you know, a million euros to make unrealistic solution.

And they've got the technical expertise, they definitely have a wide range of capabilities. So that's, those are the criteria we'd be looking at.

And, yeah, I don't think there's anything else. It's be helpful with the university as a, as a wide range of departments. So they can, they can go on different, different departments within the university. So if someone needs help with materials or some electronics or mechanical design, it makes for a lot more efficient.

I: Ah, yeah. Then I realized maybe, maybe that's a advantage of research in university because they have a lot of department. So that is easy to work together

Interviewee: And they've already got good ties with the clinical guy, so they already know the surgeon. So that makes life easier as well. Yeah. Okay.

I: Yeah. Because if they don't have this close contact with surgeon, maybe their design will be not realistic as you want.

Interviewee: Exactly. Uh…I mean, a lot of the time is we do work with universities who don't have any surgeon contact and we provide the surgeon contacts. But it's just another step. That slows things down.

I: So, if I understand, I feel like that's the…the you're all…you both you and Tim you…both very emphasize the realistic solution. And I found in this way, you address the same issue. And I feel like that's the foundation of your collaboration.

Interviewee: Oh yes, definitely. I think our philosophies on the same. Yeah, medical devices are too expensive to…you know, they're not accessible for the majority of the world where they should be. And, you know, you can solve 90% of those issues from a design perspective. Yeah, I think that's…we have a lot in common.

And that's really important because if we, if we, you know, if Johnson and Johnson want to just make a big fancy machine, you can make it but it's not going to be used, it's no point.

I: And now Tim because of the…the Corona period he and his partner, like make innovation in the reusable mask, and then they have this idea to create a new living lab that will adjust the circular and sustainable medical instruments. Yeah, so they're really focused on the sustainability.

Interviewee: Right. Yeah.

I: They also…I wonder if your company also address the sustainability of medical device.

Interviewee: We are looking at it. We do have…we do have a lot of schemes in place to ensure that we have the most sustainable devices we have…returned to, mainly from a design point of view but also from a logistics point of view, to make sure that our hospital only has what they need to not, not shipping, you know, we're not wasting carbon footprints on shipping instruments across the world where they don't need it, in that sense. And also, what's the cost of sterilization? Is that, is there a more efficient way of doing that? So yes, sustainability is key at the moment.

I: Okay. And during this collaboration have your experience and difference, for example, in mindset or working ways. So maybe difference will become the ways of TU Delft and ways of companies, have you experienced that.

Interviewee: I think companies have a lot more red tape, the…

I: red tape?

Interviewee: Red tape, we always have a lot more procedures to follow. We need a lot more approvals, a lot more permission for every single step of the way. To get this for example, this contract with Delft has taken over a year to get to go through legal and ethical through what we call healthcare compliance, healthcare compliance, make sure that everything is paid, accurate rate and prices are inflated. So that that takes a lot…a lot of time. And, you know, even we…even we sharing things like CAD design, etc, those need approvals before we can send it over to. So yeah, I think businesses are a lot more cautious from a legal point of view from the sharing of data point of view. So that slows us down a lot. But otherwise, Delft University, I think they work, you know, they could collaboration in the same way we do. They run the meeting [???]. I'd say the…the one…one thing I'd say maybe the meetings and the…they seem to be a lot more informal. So they more like to say a chat. That is good in a way. But we're not used to that…we in…in business we like to try a design meeting especially amongst the main guys the main parties will always have minutes always have a chair and have an agenda so that when you go back, you can pick up what decisions were made when they were made who…who made the decisions, I think that's…we're in slightly difference and it's easily addressed for that…yeah universities seem to a bit more informal. But yeah, I've been covering that. No, nothing stands off.

Interviewee: Now, can I say maybe that would be the reason like the researchers in university work faster in their design?

Interviewee: I think so. Yeah.

I: Yeah. Okay. Um, And last questions is, what do you think that the collaboration between you and Tim…uh yeah, I rephrase it. So what do you think that you can achieve together by your collaboration with you and Tim?

Interviewee: Well, I'm hoping, at a minimum, hoping we get good few papers out of this…started clinical study. And I sincerely hope this is just one of the first of many PhDs we can do together. I hope we can sponsor at least two or three PhDs every year across a wide range of topics to explore how we make surgery a lot more efficient, a lot more effective for surgeons and patient. Especially making…making use of Tim's expertise in electronics to make it especially hip surgery a lot more intelligent. In hip surgery at the moment, everyone jokes in the carpenter in the medical world. You just need a hammer.

I: Sorry, I didn't get it.

Interviewee: So they say hip surgeries like carpentry…like woodwork. Because all you need is a hammer and a chisel to…to put the implant in. So it's…it doesn't have a lot of finesse. And that's the problem in…why it takes so long to teach a surgeon how to do surgery. They say it takes up to 100 surgeries who a surgeon to become a good and a surgeon would only do 20 a year. So those five…first five years those patients are not going to have the ideal outcome. And we believe that that is not the surgeons' fault. It's our fault. Designing instruments that are not intelligent enough. It's like giving a surgeon a car with them…with no power steering with no power brakes, etc. What we want to try and do is now, you know, give them a car with automatic transmission etc. So it takes the thinking out of…a lot of the mundane tasks, gives them a lot more control so they can focus on the important thing. I think if we can incorporate electronics, using Tim's expertise. Somehow I don't know how, but into…into surgery as a whole. I think it'll make surgery a lot more effective, way easier to learn, but also efficient. So you know, your sustainability question. it'll…it'll reduce the number of incidents actually take them to the theatre, how many need to be washed every day. Maybe possibly save time in theatre. But the patient on the table is now which is a massive saving. So yeah, I think hopefully this…this first few instruments will…you know, hand the clinical data that comes behind it if we can publish those really good foundation to go forward.

I: Yeah, so…so company they also have interest in publication?

Interviewee: Definitely.

I: But why?

Interviewee: It's the…it's a backbone of proving that your…your implants and instruments are capable before you sell them, you know, full capable data. So, if you coming up with a new instrument in the implant, very difficult to prove to the surgeon community that: oh, it works fine. Even you have a chemical study so to say, two years or four years, clinical study can cost a million, two million dollars, two or four years is a long time to wait. And even then surgeons won't trust it. So if you have a lot of published papers, and this instrument works very well, with these settings. And implant works very well in the setting, it's been proven again, yeah, there's a lot more confidence to the to the wider surgeon community, but also, internally helps us build our knowledge so that we can use that to progress our designs, next steps. It's vital. Otherwise, otherwise, we just, we do a lot of internal testing, but if we don't have peer reviewed publication, it doesn't have as much reliable.

I: Yes, that's like a proof of your accountability.

Interviewee: Yeah.

I: Okay, thank you. I think I finished my questions. So yeah, the last general one. Is there any important questions that we didn't address before or something you want to add your ask?

Interviewee: No, no, no, this is fine. If I think of anything, I will let you know. But I think no, no, it's good. I think communication is a big one. It's really important, especially when communicating with surgeons. And even internally in our, in our design groups, like, Tim as his design group of maybe 10, 12 people. We have, to me, I've got 15, 20 people. Making sure everybody's on the same page, it's very difficult.

I: Yeah, I can imagine, especially in this period, and you can only meet through the screen.

Interviewee: Yeah, I mean, to be honest, probably meeting more than we were and, that's good

I: Yeah. And I wonder if you're, because you mentioned there are 15 people in the team. So are they also, like, in a same place or they also separate in the world?

Interviewee: Worldwide. The US…

I: Yeah, I can imagine that it's hard to keep on the same page.

Interviewee: It is, especially when you have all these different ways of communicating like teams or, or email. I sent you an email. No, I put it on teams. Oh, I put it on the sharepoint.

I: Yeah.

Interviewee: But oh, thank you. This is very interesting. All questions.

I: Okay, well, thank you very much. I really like this conversation.

Interviewee: Anytime, anytime.

I: So, thank you so much for the time.

Interviewee: Enjoy your day, Weiwei, and enjoy the weather.

I: Yeah. Well, thank you. Bye

Interviewee: Bye.

Innovation Manager of Medical Delta (2020/06/11)

Interviewee: It's more of a field lab.

I: What do you mean a field lab?

Interviewee: Afield…a living lab with a well, that is there's always an end user and an end user organization involved. And it's less technology, around a kind of focus of technology.

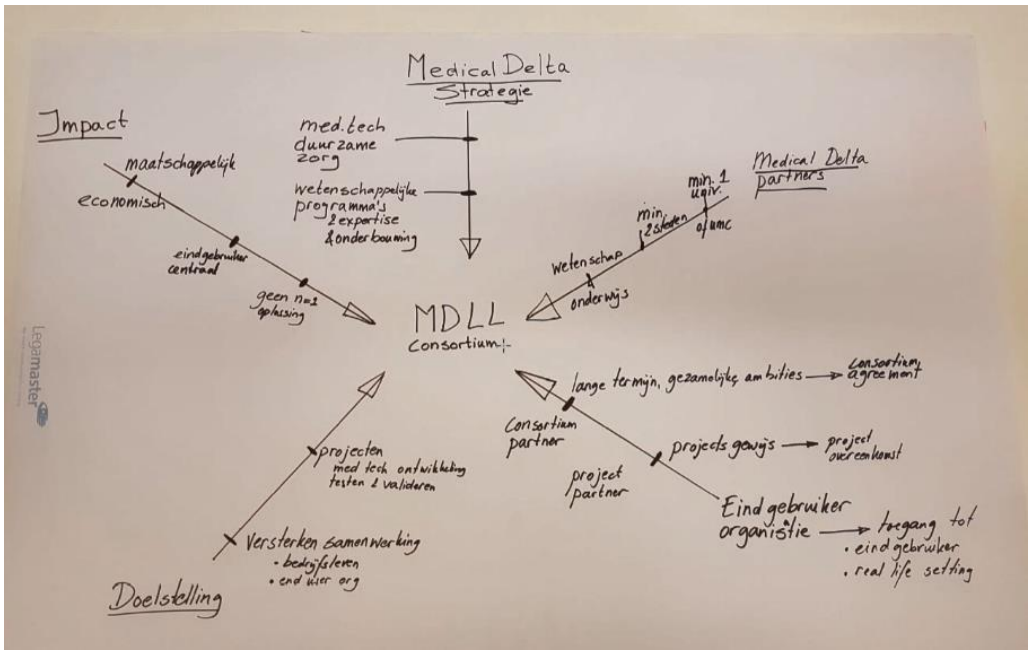
And a field that is more knowledge Institute and technological companies. Yeah, less an end user organization, for example, a care organization involved, on the less level. I think I can…I might find…

I: Yeah, I think so. Because I also talked To Tim. He also…I my feeling is the living lab is just more like his research lab. But he also involved surgeons and companies in that.

Interviewee: Yeah. Yeah. Yeah. I will…I will find out later that that difference. And I think I will explain our view from medical Delta on living labs and cooperation. And I start…it's in Dutch. Sorry, but I started with Medical Delta strategy.

I: Yeah.

Interviewee: We have strategy of Medical Delta. It's about two years ago. It has been reviewed. And it's…its focus point is on medical technology for sustainable healthcare. Yeah. medical technology for sustainable healthcare. The first point that's summarizing our strategy and the most important basis of Medical Delta are its scientific programs. And there the expertise and the scientific support. The scientific expertise and scientific support of the scientific knowledge is the basis of what we do. So all projects we do also in living labs should have a scientific basis. So, the focus on living labs that can be a different type of focus, we always take a scientific focus. There are also living labs that has more…well, we experience new technology focus. That's not sufficient for us. We want to approach it scientifically. Also, living labs that are more have more a focus on pre-purchase experience. So they say well we are interested in E-health and we have living lab or kind of companies. We do a kind of pre-purchase experience. So



come on, come with your ready product and we test them and then we decide to purchase or not. It's a different type of focus for living lab. We have more scientific focused and more developmental focus.

I: If I understand right is the living lab of Medical Delta, they want to boost the, for example, research or yeah scientific research in the sustainable healthcare.

Interviewee: Yes, we want to bridge the research, the scientific basis. Yes the end users and we want to accelerate the valorization of knowledge to the…to startups and end user organizations. So breaking that together and in the living lab, of course the answers to organizations are important. We will see that further on, but one of our you know, pillows is that should fit our strategy.

I: Yeah.

Interviewee: That's the starting point. Yeah, a living lab should fit our strategy.

Next we say well, we are Medical Delta. So what we find important is as Medical Delta, we say, well in our research, different research organizations work together from different cities. So we say, well at least, for a living lab, at least one, university, or university medical centre should be should be involved. At least two organizations of two cities should be involved. So it can be, for example, TU Delft, and University of Applied Sciences in Leiden, or TU Delft and LUMC in Leiden, or TU Delft and Erasmus MC or TU Delft and University of Applied Sciences in Rotterdam. There should be two partners in two different cities and at least one of them should be a university partner. So that's our starting point. And both the science and education should be involved in that. Education might be students are involved for the Bachelor program or master thesis, for example.

I: Okay. So it's like the most inner circle of the partner will be universities and for example hospitals.

Interviewee: Yeah, yeah.

I: And…and the companies may they…wait, they may lie in a more outer circle.

Interviewee: Yeah, yeah the companies, you will see the companies will more be a kind of project. Companies work…we work in project-wise, within the living lab.

I: Yep. Okay.

Interviewee: So companies are most often for a living lab, not a primary partner. In a field lab, which is more technology driven. They can be…the companies can be a primary part.

I: Yeah. Because now I read the concept of Tim's new Living lab. And I noticed there's a partner, there's a company will be a primary partner of his living lab.

Interviewee: Yeah. I will come to you later on, is different, so as I see the difference between living lab and field lab.

I: Yeah.

Interviewee: This is this picture has really started with living labs. We say well, every living lab should have an end user organization. End user organization can be a hospital, likely [???], can also be an elderly care organization like [???], can be a rehabilitation organization, like [???] or [???], so they work with patients or clients that needs care. You understand the difference?

I: Huh…It's more like a day-care hospital…

Interviewee: Yeah, can be a hospital. That is the organization that really give the care…

I: Yeah.

Interviewee: patients, clients like elderly people. They can be a care home, but also can give care at the home of the client.

I: So they are more the actual practitioner in healthcare.

Interviewee: Yeah. So that always need an end user organization involved when you have a living lab. And then we say, well, what we believe is that they should…the cooperation to a consortium should start with a cooperation project. The first cooperation is project-wise. Then you should arrange project agreement, where you say, well, within this project, we…each of the partners has this goal. We have our org… private organizational goals. You should define that and we have a cooperation goal and you will define that and you agree on, well, each organization brings in this amount of people, this amount of hours this amount of money for cooperation. You understand?

I: Hmmm, so it's like every actor they propose their idea what they want to achieve in this living lab, and among that or they discussion together and find a common ground and build up one common vision that they can work on.

Interviewee: Yes. And often this step is forgotten. They say oh, we are going to work together. Okay, forget about what's important for each of you. Rather you as organization can have to back up of your management. Because if there are new ideas are arriving, arising. You can easily say, well this is…this really fits our cooperation, we put our energy on this. Or, no, this doesn't fit our objectives. We can't put energy on it. So it's important to know, well, **what's important for each of the organizations individual and together.**

I: So, if it's like, we should reminder regularly that you have two goals, what is what you can gain from this individually and what you can achieve together. You have to reflect on that…frequently.

Interviewee: Yes, you have to take time for that. Because it's important for each of the partners to be aware of what's important for the other partner because then you understand each other and then you can understand well now, there is a project idea. And I can understand it's in interesting for the whole consortium as a whole, or is primarily interesting for me and only for small part, for the all the partner should be aware of that. I used to discuss about it. And if there's interest, there should be sufficient joint interest for working together. If it is too small. I don't know if you see my hands.

I: Yeah, I can see it.

Interviewee: If you only have a small joint interest, okay. You have two partners each hand is one partner, is a joint interest. If there's no joint interest, you should at all you shouldn't work together. If the joint interest is fairly small. Well, there's not so much common ground to work together. It might be one project. But if you have really strong joint interest, then there is a basis for a long-term living lab consortium, then you can make a consortium agreement. You say, you can say, okay, we don't work for a project for one or two years. You have the ambition for the next 10 years to work together and to build and to strengthen this into a really strong living lab or field lab or consortium. You want to work together, strongly together. We know what we want to achieve together. We know each other's positions, and we know together we are strong. Yeah. And that's what you need to define. And that's this process. I want to start after my holidays and of June. I'm back. Tomorrow is my holiday start. End of June, I sit together this Tim and exactly this I want to discuss with Tim.

I say well you need to go and sit, with Van Straten Medical, to go to sit with LUMC and discuss, well what each of your individual objectives? How do you match together? And what is a joint and if you see there is a joint, what are you prepared to invest in it? Only in hours but also in facilities and money and well, and also how do you share the results that will be the end of it. Because that's what you should put into it. You want also something out of it? What is it that comes out of it? It's not only intellectual property or money from companies that come with a project and pay for it, but might also be communication, might also be excellent students. All can be all kinds of results. Yeah. And you should define them. And you should say, well, each of the partners is interested in that kind of results. And we agree together, how we share the results. And that should be written down in a consortium agreement.

I: Yeah.

Interviewee: And in that consortium agreement that is written down, we will work together in this way. Do this effort to make this initiative to get it really fly. In this way, we deal with the results and…so that's as long term, and it's your joint, the joint…joint ambitions are written down. So yeah, yeah. And then this living lab or field lab is there as well. We do this type of things together. But we also do it with all our external partners and for a living lab is a end user organization like a hospital or home…elderly care organization, they often do it with companies set up innovative solutions for them. And then you say, well, the start of projects we can take on for you.

Of course, you have to bring money for it, so we can do the work. And well, this is often testing and validating MedTech development. And I think that's the same for Medical Delta instruments.

So, that is, the objective is to reinforce the cooperation between companies and…and end user organizations and the scientific partners and work in that project based.

I: Yeah.

Interviewee: Because, you know, I think Van Straten Medical is a consortium partner, as partner in the consortium, for example, jointly they will do a project for Johnson and Johnson, which want to have a sustainable product on…well, whatever it may be.

I: Yeah.

Interviewee: And that will be a project-based cooperation is for Johnson and Johnson together with consortium partners.

I: Yeah. And you just mentioned they should really define well, a consortium agreement. And because I also interviewed some partner from Tim's lab, and they also talk about, it's really difficult to make an agreement yet it's very important. And I wonder if it's possible that we can have an agreement before the project starts?

Interviewee: Yeah, it should be.

I: Yeah.

Interviewee: Yeah. Yeah. I think you should have a consortium agreement. So that would be the basis. And that should also tell, well, how do we deal with projects?

I: Yeah.

Interviewee: And what is the format? So the basis for the…for how we deal with projects and what kind of agreements we do project wise.

I: Yeah.

Interviewee: So as you start with a consortium agreement, and this consortium agreement, you'll…you say, well, we work project based, for the project, we have projects agreements. And…and that should be signed by the partners involved in the project. And it's not always all the partners of the consortium, so that might be different.

But it's good to think. Before you start, about the agreements. And, you know, in practice, you know, with scientists. They also start already, you know…

I: Yes.

Interviewee: And they say, oh, we solve that agreement later. I think it would be…it's nice that you are involved now. we have idea from Medical Delta on how to start this. Well, we define a kind of format for this.

I: Yeah. Okay. Yeah. Because now I'm thinking of my thesis. I also…I also have a feeling that maybe my intervention will be focused on how they can work together to come up with a consortium agreement, together. It's like, yeah, how I can help them to...yeah come up this discussion on the agreement. Yeah, yeah. So I have that feeling right now, but I don't know what would be on the end.

Interviewee: Well, I think it would be good, I speak about this. And explain to him after my holidays.

I: Mm hmm.

Interviewee: And then I will suggest to him to involve you with…working it out for his consortium.

I: Yeah. Okay.

Interviewee: I don't know if that's alright with…with you. Is that what you mean?

I: Yeah, I think so. Yeah.

Interviewee: Yeah. And I think therefore another living lab, we already have kind of basis. For a consortium agreement worked out, and we can start with that? I don't know if it's…I think it's in Dutch and that might be a difficulty. You understand? Dutch, Dutch language, Dutch contracts might be a difficulty, but we will see. Yeah?

I: Yeah, I can try my best.

Interviewee: Yeah, you can try your best and we will see how to manage.

I: Yeah.

Interviewee: You understand this this picture, I think.

I: Yes, I think so. Oh, what's the impact?

Interviewee: Yeah, I think. I think every living lab consortium should define what kind of impact they want to achieve. And the impacts can both be societal impact and economic impact.

I: Yeah.

Interviewee: And we say we're having the impacts should also have the end user as a central point of view. So, for a living lab, if it's…the impact should be on…within the patient quality…should be quality, should be for the..for the patient care, should be central and it can be the quality can also be the safety for the patient. But the impact can also for the end user can be more on an organizational level, that is more efficient care. So, that impact for the end user should be…should be focusing on that it has really impact on end user level, both on the patient, on the client as on the organization of the end user. And it can also not be, well, I have said it here it's and is one solution. It can…cannot be a solution for one surgeon. So you can say, well, for example, there might be a surgeon that say, well, I have difficulty for my wrist to make this turn. So if we develop a pin set or a tool, that is a solution for that, for me, only, then isn't good innovation. Now we say well, it should be for a generic solution for a problem experienced by a broad range of surgeons in that field. It should be a solution for E-health solution. That is not only for one typical…a person with disability, which are only two or three persons in over the Netherlands. It should be a broad group of about at least a few hundred of people.

I: Yeah.

Interviewee: That's really has this need. Not only for one or two people.

I: Yeah.

Interviewee: That should be…have a broader impact.

I: Yeah.

Interviewee: So that's what we have said. So, impact should be societal and economic, really be impact on the end user, patient and or caregiver. And not for only one or two problems for people, but a broader range, really be a broadly perceived issue.

I: And I want to ask, for example, in the field lab of Tim, I feel like the end user, they are surgeons, so I don't know if I should also think about the patients in this context or just…yeah, the boundaries is on surgeon.

Interviewee: Well, I think the surgeon, if you see what if…what…what the surgeons would like to have as impact, if they would like to have a better quality of the patient care, and it's an important impact, and safer patient care.

I: Yeah.

Interviewee: And next to that, they would like to be the care more efficient. So that might be…it cost less. And with sustainability, you can say, well, it generates less waste, for example.

I: Yeah.

Interviewee: But I think the surgeons, number one is they… he surgeon don't want more sustainable solution, if it has a negative impact on patient care, they say we can't have that. So at least the same quality and safety for the patient should be achieved.

I: Yeah.

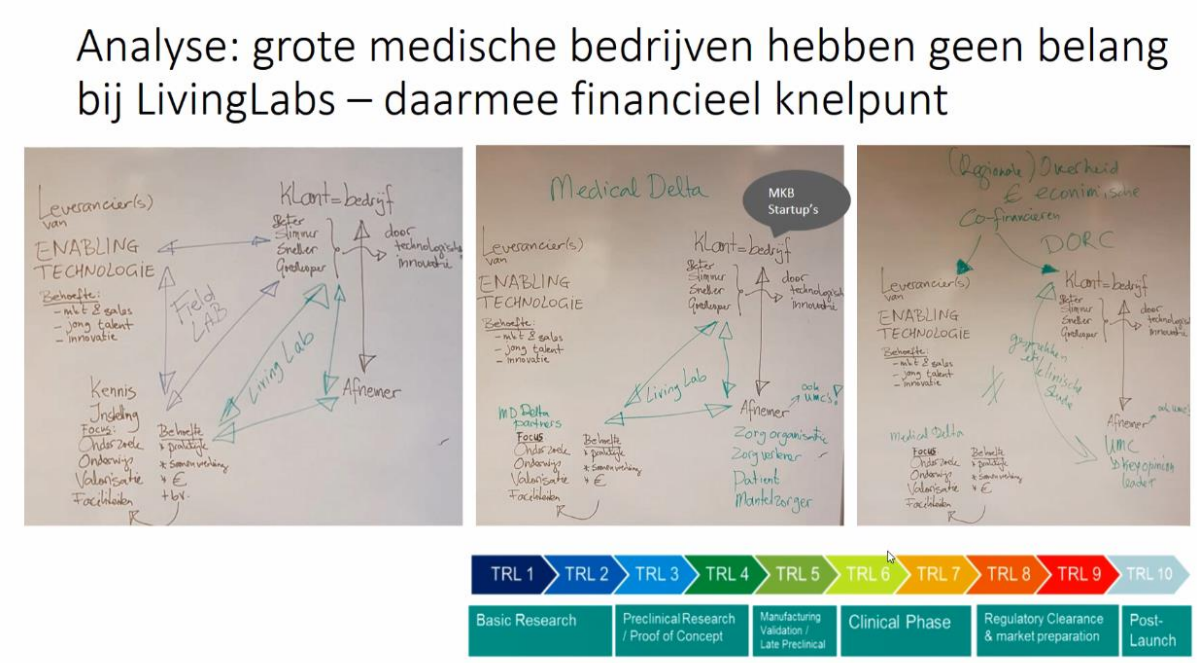
Interviewee: And that's always in, yeah top of mind is the surgeon. But I agree with you, the developments in this and therefore I call it field lab is more focused on new technological solutions. Primarily, and a boundary condition will be…patient care shouldn't be deteriorated.

And I would like to search a difference between field lab and living lab for you. I'm not sure where I have this.

Uh…I think this…this slide…what you see here, on the left page is what I see as the difference between a field lab and a living lab.

I: Yeah

interviewee: So again, it's in Dutch, I am sorry.



Here on the left bottom is the knowledge institutes, the university or the University Medical Center, focus on research, onderzoek. And education, onderwijs, and then valorisation, so bringing knowledge to society and they have certain facilities. So they can…And what they need, to do good research as they need the…they need to know more about day to day practice of, for example, a hospital or a doctor.

They want to cooperate with companies and doctors. And of course they need money to do the research. So that's here is the research organization. And then above here are suppliers of **enabling technology**. And in this, I think Van Straten Medical, so these are often companies. And they have kind of enabling technology. For example, you can say, well, you're robotics companies that have robotic solutions, for example, for warehouse applications, or robotic solutions for production…production application or like Van Straten Medical, they have solutions for reuse of medical instrumentation, cleaning or reuse. That's they have that kind of technology.

I: Yeah.

Interviewee: I call that enabling technology.

I: I am not sure if I understand was the enabling technology.

Interviewee: Enabling technology is technology that makes something possible. So that's a technology. For example, a company that is a specialist in robotics solutions. And that robotic solutions, that robotic technology enables you to transfer your production from done by people. Enable it to be done by a robot.

I: Okay.

Interviewee: So and I think Van Straten Medical, they have solutions for your, for, for example, hospitals, they have the solutions, well instead of you yourself, and doing the sterilization, of your tools of your insurance, we do that. That they enable hospitals for this sterilization and packaging of the instruments. They also say well if you want to be more environmental friendly, we have solutions to reuse your tools. And it can be that we really, really clean them again so that they can be used again or we make sure they are molten and brought into the production process of you.

I: So it's like, if I understand, right, so the university in the lower part, they are more like generate new ideas, but the suppliers, they're more good at, they are better at translating the idea into real solution.

Interviewee: That's it. So, and therefore, the…these are companies and they want to bring their knowledge into the markets and they are good to bring new innovations into the market because they offer a real…they have…they offer solutions to other companies. Yeah. So they…that are companies of enabling technologies.

And then on the right, so they're also often companies, and they say they are often…yeah…in our…in the field of healthcare. They say, well, we really developed a new solution for you as a doctor, or as a hospital. For example, they develop…you could say enabling technology might be ICT company, they deliver ICT solutions.

I: Yeah.

Interviewee: And then there are a lot of companies, they say, well, we develop e-health solution. And we make use of a Google application or Google as enabling technology supplier. But we develop a special Google application for home care. So a home care organization here as an end user organization. They say well, we buy this home care ICT solution from this start-up or this could be company. And okay, they use Google but we don't work with Google we work with this company because they really have adapted the enabling technology to the special needs that I have as an end user organization. And then what you see is if you have a living lab, you see effect more here, where the living lab is designed to have the university partner here.

I: Yeah.

Interviewee: You have, for example, e-health solution and you have a care organization. And they…they are testing new solutions. And that are the…these are the three, well, these are…these two are the partners more often for the consortium. They do projects together with this type of companies, SMEs and start-ups they often. What you see here, field lab, is that this type of these two, enabling technology like RoboHouse at TU Delft. TU Delft with robotics technologies. They start a field lab, built based on joint technological solutions. And the customers are all companies that want to have…want to deliver improved products, innovative products. And I see, I see also Medical Delta Instrument right here, TU Delft, but also LUMC, as a research…university hospital, as a research organization, they are…they deliver the knowledge, they work together with Van Straten Medical. They delivery enabling technology on sustainable solutions and sustainable technology. And they do that for, for example, Johnson and Johnson, for Philips, for all kinds of companies, Biomed, who will want to have a more sustainable product portfolio.

So, they are more this triangle, the upper triangle.

I: So, yeah, if I understand right, the companies in the…in enabling technology they…well, no, the company in the client. So the customer companies, they're more close to normal people, the public, but the company in the enabling technology there are more….

Interviewee: Business to business. Yeah. Yeah. And in right this, they are more business to hospitals, business to care organizations, or business to patients. But right here It's always business to business.

I: Okay.

Interviewee: And I think the good thing is, if you have a good proposition here together, yeah. You'll have a business. And you might have larger companies that pay for your proposition.

I: Hmmm, what do you mean?

Interviewee: Well, I can say a company like Johnson and Johnson or a company like Philips or a company like Biomed, they are big companies. If they have a question on how can we have more sustainable products?

I: Yeah.

Interviewee: You as a living lab together, or as a field lan can say, well, we can do a project for you. We bring in some research, we bring in some new technology, and together in the field lab, we have this proposition for you. That's will cost to this type of money, and we agree, this part will be done by students, this part will be done by researchers from the University, this part will be done by the company. And because they are big companies, they really have money to spend to you. You don't…if you only have small companies or start-ups, you should in the living lab situation, you have to focus on joint grant applications.

That' difficult, because we have to wait if the grant…is the application grant them a lot? You can have a proposition for companies who want to innovate and they have an innovation budget. They are your reach closer. You should develop proposition that's much closer the direct innovation needs of the company, and you are not so dependent on the grant application.

I: Yeah. Okay.

Interviewee: So that's the difference between field lab and living lab. And I think the Van Straten and Tim want to do is a field lab. And I think it's a good choice. It's a better choice than another living lab. Living lab will be always the series struggle. Field lab is already difficult, but living lab is even more difficult.

I: Yeah.

Interviewee: So good choice.

I: Yeah. I really learn a lot.

Interviewee: Yeah, I think there is few of time, I think this is already a lot for you…

I: To digest.

Interviewee: To digest. You also…do you know this TRL line? Have you ever learnt the technology readiness level?

I: I learnt a bit. So the higher is the…yeah, the higher level will be the most close to the customers…go to the market.

Interviewee: Yes, yeah. I think really there, TRL 7, 8 and 9 is always done by companies.

I: Yeah, yeah.

Interviewee: And TRL 4, 5, 6 is often a combination of…well, here, TRL 1 to 3 is research.

I: Yeah.

Interviewee: Often research from university. Or university medical centre. And in between here, 4, 5, 6, is the difficult, you know, because it's too early for big companies to step in. They say, well, show it with a few patients first. And you are in 6, first we can not go study. So they don't want to invest. So this is…you need researchers like Tim, they say, well, I struggle through these levels and to really bring it further to this now. And you can…have your cooperation, the field lab will also be, will, often in this field, and should be a bit, well, driven from companies here who want to innovate with their existing product portfolio. And say, well, we want to innovate here, can you bring solutions? From TRL 3, 4, 5, to there. So you need to find this match in the area of 4, 5, 6.

I: Yeah. Okay.

Interviewee: And that's what you will be looking for this different…yeah, within your consortium, but also within the project with your partners.

I: it's like you have to bring a well value proposition to these…to the big companies. So they can invest you.

Interviewee: Yeah. You should match. And I think that's the…should be the challenge for this field lab, is really get some big companies, as an example, well whether you see, we can be your service of your innovation line, related to sustainability. So that you…are you willing to invest us for the coming years, regular new projects? And that's what you have to define your proposition. What will you do as a field lab? Your focus should match your new customers. You should match your own ambitions, you should also find that market that your customers would like to invest you. Your customers should not say, well, what you want to do for university as Tim, should also match his research interests, otherwise well, there's no reason…people will join this. You should also match Van Straten Medical as a company benefits. Otherwise you say well, find it out, yeah nice you have this innovation ambition, but if it's not in line…sufficiently in line with our company focus. Yeah, we would not do this.

So that should almost be this (only finger tips touch each other), you know. So should almost be sufficient. If only be this (only finger tips touch each other), that's not ground, to have a real hand shake and work together.

I think that metaphor of those hands…if they don't touch, there's no ground. The more they touch and if there's a real hand shake, then it's ground for cooperation. If there's only two fingers, well you work together in a work package of project, but that's it. You work for few students that you change, that's this. But real cooperation, you need to make a hand shake. If you get a hand shake, you need a cooperation agreement, from consortium agreement to project agreement. Otherwise, you work with some students together.

I: Yeah.

Interviewee: You send some emails, you say, well we expect to do this, it's important to do that. Well, and that can be done with some emails. But if there really is cooperation, then you need an agreement.

I: Yes, I like this idea.

Interviewee: Yeah, it's a really nice metaphor, isn't it?

I: Yes!

Appendix C – Coding process

This appendix elaborated the themes of code groups, code groups, codes of each group, and the quotations that grounded the interpretation of the codes.

Network: Motivation

Theme: Motivation

Under the network of motivation, there were several themes. The first theme was the motivation to join the collaboration, with four types of motivation, respectively, general motivation, motivation of companies, motivation of researchers and motivation of surgeons. These four types of motivation became four code groups under the theme of motivation. The grounded quotations of the codes can be found in the Table A1 below.

General motivation

In the code group of general motivation, there were three codes. General motivation are the motivational opinions mentioned by multiple interviewees or the opinions of one interviewee but are also universal for other interviewees.

The first code was "GM – 1: You need everybody to make successful projects". Several interviewees highlighted that they should utilise the network and connection they have as best as possible to make their projects more successful. The necessity of collaboration with various partners was also because of the fact that it was difficult and even impossible to realise the project ideas solely.

The other code in the code group of general motivation was the perspective of "General Motivation – 2: Friendship", which indicated that the friendship between stakeholders was also an important element of the motivation to join the collaboration. Friendship served as the foundation of a favourable collaboration and it also represented in the intense communication between each other.

The last code in this group was "GM – 3: A call for sustainable medical devices brings people together". During the period of fighting with Covid-19, the shortage of medical device and material was one of the most intractable issue faced by healthcare practitioners. As a result, people became more aware on the importance of sustainability in the healthcare system, and especially in the medical devices. Based on the increased awareness, people became interested in participating the research line of sustainable surgery and this common interest brings people from different sections work together.

Motivation of companies: efficiency and reliability

In the code group of motivation of companies, the variety of motivation of companies can be summarised into two common objects, efficiency and reliability in the process of product development. These two common objects were divided into three codes, which were elaborated below.

The first code was "MoC – 1: Collaborating with universities is more efficient than doing research ourselves". The pressure of competence drove companies to seek better

solutions for their product development. Thus, companies would like to make use of the research done by universities, because it is cheaper than doing research themselves, according to the following quote from an engineer from a company of enabling technology. Meanwhile, usually the R&D of a large company doesn't have the luxury to focus on one problem and in this sense, they also instead prefer to sponsor academic institution to work on certain problem.

"even all the money company would pay to the university, either licensing a patent or paying for the research with, you know, grants, etc. I think that's still less money than it would take the company to do the whole research phase themselves like you, if you do it, right."

The second code in this group is "MoC – 2: Universities' wide range of capabilities makes their work more efficient". Having a wide range of departments is a prominent advantage of doing research in university, because it is a lot easier to get obtain help from different departments. In this way the research became more efficient. And together with the competent expertise of academic researchers, companies were able to realise their goals of making surgery more intelligent and effective.

The last code in the code group of motivation of companies was "MoC – 3: We want publication to prove our reliability". Even though having publication was not the main focus of companies, companies would like to have a lot of published paper to prove the reliability of their design. Publication would greatly increase the confidence to the client community.

Motivation of researchers: increase competence

There was one code under this group, which is "MoR – 1: High-end projects with partners boosts your brand in university". This was a practical motivation for academic researcher, as collaborating with multiple partners increase the possibility of generate more high-end and high-tech projects in the research line. In return, these successful projects proved the competence of academic researchers and increase their academic status.

Motivation of surgeons: interests and publications

There were two types of motivation of surgeons to join the collaboration, according to two interviewees. These two types of motivation were divided into two codes respectively.

The first code was "MoS – 1: New perspective outside own discipline gives energy, ideas and fun". During the interaction with engineering researchers, new perspectives beyond surgeons' own disciplines gave them fresh ideas and fun. This boundary-crossing interchange also gave them a chance to reflect on their own work in a different point of view.

The second code was "MoS – 2: Surgeons will get publication as return of their contribution". This is a more practical motivation of surgeons compared with the first one. Surgeons were interested in the researches on sustainable surgery, which was also closely related to their own work. Addition to this, getting a position in publication was also a reason for their willingness to contribute in research.

Table A1 List of code groups, code and corresponding quotation in the theme of motivation

Code group	Code	*Grounded quotations*	Occupation
General motivation	GM – 1: You need everybody to make successful projects	*"the new part is really that we are doing good in like this kind of network. And yeah, we really try to utilise our resources like as best as possible."*	ETC Engineer
		"It's the capacity of the partners, you need people who are willing to…you need, you need hospitals who are willing to offer their waste now we have a law not only in the Netherlands but also in the whole of Europe. That's not allowed to collect the waste because it's considered as contaminated as dangerous. So we need a partner in that who has a permit a license to collect it. Which is…is Renewi, the waste processing company. But you also need the hospitals willing to collect the waste after surgery in special bins on the OR and also locally in the OR make separation of the waste, separated plastic from the paper and stainless steel." *"we need this cooperate for everybody. So oh yeah. I think only together we can make this really successful projects, which might last years."*	PhD researcher
	GM – 2: Friendship	*"The foundation for me is that I like him a lot. He's a friendly guy, and he's really become a friend. So I think the thing is…the other way around. So yeah, it's a friendship that is a big part of this collaboration."* "well, we talk or we WhatsApp about every week, a couple of times. So it's rather intensive."	Surgeon
		"I just actually spoke to him just 10 minutes ago. Yeah, we speak quite regularly. You know, either I call him, WhatsApp, email just you know, on the normal communications."	ETC Engineer
	GM – 3: A call for sustainable medical devices brings people together	"we need to find out and we have an idea of making a waste production strain where you have on the one hand, you have a production line and the input in your production line is waste collected from several hospitals who participate, want to participate. And that is through the production line melted, shredded, cleaned, and then used as raw material in a blow molding machine to manufacture new products. So, we have two hospitals who want to participate, we have Johnson and Johnson wants to participate. And we have a waste	PhD researcher

		collection company, one of the largest in Holland, Renew, who want to participate. So I think together we have a very good network." "European Commission, they declared this period as a period to…use to make the economy greener, and specifically for medical devices to be more independent from other countries outside Europe. So we were asked to, to investigate more on this issue. So it's really, you know, connects good together." "I had quite some discussions with the Dutch authorities about this and they made the separate they made a, who do you call it, a special provision for us temporary to do this. So that so that that's also a very important partner in this potential living lab. That's the RIVM, the Dutch Ministry of Health."	
Motivation of companies: efficiency and reliability	MoC – 1: Collaborating with universities is more efficient than doing research ourselves	"Industry, obviously, yeah, they have problems. They lose money or their products are not functioning. Therefore they have to put a lot of effort in to sell it. Or they are forced now by the government to make it more sustainable if you don't accept any waste anymore. So there are all kinds of…either…Yeah, they're always forced, either forced by making more money within their own company, or they are forced by the government because they have to deal with one of the problems. […] Most of the time, it's only commercially driven."	Lab coordinator
		"even all the money company would pay to the university either licensing a patent or paying for the research with, you know, grants, etc. I think that's still less money than it would take the company to do the whole research phase themselves like you, if you do it, right"	ETC Engineer
		"*but* really in R&D do we have the luxury of actually focusing on one project? And you know, for three years and making it work, we have to [???] so it's easier for us to sponsor someone in a Master or PhD just to focus on one thing."	CC Engineer
	MoC – 2: Universities' wide range of capabilities makes their work more efficient	"It's be helpful with the university as a, as a wide range of departments. So they can, they can go on different, different departments within the university. So if someone needs help with materials or some electronics or mechanical design, it makes for a lot more efficient." "And I sincerely hope this is just one of the first of many PhDs we can do together. I hope we can sponsor at least two or three PhDs every year across a wide range of topics to	CC Engineer

		explore how we make surgery a lot more efficient, a lot more effective for surgeons and patient. Especially making…making use of Tim's expertise in electronics to make it especially hip surgery a lot more intelligent"	
	MoC – 3: We want publication to prove our reliability	"we already have something new that we are doing. And, and it's even though we do some publications. That's not the main focus. So it's more about like trying to…yeah it's really just moving like PhD and master thesis knowledge to the industry."	ETC Engineer
		"So if you have a lot of published papers, and this instrument works very well, with these settings. And implant works very well in the setting, it's been proven again, yeah, there's a lot more confidence to the to the wider surgeon community, but also, internally helps us build our knowledge so that we can use that to progress our designs, next steps. It's vital. Otherwise, otherwise, we just, we do a lot of internal testing, but if we don't have peer reviewed publication, it doesn't have as much reliable."	CC Engineer
Motivation of researchers: increase competence	MoR – 1: High-end projects with partners boosts your brand in university	"If those partners start to become available also for high-end, high-tech projects that are of interest of your research line. Then it is helpful. And if that happens, then somehow it pushes yourself as a brand, your research line as a brand in the university. Or, it boosts your, your label, let's say." "You have to compete with others. And if somehow what you do is important for the university, then it is good for your name. Yeah."	Lab coordinator
Motivation of surgeons: interests and publications	MoS – 1: New perspective outside own discipline gives energy, ideas and fun	"I think it's, it gives me a lot of fun…it is a fun, fun situation in the sense that I've been doing surgery for 20 years now and after 20 years have seen everything about…almost everything there is to see. So new things are always given me energy and new ideas. So that helps me a lot." "When I you know, when the example I told you about with the movement in the plateau. Now, I looked ahead at the in the operating room, I looked at what I saw as what kind of movement there was. And I didn't…haven't done that for 20 years. So you know, it's sort of in your, in your system. And you don't have a look at it. But when we had to explicitly look at it, it was I saw things I didn't see before. So it's very nice."	Surgeon

	MoS – 2: Surgeons will get publication as return of their contribution	*"So, in case of the specialist, that you often see is that they're interested in my work. And they are interested in publications and that match. So my work, what I'm doing is very close to what they can use. That's why they like sustainable surgery. And therefore they…they're always willing to contribute. And then as a return, they will be, they get a position on the publication as an author."*	Lab coordinator

Theme: expertise

The last theme in this network is the expertise of participants that could be brought into collaboration. Various and complementary expertise brought in by different partners were the precondition to create more values out of the collaboration. The theme of expertise includes three code groups, expertise of companies, expertise of surgeons and expertise of researchers in TU Delft. The grounded quotations of the codes can be found in the Table A2 below.

Expertise of academic researcher: technical competence

Strong technical competence is the expertise provided by academic researchers. The competence can be categorised into two slightly different codes according to the interviews. The first code in this group was "Er – 1: Have a wide range of capabilities the technical expertise". This is also a criterion of companies.

The second code was "Er – 2: Have the technical expertise to make things happen". Specifically, the technical expertise included high working efficiency, effective design and a proactive attitude to look for solutions.

Expertise of company: with knowledge on fabrication and commercialisation

Compared with academic researchers, engineers working in companies with more knowledge on fabrication and commercialisation. With this knowledge, they are able to provide better estimate on the feasibility of certain design. Engineers for companies of enabling technology and customer companies also had different emphasis, which led to two codes in this group.

One was "Ec – 1: Make prototypes efficiently within fabrication limitations". This was slightly similar to academic researches, yet engineers in companies of enabling technology were more skilled in designing prototypes within the limitation of fabrication and test capabilities. In other words, they more prefer an economically efficient fashion to prototype.

The other one was "Ec – 2: Make sure there's a viable product that can be commercialized in the ecosystem". Engineers from customer companies need to constantly keep the viability of the products in mind, which meant that they can commercialise the products in the end. One indicator of the viability of the product was that if it can fit in the current ecosystem, and this required the engineers a holistic point of view to estimate and compare with existing technology. With this they can make a good assessment on the effectiveness of the design and make decisions.

Expertise of surgeons: clinical experience

Another critical player in this collaboration was user, and in this case, were surgeons who use medical devices in their daily operations. Their expertise that can be contributed to the collaboration was summarised into the code "Es – 1: Provide hands-on experience to make sure new technology is clinically effective". All the interviewees emphasized the importance of the surgeons' role in the process of moving technology forward. In the process, translating the users' needs was an indispensable element. Abundant hands-on experience on surgery and resident training allowed surgeon supplement clinically practical insight on the technical ideas of engineers and researchers. These two minds together increased the chance of bringing out more realistic solutions and which can really bring benefits in the real life.

Table A2 List of code groups, code and corresponding quotation in the theme of expertise

Code group	Code	*Grounded quotations*	Occupation
Expertise of TU Delft researchers: technical competence	Er – 1: Have a wide range of capabilities the technical expertise	"they've got the technical expertise, they definitely have a wide range of capabilities."	CC Engineer
	Er – 2: Have the technical expertise to make things happen	*"*I think his idea is brilliant. I think they got the technical expertise to actually make it happen. So they're very appealing to me. They work very fast as well. Yeah, I like the way they design the designs are very efficient, not overly complicated.*"* *"*I think someone like I said, like someone like Tim's group, because they're really proactive. They look for opportunities to look for solutions. They work they the fastest workers we've seen from all our universities so far and they look for…you know, realistic solution, not something that's going to cost, you know, a million euros to make unrealistic solution*"*	CC Engineer
Expertise of company: with knowledge on fabrication and commercialisation	Ec – 1: Make prototypes efficiently within fabrication limitations	"So I need to make sure that we can make prototypes using only what we have access to, because it's very limited. And make sure that that the prototypes will reflect what the end product will be. So…so like, you know, like usually you…like the big companies, they would like design and start like a manufacturing process. They already know what the end product is going to be. So their prototyping phases can be really expensive."	ETC Engineer
	Ec – 2: Make sure there's a viable product that can be commercialized in the ecosystem	*"*primarily from my point of view, I'm…two things want to make sure that clinically it's effective, by using all experience with, you know, previous techniques, previous instruments and comparing it to what's out there already, understanding the engineering	CC Engineer

		of it so that we can make a good assessment of what they call it effective and then also from a commercial point of view, looking at each…each stage of the process to see how much risk there is, and really there is a commercial benefit. And whether…whether it fits well within what's really on the offering. Sometimes you have a single instrument that is brilliant, but it needs an entire ecosystem to work.*"* *"*my role is to look at merging the engineering side and the chemical side, make sure there's a viable product at the end of the day that we can commercialize.*"* *"*taking it to production is also a very big step. […] It's a very big step, and then making sure that it gets all the regulatory approvals etc. That's another big step. But really, we'd like to confirm those two things. And then the third thing is making sure that we understand the whole ecosystem that the component will need to actually work.*"*	
Expertise of surgeons: clinical experience	Es – 1: Provide hands-on experience to make sure new technology is clinically effective	*"So we really have to, like have a close ear to the surgeon needs which is like the user needs and like translate that into how we want to move the technology forward."*	ETC Engineer
		"I have a lot of experience, hands-on experience with also with training, training…trainees, residents in surgery, residents in general…general medicine and we call huisarts, so GPs. So I have a broad experience in the day to day workings of laparoscopic surgery…surgery in general." "So, you know, we talk a lot and then we throw ideas at each other and both times we have brought Tim about something which he is developed or is trying to develop or as in his head. And then we try to figure out how to make that more practical thing or try to find out if we can test it or what is the best way to use it or alter it or so to learn from a discussion about the products he designs and works with." "there's an idea develops from a really good technical idea to with the input from the clinicians and clinical ideas develops to extremely good clinical thing or material whatever. Because of this collaboration, you know, when you put two minds together, focus on one thing, it always brings out more."	Surgeon

Network: Perspectives on operation

Under the network of perspectives on operation, there are 3 themes concerning the perspectives of interviewees on the operation of collaboration.

Theme: Perspective on project level (Pop)

In this theme, code groups concerning the perspectives on a successful collaborative project were categorised. There were 6 code groups in this theme, each described one requirement or suggestion from interviewees on the collaboration in a project level, including there should be matched interests but without conflicts of interest, the need of agreement before collaboration, the need of interaction with users, knowledgeability in the collaborative ecosystem and the definition of desirable results. The grounded quotations of the codes and corresponding code groups in this theme can be found in Table A3 below.

Pop 1: Matched interest

There was one code under this code group, which is "Pop 1 : All partners have sufficient matched interests on research line of sustainable surgery". This opinion was shared by multiple interviewees, and was considered as the foundation of the collaboration. In this case, the common interest of participants is on the research line of sustainable surgery, specifically, design medical devices to make surgery more efficient and sustainable. The interest on sustainable surgery was built on the mindset of circular economy, which emphasise that the current linear process of fabrication and consumption of medical devices needs to be changed. The joint interest was the source of motive force to work together, and also the generator of new project ideas, according to the innovation manager of Medical Delta and the lab coordinator.

Pop 2: Separate interest

There was one code in this code group, which is "Pop 2: There should be a clear separation between research and commercial activities to avoid conflicts". There was intrinsic difference between the objectives of companies and academic institutions. The former pursued commercialisation and transferred the academic knowledge into industry, while the latter emphasise on the scientific research and the generation of new knowledge. The collaboration with all kinds of different partners allowed the academic research becoming more commercial and increasing the viability of academic results in the industrial ecosystem. However, the main attention of university participants should be paid on the academic researches and there should be a clear separation between research and commercialisation, according to the requirements of TU Delft.

This code indicated the one of the current distractions, the conflicts of interest. There already were participants who were motivated to join the collaboration, but were distracted by the conflicts of interest. Multiple interviewees agreed that there should be an explicitly defined separation of interest to avoid the conflicts of interest. And this led to the main information of next code group, the need of an agreement.

Pop 3: Need agreement beforehand

All the interviewees agreed on that there should be a well-defined agreement at the start of collaboration. This is the main subject of the code group Pop3: Need agreement beforehand. There were two codes in this code group, one emphasised on the importance of discussion potential input and output beforehand, and the other one addressed on the variety and flexibility of input and output.

The first code in this group was “Pop 3 – 1: Agreement on input and output should be defined well beforehand”. Based on interviewees, the agreement must define clearly at least four basic structural questions: what input is necessary for the collaboration, which input will be brought by whom, what will be the potential output and which output belong to whom. The answers were the results of discussion and should be accepted by each partner before actual working together. Otherwise, the situation would be more difficult, as said by the lab coordinator: “You have to start a discussion and the solution is already on the table, and then it's more difficult.” Meanwhile, if the gain from the collaboration could be defined explicitly, the enthusiasm may increase, according to one interviewee.

The other code in this group was “Pop 3 – 2: Input and output can be various form and need to be equal from all partners”. Interviewees thought that it is important to have equal input from all the partners. Yet the input can be in various kinds, for example, can be sponsorship, but can also be knowledge providing. This variety also applied in the form of output. Both the potential and various forms of input and output should be explored and defined in the conversations with different partners.

Pop 4: Interaction with surgeons

There was one code this code group, which was “Pop 4: You need constant contact with surgeons and help them understand to make sure decisions in design are still viable”. The code of “GP 1 – 1: Good relationship with users results in not too risky research for companies” mentioned previously addressed the importance involving surgeons in research. While this code concerned the practical interaction with surgeons, in order to optimally utilise clinical expertise in the decision-making of design. The interaction between the surgeon and lab coordinator, according to the interviews, was active and frequent brainstorms on the clinical feasibility of technical ideas. During their discussion, both of them utilised their expertise to “mould it [the technical idea] back to the reality”. So that the idea would in the end become a nice technical invention. According to the engineer from a customer company, constant contact with surgeon was vital “in order to make sure that those decisions you’ve made are still viable”. Especially the constant contact meant reminding on existing decisions, which could be in various communication manners, for example, a concise summary, infographic text for each major decision point. In the development of new instrument, the opinion of surgeons took up also a big portion in decision-making. Thus, during the interaction, the engineers should show both the technical possibility and impossibility to help surgeons better understand the situation. So that the surgeons can provide more realistic opinions which reduced the risk in the process of new product development.

Pop5: Knowledgeability

The concept of knowledgeability manifests the insights of participants into the social expectation of the values of practices in the landscape, as elaborated in the previous section (Wenger-trayner & Hutchinson, 2014). These insights come from not only the understanding on their own possibility and limitation in the living lab landscape, but also the understanding on the possibility and limitation of other participants. So that the actors would know why and when they should collaborate with whom on what. The importance of knowledgeability was also addressed in the interviews. Interviewees acknowledged that they should obtain the understanding of each other’s objectives and potential position in the collaboration, which became the first code in this code group: Pop 5 – 1: Actors should know what's important for each other and for together.

Interviewee regarded that it showed respect to understand the workflow and aim of your partner before seeking collaboration. Understanding and trying to make benefit of the difference were good for the collaboration. And being familiar with the workflow and objectives of your partners was also an advantage of collaboration. Vice versa, everyone should also help others to understand why certain things were important and necessary to me. Only when everyone expressed explicitly their own organisational

expectation on this collaboration and understand each other's goal, they could later define a cooperative goal of the collaboration where allowed the realisation of each other's individual goal. And from the cooperative goal the project idea generated. When every participant understood what's important for each other, they had a better picture on if there was sufficient joint interest for working together and what was the joint interest. At the end of the process, participants knew each other's position in the collaboration, so that they could work strongly together to realise their goals.

The second code in this group was "Pop 5 – 2: Difference in working ways are easily addressed". Knowing the difference between partners and ourselves and actively to addressing the difference was also an important aspect of knowledgeability. During the interviews, interviewees indeed noticed some difference in the working ways between universities and companies. For example, the larger an organisation was, the longer process and more procedure a decision took. Thus, companies were slow down by the red tape compared with academic institutions. While researchers in universities tended to be more informal in the meetings and worked faster. However, many interviewees regarded that this difference was easily addressed, and in their current collaboration, nothing stood out.

Pop 6: Desirable results

During the interviews, interviewees also elaborated their perspectives on desirable results of the collaboration. The answers were summarised in this code group, as the code "Pop 6: Viable decision are made clinically, engineering and commercially". In the collaboration with researchers from technological university, engineer from companies and surgeons as user, the optimal decision was made clinically, engineering and commercially. The clinical element was usually insights of a broadly perceived issue in surgery, according to innovation manager. The engineering element was the technical expertise that can really solve the problem (Er - 1), and the commercial element was the holistic perspective on the process of knowledge transferring to industry (Ec - 1). With the input from these three elements, the decision was more viable in the later commercialised process. In short, looking at all the three elements led to a viable product in the end.

Table A3 List of code groups, code and corresponding quotation in the theme of Perspective on project level (Pop)

Code group	Code	*Grounded quotations*	Occupation
Pop 1: Matched interest	PoP 1: All partners have sufficient matched interests on sustainable surgery research line	*"*that's ideal. So they have to come with a question that I can turn into, let's say, into a project very easily. That within the knowledge field that I have.*"* *"*So that happens often and because a surgeon with a problem, it is not necessarily beneficial for the large industry to do something with it because it only costs time and effort to develop it. And for an academia like me, I mean to biomechanical engineering and medical devices. Yeah, it's interesting to develop something new or for example, for my PhDs. It's interesting to develop something, and then to publish about it. So sometimes, you know, we say yes, okay, interesting, let's do something.*"*	Lab coordinator

		"Involvement in this network and all of the partners realize that for the future things have to be changed. We can not consume products, buy them, use them, throw them away. You have to buy them, use them and reuse them, which is the circular economy. […] We have to go from linear to circular. And companies like Johnson and Johnson they already…from out of the States, United States already put it in their vision to become more sustainable. Of course for these kind of companies, it's also competitive edge. If they do this, they will have an advantage over their competitors. But it's also built up out of intrinsic motivation. Something has to be done. "	PhD researcher
		"you have to take time for that. Because it's important for each of the partners to be aware of what's important for the other partner because then you understand each other and then you can understand well now, there is a project idea. And I can understand it's in interesting for the whole consortium as a whole, or is primarily interesting for me and only for small part, for the all the partner should be aware of that. I used to discuss about it. And if there's interest, there should be sufficient joint interest for working together."	Innovation manager
Pop 2: Separate interest	PoP 2: There should be a clear separation between research and commercial activities to avoid conflicts	"So, the problems are not that there are no partners, that there is no interest but it is distraction that is now the main problem. So how can we create a living lab that allows real collaboration between all kinds of different partners and allows it to be a little bit more commercial than an academic university is. Without all those conflicts of interest." "There are very commercial entities working together with academics that cannot facilitate any Yeah, let's say they're not allowed to support any activity that leads to commercialization. So huge, uh yeah, set of conflict of interest. Let's say, issues around conflict of interest."	Lab coordinator
		"*[…]* an innovation hub, I think that's a better…better description because we don't want to commercialize too much. We had the discussion earlier to TU Delft, there should be a clear separation between research and the commercial activity."	PhD researcher
		"we already have something new that we are doing. And, and it's even though we do some publications. That's not the main focus. So it's more about like trying to…yeah it's really just moving like PhD and master thesis knowledge to the industry." "we are interested in, in new technology and like to see if there is a market for something. And if	ETC Engineer

		something can be transferred from academia to industry, yeah, that's the role we see us in.”	
Pop 3: Need agreement beforehand	PoP 3 -1: Agreement on input and output should be defined well beforehand	“And then I have some questions. Are you willing to, to, to give us all the files to work on? Let's say all the technical drawings. So And what about IP issues? So those are a little bit the standard session, if you start a project and new IP comes out, we need to have format uh typically, let's say we have a format to deal with that. Are they willing to accept that? And also, are they willing to free up some expertise, some people there within the companies to support this project? This question should be answered with a yes.” “But at least now there's nothing and now it's everything is under discussion, and you have to start a discussion and the solution is already on the table, and then it's more difficult.” “Because there was no, before we started this, there are no good regulations for it. If I just say…yeah it is a just bachelor group and we have an external that came from the problem, then, and then the better bachelor group works at the external and then the other IP is for them. Yeah, in this case, it is a partner that works in the living lab. Let's say. They already activated us. I also worked there a lot. There's a lot of interaction with me and actually, some of the solutions are came from myself. And then of course, the bachelor group they were executing it, yeah that changes it a little bit. So I have no idea in a practical way, what is best? If I just let them have the IP and that…yeah they are allowed to patent it for themselves. Or that I go back to my…let's say, my department and tell them to apply for this patent, under their name and then make them do with them. Yeah. I don't know.”	Lab coordinator
		“I think all these contracts are always going to be quite like I mean yeah, they can have like the…all the kind of same structure more like the all these like same things that they have to talk about beforehand. Result would be different for each project.” “And usually what happens like so he is…he was a PhD student and, of course University has some agreements with the company etc. So, up to him, it's more of…it's more of an issue with contracts and lawyers, like agree-on. So it's a, it can be a tricky situation if you don't talk about it in the beginning. Yeah.”	ETC Engineer

		*"*But I think if such a living lab should establish them, it's very important to make an agreement with all the parties, the parties and for them to sign upon the agreements we make with regard to patents, intellectual property, but also, until which point we considered the research and from which point we say it's now up to the company to use it commercially. And that's something really it brought me already in some discussions before. The only way to attack this is to make a good agreement.*"*	PhD researcher
		*"*well what each of your individual objectives? How do you match together? And what is a joint and if you see there is a joint, what are you prepared to invest in it? Only in hours but also in facilities and money and well, and also how do you share the results that will be the end of it. Because that's what you should put into it. You want also something out of it? What is it that comes out of it? It's not only intellectual property or money from companies that come with a project and pay for it, but might also be communication, might also be excellent students. All can be all kinds of results. Yeah. And you should define them. And you should say, well, each of the partners is interested in that kind of results. And we agree together, how we share the results. And that should be written down in a consortium agreement.*"*	Innovation manager
		*"*So it's very important that you explicitly, or make explicit the gain you get from the working together and then probably the enthusiasm will increase.*"*	Surgeon
	PoP 3 - 2: Input and output can be various form and need to be equal from all partners	*"*I think that participation, first of all the partnership isn't necessary, but I'm sure that they will participate. And there should be an equal input from all of the partners. That can be in any kind, but it can also be sponsorship, but it also can be providing knowledge. So one of the three and we only, we only need different four different parties, which are the government authorities and medical industry., hospitals and TU Delft.*"*	PhD researcher
		*"*What is it that comes out of it? It's not only intellectual property or money from companies that come with a project and pay for it, but might also be communication, might also be excellent students. All can be all kinds of results. Yeah. And you should define them.*"*	Innovation manager
Pop 4: Interaction with surgeons	PoP 4: You need constant contact with surgeons and help them	*"*I try to…to…to…to guide him or, or the team…or try to guide them in the right direction, or to moulded the idea a little bit so that it becomes a nice, nice invention for the clinic. So, at the moment, we're working on a system where there is moving plateau on which we do technical	Surgeon

	understand to make sure decisions in design are still viable	exercises or exercise…laparoscopic exercises. And they started all with the plateau moving very fast and in very awkward directions. And then I told them but in clinic…in real life that is always a very small movement and not very awkward. And then they scaled it down and now it's clinically it's very interesting. It's an interesting thing. So the idea was good and we had to mould it back to the reality now, it's a very nice technical invention.” “it's very hard to convince him that something which he has thought about a long, long time is not gonna work in practice, you know, when you when you have a very bright idea technically it's probably a bright idea but if it doesn't work in practice, and then you don't have anything…”	
		“Yes, and it's really important because whole projects are quite long, you know, anywhere from 3 to 10 years, in that time, surgeons may change their mind, they use a requirement may change. So you have to make sure you're in constant contact to make sure that those decisions you've made are still viable, uh, still hold true.” “So getting surgeon communication is vital. And also…also not just to make sure that you are hitting the right target, but also, we found that with…with our surgeon group, they, they need constant reminding on decisions that have already been taken. They tend to either re-debate an existing decision that's already been made, or they just forgot that they made that decision, and they go for something entirely different.”	CC Engineer
		“So getting surgeon communication is vital. And also…also not just to make sure that you are hitting the right target, but also, we found that with…with our surgeon group, they, they need constant reminding on decisions that have already been taken. They tend to either re-debate an existing decision that's already been made, or they just forgot that they made that decision, and they go for something entirely different.” “whenever you make a decision, really exploring things, you have to both show them what's possible, but also you have to show them what's not possible because a lot of the time, they can say, oh, just do this, just do that. But it takes an enormous amount of effort. And, you know, not only will it delay timelines and costs, but you don't…you don't know if it's great, actually, but they'll be so much risk in your process. And, yeah, so we have to, we have to show them what's possible to make it realistic.”	

Pop5: Knowledgeability	PoP 5 - 1: Actors should know what's important for each other and for together	*"*Yeah, again, it is all about respect. So those people, they know what you're doing, that's why they approach you. And yeah, and then of course, they experienced that you're working…uh, your workflow and your aim is different from theirs. And then, yeah, it is very nice if they try to understand it, and they try to benefit from that instead of starting making issue out of it*"* *"*you also have to translate it and you have to explain to each partners why it is necessary that they start talking and collaborating with each other.*"* *"*Yeah people in [customer company] they know how surgeons think and what they are doing and…I am in between because…I…those people already…they know, yeah, they know what to deal with those people. That's no problem.*"*	Lab coordinator
		*"*Then you should arrange project agreement, where you say, well, within this project, we…each of the partners has this goal. We have our org… private organizational goals. You should define that and we have a cooperation goal and you will define that and you agree on, well, each organization brings in this amount of people, this amount of hours this amount of money for cooperation.*"* *"*They say oh, we are going to work together. Okay, forget about what's important for each of you. Rather you as organization can have to back up of your management. Because if there are new ideas are arriving, arising. You can easily say, well this is…this really fits our cooperation, we put our energy on this. Or, no, this doesn't fit our objectives. We can't put energy on it. So it's important to know, well, **what's important for each of the organizations individual and together.***"* *"*you have to take time for that. Because it's important for each of the partners to be aware of what's important for the other partner because then you understand each other and then you can understand well now, there is a project idea. And I can understand it's in interesting for the whole consortium as a whole, or is primarily interesting for me and only for small part, for the all the partner should be aware of that. I used to discuss about it. And if there's interest, there should be sufficient joint interest for working together.*"* *"*You want to work together, strongly together. We know what we want to achieve together. We know each other's positions, and we know together we are strong. Yeah. And that's what you	Innovation manager

		need to define. And that's this process.”	
	Pop 5 - 2: Difference in working ways are easily addressed	“…if a comp…organization is large…becomes larger, that it takes longer time to get decisions from the organization.”	PhD researcher
		“we always have a lot more procedures to follow. We need a lot more approvals, a lot more permission for every single step of the way.” “So yeah, I think businesses are a lot more cautious from a legal point of view from the sharing of data point of view. So that slows us down a lot.” “they seem to be a lot more informal. So they more like to say a chat. That is good in a way. But we're not used to that…we in…in business we like to try a design meeting especially amongst the main guys the main parties will always have minutes always have a chair and have an agenda so that when you go back, you can pick up what decisions were made when they were made who…who made the decisions, I think that’s…we're in slightly difference and it's easily addressed for that…yeah universities seem to a bit more informal.” “that’s…we're in slightly difference and it's easily addressed for that…”	CC Engineer
Pop 6: Desirable results	PoP 6: Viable decision are made clinically, engineering and commercially	“…in terms of the clinical knowledge, you know, like what the, what the medical side or medical effect of devices. They are experts but like you say they're not always aware of say, different manufacturing techniques, well, limitations of manufacturing techniques and you know, different materials that are available, etc. Or things I don't…so they do need, guiding in that sense. And we…one of the big mistakes we've made, in hindsight is we leave the entire decision to the surgeons, the only one component of the decision. Decision is part-clinical, part-engineering, commercial. Look at all three aspects to make sure that you have a viable product.”	CC Engineer
		“impact should be societal and economic, really be impact on the end user, patient and or caregiver. And not for only one or two problems for people, but a broader range, really be a broadly perceived issue.”	Innovation manager

Theme: Perspective on a field lab consortium (Poc)

In this theme, code groups concerning the perspectives of upgrading the collaboration on project level into forming a consortium with all the partners. There was only one code group in this theme, with the name as “A field lab: Transferring knowledge from academia to industry”. The elaboration on the concept of consortium was based on the interviews on lab coordinator and innovation manager, while other interviewees also expressed similar ideas on the structure of consortium. The concept of consortium would be elaborated later under the code group section. The grounded quotations of the codes and the corresponding code group in this theme can be found in Table A4 below.

A field lab: Transferring knowledge from academia to industry

The definition of the consortium, a field lab, was given by the innovation manager during the interview. The main purpose of the consortium was to facilitate the knowledge transferring from academic to commercially mature products which can actually benefit the society. The consortium consisted of three main components, knowledge institutions, suppliers of enabling technology and customer companies (Figure A1), and the explanation of their respective roles and relations can be found under the code description later. The definition and structure of field lab, three roles of three components in a field lab together became four codes in this code group.

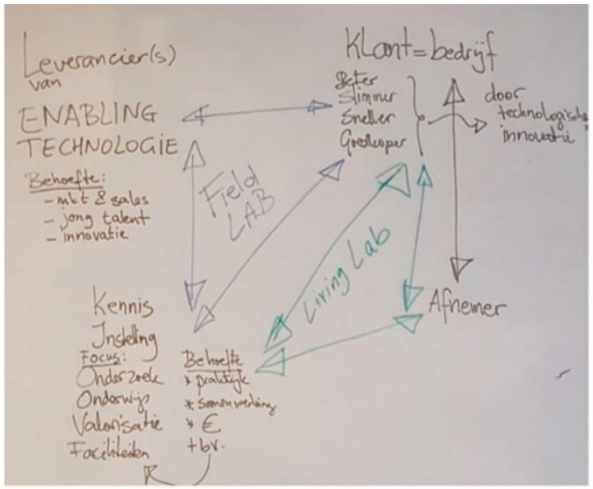


Figure A1 Illustration of a field lab setting in the healthcare section

The first code in this code group was “PoC - 1: A field lab: from a project to consortium”. According to lab coordinator, the consortium would be set up with academics and non-academics partners to together find a solution for problems of interest. Usually the problems came from the clients, which were big medical customer companies. The consortium should also become an autonomous entity, which was backed up by the dean, but have the freedom to start project with industries. Usually, a consortium should start with a cooperation project, according to innovation manager.

The second code was “PoC - 2: The role of knowledge institute: research, education, valorisation”. The knowledge institutes were universities, or the university medical centres, which focus on research, education, valorisation as bringing knowledge to society. They had certain facilities to realise their function. In the biomedical or biomechanical field,

if researcher wanted to do good research, on one hand, they need to know more about the daily practice of healthcare practitioners. Thus, they needed to collaborate with surgeons. On the other hand, as mentioned above, doing good researches also needed money and facilities. For researcher in academic institute, they had ideas on new projects, but "in the end, you need to have the money and the facilities to make it happen", and those were the input brought by various company partners, for example, customer companies and suppliers of enabling technology. As a result, researchers also need to collaborate closely with companies in a field lab.

The third code was "PoC - 3: Companies of enabling technologies are good at bring new innovations to market". Enabling technology were equipment and/or methodology with associated technologies that provides means to radical innovation and performance and capabilities of the user(*What is enabling technology? definition and meaning*, n.d.). In short, according to the innovation manager, "Enabling technology is technology that makes something possible". The suppliers of enabling technology were often companies, which have certain technology or solutions that can be applied in production. And these companies wanted to bring their knowledge from academic into the markets and they were good at doing so, through offering solutions to other companies, which usually were bigger customer companies. The latter might either buy out the license or integrate into their product line. The companies of enabling technology, firstly they needed professionals in marketing and sales, who helped the companies to sale their solutions to other companies. Meanwhile, they also had enormous demand on young talents and innovation (Figure ??), which can be obtained from the collaboration with knowledge institutions.

The fourth code was "PoC - 4: Customer companies: provide technological innovation to users". Customer companies were usually bigger companies which directly develop new solutions or products to end users. These companies were the clients in this field lab network. Customer companies worked with companies of enabling technology because the latter had really adapted the enabling technology to the specific needs that customer companies had for their customers. Through the collaboration with enabling technology companies and universities, the customer companies can directly adopt the knowledge and technology for their product development. Through this way, they could improve their product portfolio of interest in a better, smarter cheaper and faster manner. In return, customer companies usually have abundant innovation budget, which nurtured the companies of enabling technology and loosen dependency of knowledge institutions merely on grants.

Table A4 List of code groups, code and corresponding quotation in the theme of Perspective on a field lab consortium (Poc)

Code group	Code	*Grounded quotations*	Occupation
A field lab: Transferring knowledge from academia to industry	PoC - 1: A field lab: from a project to consortium	*"*So, if you create a consortium with academics, non-academics, and you want to be of interest for the partners that are trying to uh… for the clients let's say, the companies would like to try, would like to find a solution for the problem.*"* *"*So what we need, we need an entity that can just use work on itself and has the…it is the existence of this entity, this living lab is basically backed up by the dean, and they allow us to with our academic knowledge to help industry to make better products.*"*	Lab coordinator

		"what we believe is that they should…the cooperation to a consortium should start with a cooperation project."	Innovation manager
	PoC - 2: The role of knowledge institute: research, education, valorisation	"Here on the left bottom is the knowledge institutes, the university or the University Medical Center, focus on research, onderzoek. And education, onderwijs, and then valorisation, so bringing knowledge to society and they have certain facilities. So they can…And what they need, to do good research as they need the…they need to know more about day to day practice of, for example, a hospital or a doctor. They want to cooperate with companies and doctors. And of course they need money to do the research. So that's here is the research organization."	Innovation manager
		"You can talk about making a project and create something new but yeah, in the end, you need to have the money and the facilities to make it happen."	Lab coordinator
	PoC - 3: Companies of enabling technologies are good at bring new innovations to market	"And then above here are suppliers of **enabling technology**. And in this, I think Van Straten Medical, so these are often companies. And they have kind of enabling technology. For example, you can say, well, you're robotics companies that have robotic solutions, for example, for warehouse applications, or robotic solutions for production…production application or like Van Straten Medical, they have solutions for reuse of medical instrumentation, cleaning or reuse. That's they have that kind of technology." "Enabling technology is technology that makes something possible. So that's a technology. For example, a company that is a specialist in robotics solutions. And that robotic solutions, that robotic technology enables you to transfer your production from done by people. Enable it to be done by a robot." "these are companies and they want to bring their knowledge into the markets and they are good to bring new innovations into the market because they offer a real…they have…they offer solutions to other companies. Yeah. So they…that are companies of enabling technologies."	Innovation manager
		"So the end phase is to have a design ready to go through CE certification. We're not sure if we would go through CE certification yet…yet or just have all the documents ready in the design, like semi approved with our consultants. That's what we see. Because then…then at that point, then it	ETC Engineer

		becomes interesting for uh…bigger industry players who might want to either buy out the license or integrate into their product line.”	
	PoC - 4: Customer companies: provide technological innovation to users	“And then there are a lot of companies, they say, well, we develop e-health solution. And we make use of a Google application or Google as enabling technology supplier. But we develop a special Google application for home care. So a home care organization here as an end user organization. They say well, we buy this home care ICT solution from this start-up or this could be company. And okay, they use Google but we don't work with Google we work with this company because they really have adapted the enabling technology to the special needs that I have as an end user organization. And then what you see is if you have a living lab, you see effect more here, where the living lab is designed to have the university partner here.” “so they’re also often companies, and they say they are often…yeah…in our…in the field of healthcare. They say, well, we really developed a new solution for you as a doctor, or as a hospital. For example, they develop…you could say enabling technology might be ICT company, they deliver ICT solutions. ” “I see also lab right here, TU Delft, but also LUMC, as a research…university hospital, as a research organization, they are…they deliver the knowledge, they work together with [name of a company of enabling technology]. They delivery enabling technology on sustainable solutions and sustainable technology. And they do that for, for example, Johnson and Johnson, for Philips, for all kinds of companies, Biomed, who will want to have a more sustainable product portfolio” “You can have a proposition for companies who want to innovate and they have an innovation budget. They are your reach closer. You should develop proposition that’s much closer the direct innovation needs of the company, and you are not so dependent on the grant application.”	Innovation manager

Theme: Good Partners

The second theme is the definition of good partners. During the interview, questions concerning the definition of meaningful partners were asked. The recognition of each other as a good partner with whom interviewees would like to collaboration is also an important element to initiate the collaboration. In this theme, there are two types of good partners: who allow cutting-edge research to be viable in industry and who have sufficient willingness to engage. The grounded quotations of the related codes can be

found in the Table A5 below.

Good partner 1: who allow cutting-edge research to be viable in industry

There were two codes in this group, the first one was “GP 1 - 1: Good relationship with users results in not too risky research for companies”. This definition was mostly from the point of view of companies. The reason of companies’ willingness to collaborate with certain academic lab was that their researches were cutting-edge but not too risky for commercialisation, so that when the researches graduated from universities, they can be easily taken over by industries. The most important prerequisite of these desirable researches is the early involvement of users in research, in this case, is the frequent exchange with surgeons. This increased the likelihood of the academic knowledge being transferred into industrial ecosystem. In short, in the point of view of companies, the good academic partners were who can provide commercially realistic solutions to their technical problems.

The second code in this group was “GP 1 - 2: Companies want academic partners have certain market knowledge while focusing on academic research”. There was a blurry but certainly existing line between the academic research and further development in industries in order to avoid conflicts of interest. Companies would like academic researchers to equip with knowledge on manufacturing, application and be close to users, so that researchers can come up with feasible solutions for companies. Yet companies don’t want professors to involve too much market researches.

Good partner 2: who have sufficient willingness to engage

Almost all the interviewees emphasized the importance of bringing time and effort to work synchronously and make things really happen. There were three codes under this group with a common subject, which is the sufficient willingness to engage.

The first code in this group was “GP 2 - 1: Open door to share facilities”. This is a crucial element for the collaboration of this case study because test capabilities for both partners can be greatly extended by sharing different facilities. Sharing infrastructure was a strategy that can really bring benefits to all the partners and could generate more generalised researches.

The other code in this group was “GP 2 - 2: Spend time and effort to work on the same level to really make things happen”. A project can only be done when partners really start actively engaging in it and everyone made sure things were actually done. And the latter goal can only be realised when partners were sincerely willing to spend time and effort in a project. Specifically, the academic researchers and engineers from companies who were both involved in one project should have sufficient communication to update their respective progress to work synchronously.

Table A5 List of code groups, code and corresponding quotation in the theme of good partners

Code group	Code	*Grounded quotations*	Occupation

Good partner 1: who allow cutting-edge research to be viable in industry	GP 1 - 1: Good relationship with users results in not too risky research for companies	*"*But in Tim's case, because he does have, like he has good relationship with these people. And he usually like already has that in mind. So he's doing things that are publications and it is new technology, it's cutting edge, but nothing like we would say like to risky.*"* *"*So, yes, like the university is supposed to do like concepts and really cutting technology but when the…when it graduates and goes to like an industry partner or moves away from the university ecosphere, it has to be viable. Like it has to be at least like tested that it's…it's an idea that can work and something that can be made and used. And and…and like also like with current technology.*"*	ETC Engineer
		*"*I think someone like I said, like someone like Tim's group, because they're really proactive. They look for opportunities to look for solutions. They work they the fastest workers we've seen from all our universities so far and they look for…you know, realistic solution, not something that's going to cost, you know, a million euros to make unrealistic solution." *"*they've already got good ties with the clinical guy, so they already know the surgeon. So that makes life easier as well*"*	CC Engineer
	GP 1 - 2: Companies want academic partners have certain market knowledge while focusing on academic research	*"*it's blurry because you don't want the professors to do market research or, or like something like that. But you also want them to a little bit, you know, think about it.*"* *"*Because Tim is quite unique in that he already thinks about these things a lot. Most of the stuff he does is already really feasible and, and he has knowledge on manufacturing and application so he can kind of see if…if he's making something that just doesn't make any sense.*"*	ETC Engineer
Good partner 2: who have sufficient willingness to engage	GP 2 - 1: Open door to share facilities	"Not only discussion, but also they're willing to open their doors. And that you really can use the partner as an extension of your living lab. Yeah, I think that's crucial because it, uh, I can only define that now very well because I have some of the companies that work like that. So what happened with the test facilities that we built in another location at the partner, those companies were able to open the doors are able to say: Okay, we give you a room. You can build up your test locations. One of the guys are even doing a PhD with me now. So they work on an academic level. And they're not only in it for branding."	Lab coordinator

		*"*I think it's also really important to think about like the infrastructure. So, so like to make it all work out. Like the PhD students. They have access to the labs at TU Delft. And the industry usually has some different kind of labs. So I think, like in the future, it would be nice to see more like collaboration of like sharing the…like infrastructure, both machinery, testing labs and equipment. Because I think that could open up the doors to just more generalised research.*"*	ETC Engineer
	GP 2 - 2: Spend time and effort to work on the same level to really make things happen	*"*it only can be done if you really start the project and you really be active in it and really make sure that things are being done.*"* *"*That's the partner that is uh, really willing to spend time and effort in a project, so not the partner that only wants to put TU Delft logo in their website, but it is one that is willing to Yeah, to also help you in writing the proposal that will also be execution, uh do the execution of some part of the work so that they work on the same level as you are.*"*	Lab coordinator
		*"*But I think it's important to also see that, like, usually there's a PhD student working on a project and then on some engineer who works at the company, and they have to speak very often. So they are the ones who have to collaborate to make sure that that everything is being done at the same time.*"* "And then usually, one of the engineers from the company would come visit the University at least once a month. Oh, but it depends on the project. I mean, this is always…is always an ongoing conversation how it's best to, you know, stay in communications and work, you know, through a distance."	ETC Engineer
		*"*I think communication is a big one. It's really important, especially when communicating with surgeons. And even internally in our, in our design groups, like, Tim as his design group of maybe 10, 12 people. We have, to me, I've got 15, 20 people. Making sure everybody's on the same page, it's very difficult.*"*	CC Engineer
		"that meaningful would be that we both benefit from the partnership that also creates more than we put it. Like, one and one becomes three, you know."	Surgeon

Appendix D - Protocol of co-design session

Participants: Stakeholders of the case study, communication professionals

Setting of the co-design session: Author of this thesis, one or two experts from practice side or communication side.

Procedure:

Part 1: Introduction & Presentation of research results (15 minutes)

The purpose of today is to design a concept of the intervention by using a morphological chart. I will guide the session. First, I would like to present my interpretation of the interviews and consequential critical node and problem statement. For my thesis, I look into how can the social learning theory community of practice can facilitate the collaboration with various partners. After my presentation, please share to what extent do you agree with the critical node and the problem I identified.

Part 2: Fill in the action form

When analysing the interviews, I formulated the content-based design criteria of the intervention. The content-based design criteria generated from the combination of literature and interviews. They will be used as a guidance for the design process. In order to ease you to the situation, I describe a scenario with questions based on the design criteria, and you need to describe what actions you would take when you are facing this scenario. You are also required to imagine the potential barriers and challenges of the actions. The answers to the actions and barriers are written down in Action form.

Design criteria	Scenario questions	What's your action? (medical stuff)	Barriers and challenge of the action
The tool should encourage people make relevant assumptions about the group and others	What kind of assumption/ you would make before collaboration? What kind of assumption is relevant to the collaboration?		
The tool should help people develop realistic expectations of the different roles and expertise that exist in the group	You made some assumptions, you would like to know to what extend your assumption deviate from reality. What do you expect on the roles and expertise of other partners? What would you do to steer your expectation to the reality?		
The tool should initiate two-way conversations between participants in the group to learn about the relevant	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner.		

expertise of other participants			
the tool should support achieving alignment in the sweet spot of all the expertise, from engagement and imagination step	There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? Do you know why your partner think differently from you? And how do you deal with it?		
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?		
the tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?		

Appendix E – Notes and filled action forms

CO-DESIGN SESSION 1

Participant: Lab coordinator

Date: 2020/09/29

Design criteria	Scenario questions (medical stuff)	What's your action?	Barriers and challenge of the action
The tool should initiate two-way conversations between participants in the group to learn about the relevant expertise of other participants	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner.	Two scenarios: you are already in a project, not initial meeting. The first step is **dissection: because sometime they already bring a solution, but we need to go back to the bare problem,** make a dissection and explain from a technical point of view if is feasible within our network, and then see the feasibility by mutual discussion. We want to take a step back and see the problem. They think it would be helpful to already find a solution, but it actually would complicate the situation because they are not aware what's possible. You have to tweak to what's possible.	Challenge: **Convince them some technical knowledge about knowledge about the creative process is needed to do a good feasibility check, but it is not their piece of cake.** You have to convince them to learn some technology. Challenge: **Formulated everything in a way that people can relate to.** Tips: Keep it short and use picture and sketching. How to relate to people: because you know their working environment, and interests, so that you know how to relate your idea to theirs.
The tool should encourage people make assumptions about the group and others.	What kind of assumption you would make before collaboration? What kind of assumption is relevant to the collaboration?	**Activities of researchers you are dealing with.** Because researcher in a surgical field of industry of healthcare is doing totally different activities from researchers at TU. Partners have different priority in their daily activities, and that's also important. That directly lead to the assumption on how much freedom and time they can spend on new collaborations. So first you have to clarify your expectation. Important expectation includes the freedom to operate, the time that you have, the	The barrier is time-related, people would like to have a fast process. The challenge is to explain this development process always take a lot of time. (so again, to tweak their expectations) And the challenge is to clarify the process of device development, but still keep them interested and

		research that are available, and actually what is needed in order to use that resources. **The assumption is not about ideas, but more about all the resources that everyone can bring.** By looking for the information, they already see what is important for the collaboration.	work together. (42:07)
The tool should help people develop realistic expectations of the different roles and expertise that exist in the group	What's your expectations of the roles and expertise of other partners? Is that true? What would you do to steer your expectation to the reality? And you made some assumption, you would like to know to what extend your assumption deviate from reality.	There are several stages: at the beginning, **everyone should explain their own working process**, for example, for my role is to explain the existence of facilities, all the processes that needed to follow. The from the partners' side, they should give enough exposure about all the researches, people and stuff and availability from their side, which eventually are translated to planning. **Through conversation or portal website, with a list of questions about all the important expectations, we can create a standard common understanding before the first contact.** From my experience, this function should be addressed and finished in the first contact. **During a project, realistic expectation become topic related.** At this stage, **constant communication should address this change immediately, also when you think it has no implications. Because you cannot really assess what implication is in somebody else's field.** For example, a surgeon cannot foresee the implication of a change from my side of development. So then. It is extremely important that you start to communicate about this and to really check whether the original plan is still valid. Enhancing daily communication, and have a basic understanding about what's going to happen in a project. **So instead of working completely parallel, the surgeons need to understand that what his clinical input in the design process really means what it does.** Besides, communicate about the process of technology is also important. And one way to really educate the other field about the	Challenge: surgeons need to follow the process, you need to spend a lot of time in relationships. Tips: In the initial part of the project really explained that you're going to do this, to really learn you how process looks like. And therefore I need time from you, **during the process when milestones are reached, really to reflect on what is developed, and what it means for the project.** So that I can see whether they grab the idea of why it is so important that they understand every step of the development, because every little step somehow relates to risks into surgery or during use by the patient.

		design process, is by every time you reach a milestone, you show it to the surgeon, look at this, this is actually what I what I made. And this is what it can do. And because we have this in our hands, now, the following things needs to be addressed. Because if you do that, with every small milestone or development, basically you align his expectation of the step and his vision, do what actually is there on the table. The technology team takes the responsibility of showing every step in the design and development process, or the manufacturing or prototyping to the clinicians and to really ask them for what do you think of this part now? And you have to put it in the human body, what kind of concerns you receive? **Because you cannot expect the other way around.** Earlier, we also expected to search and really to ask this kind of questions or to really relate to the development and then in line of this search procedure, but that just doesn't happen doesn't work, as if you don't understand the context when a surgeon make decision, the this has no value of this decision. The surgeons only need to do it once correctly, then they learned the process, they also get a huge interest in actually this field, because if they start to learn, that only boosts their motivation.	
The tool should support achieving alignment within project from the sweet spot of engagement and imagination step	1. There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? 2. Do you know why your partner think differently from you? And how do you deal with it?	**For the engineers and teams, they really need to understand the surgical procedure. And they need to understand the team around it, and the logistics and everything. Spend time to understand other's point of view, to see the workplace of each other, check the ideas if really related to the clinical procedure within the context.** So if there's a technical decision to be made, that impacts how the products should function or should look like, then we really need to check what this means for the surgical procedure or for the functioning from within the physiological	Time need to elaborate in details, prioritise the time spend and how to divide the workload over the members

		system of the search of the patient. **Reflecting to the end goals and relating within the surgical and technical context** 2. Because there is no understanding of the of either surgical procedure in within the context or the development manufacturing process.	
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?	**Need to see the necessity of it, the first page should explain well why I need it.** And what you can accomplish with this tool. I need to know why this tool is essential. Then next page like a list or a form explains what is needed for the project. Mention good projects,	Keep short and appealing and informative **Successful story or technology everybody can related to**
The tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?	For external communication: an open portal for everybody to see whether a collaboration is possible with all this information. For internal communication: a closed portal and only relevant people can access. **Have a planning on the website, to see if every milestone is achieved and how development is going. And show and explain how the procedure is going.**	Make it interactive, invite other people to question and answer on it.

Feedback about the presentation:

- The supplement to the problem statement:

They are highly interested in the outcome, but not interested in the process of other disciplines (technology behind it), but become knowledgeable to the process is also important. So the in the practice, the knowledgeability means knowing the process of develop something, but they don't have to be competent in the development process. And one of the reasons to it, or another related problem is the lack of time and human resource to get the project move on, because these projects need extra effort besides their daily work.

The tool is about creating awareness and understanding, expectation management. As everybody is aware the capability of others, has realistic expectation of the project. And if partners do not align up with their expectations, the project would not work. That would save a lot of time and energy.

- How to let every participant understand the individual goals of each other, and then find a common ground to move on?

Ask the people to fill in a form at the initial meeting? That would be task of the co-design session.

- Imagination

Imagination drives the engagement?

I: Sort of, imagination serves as a guideline of engagement, prepare yourself to the potential difference and deal with it.

Tim and Bart: I think imagination is also the part bring partners together, then they go the process of engagement and alignment. But it starts with imagination, it's a certain gut feeling about what's possible, and then to see if it's feasible. Then the feasibility check is engagement and alignment.

- The relations between the three modes of identification

Tim: My gut feeling here is not a circle, but a spiral. You start with imagination and then you spiral around to alignment, basically to find the sweet spot, and in the end, you go towards your final goal in the middle.

CO-DESIGN SESSION 2

Participant: PhD candidate in Science Communication

Date: 2020/09/29

Design criteria	Scenario questions	What's your action? (medical staff)	Barriers and challenge of the action
The tool should initiate two-way conversations between participants in the group to learn about the relevant expertise of other participants	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner. (explain why I think in this way and they need to do the same)	Take a step back or go to a high level: what's our collaboration about? And regroup what's our higher goal to achieve? To see why are they thinking in this way, review argument of the design, let them see the reality	Personality (stubborn, take it personal) Bring the feedback in an open and comfortable way, being constructive of the feedback, less aggressive.
The tool should encourage people make assumptions about the group and others.	What kind of assumption/ you would make before collaboration? What kind of assumption is relevant to the collaboration? And you made some assumption, you would like to know to what extend your assumption deviate from reality.	Let them write down, for example a diary, on what do you expect from the collaboration, yourself and your partners? And after they use the tool, do an exit poll to see to what extent your expectation meet reality, and noted how your expectation evolved through after the tool.	Make sure they do it, need a nice format. Need to Use the assumption later on, otherwise people have forget to use and update their assumptions.
The tool should help people develop	What's your expectations of the roles and expertise of other		

realistic expectations(make assumption and check) of the different roles and expertise that exist in the group	partners? Is that true? What would you do to steer your expectation to the reality?		
the tool should support achieving alignment within project from the sweet spot of engagement and imagination step	There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? Do you know why your partner think differently from you? And how do you deal with it?	The two steps are the entry point of alignment. Open discussion, dialogue on expectation and goals. **Transparency in their individual goal, information, and high strategic goal. Trust building activities**	Define the sweet spot Who decide if the discussion is useful/going to a useful direction? It might last too long.
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?	Let me know what's the most important thing that I can make time for it, guide them at the first time, then they can guide themselves later on	To work with limited time
the tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?	Have reflection moment continuously, encourage people to think about daily, and discuss it, and become a habit, then the tool shows their changes	

Feedback about the presentation:

- Knowledgeability

It is about the participants in the sense that they know what their expertise is and why that's important. But it's also knowledgeability about shared decision making. So they also have to become knowledgeable about how do we make decisions together? Okay, take some more time but the end result may be better. But it as a facilitator can also backfire, that people had to spend time with each other, all of a sudden becomes a barrier, because they spend time with each other, but they found out that they're actually not on the same page at all.

- Imagination

About having a vision on where do you want to go? And it can also be how do you see your identity evolve? Imagination also has history, as what you have done projected to the future.

- The modulation of identification

These three modes can be three parameters of their behaviours or performance, can these become the indicators to assess their engagement, imagination and alignment performance.

CO-DESIGN SESSION 3

Participant: Master student in Science Communication

Date: 2020/10/01

Design criteria	Scenario questions	What's your action? (medical stuff)	Barriers and challenge of the action
The tool should encourage people make relevant assumptions about the group and others	What kind of assumption/ you would make before collaboration? What kind of assumption is relevant to the collaboration? And you made some assumption, you would like to know to what extend your assumption deviate from reality.	**How much I can rely on certain stakeholders?** If we make a task division, to what extent can I count on them to **fulfil the task**? This based on their **expertise and ambitions**	Social capital (relations built up in networking), bad experience may let me incline to not trust certain stakeholders
The tool should help people develop realistic expectations of the different roles and expertise that exist in the group	What's your expectations of the roles and expertise of other partners? Is that true? What would you do to steer your expectation to the reality?	I will base my expectation on their background and their working experience, the roles are expected to take are based on the resources they have. **In a kick-off meeting, in which everyone establishes the end goal of the project and the roles that are required to fulfil that goal. Everyone should explain what and why the other can rely on them**	Prejudice it is hard to tell everyone say the truth, lack of transparency (can be solved by more social capital in the group)
The tool should initiate two-way conversations between participants in the group to learn about the relevant expertise of other participants	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner. (explain why I think in this way and they need to do the same)	I **acknowledge** what's you need/requirement, then I will explain the design process and then my conclusion based on that. Explain the problems I see, and maybe suggest let's find a solution together. Respect their expertise first.	Challenge: To first not jump to the conclusion to deny their idea

the tool should support achieving alignment in the sweet spot of all the expertise, from engagement and imagination step	There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? Do you know why your partner think differently from you? And how do you deal with it?	Ask everyone, what's the most important thing you think needs to be taken care of. So per different perspective you know the priority. And then, because you have that on paper, you can try to align these priorities. It's important that the LL has mission and vision, because they would guide you to the sweet spot.	Maybe the stakeholder with most resources will take a dominant role here. Then the sweet spot would be out of balance.
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?	**The promise that the tool will make my work in LL more efficient. The tool will fit my daily activities, my current way of working.**	C: To use the tool on the long term, and fall back into my old habit.
the tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?	**Remind them, the knowledge that the other stakeholders use it too.** (Feel the obligation more, and the feeling that the tool is useful.)	It is an effort, it takes time, and take a while before you see the result. Keeping track of the result from using the tool

CO-DESIGN SESSION 4

Participant: Engineer from customer company

Date: 2020/20/06

Design criteria	Scenario questions	What's your action? (medical stuff)	Barriers and challenge of the action
The tool should encourage people make relevant assumptions about the group and others	What kind of assumption/ you would make before collaboration? What kind of assumption is relevant to the collaboration?	They experience, if they have any engineering background, (do they have knowledgeability), so you know what's the level they have. putting yourself in other users' shoes/ profile of end users, profile of the engineering group (do they have enough background to understand the clinical insight). So that you can know how to	When you don't have this background you can misinterpretation the requirement.

		explain to them.	
The tool should help people develop realistic expectations of the different roles and expertise that exist in the group	You made some assumptions, you would like to know to what extend your assumption deviate from reality. What do you expect on the roles and expertise of other partners? What would you do to steer your expectation to the reality?	We tend to think medical stuff Understand everything in the engineering world, but they don't. so we need to understand the boundary of their expertise. Even though they don't have certain engineering expertise, they can still be useful, as long as you ask question within their expertise boundary. Ask other surgeons (luxury that you have a large surgeon group to work with).	You don't have a wide range of surgeons with various expertise. When do you use this particular surgeon in particular life circle of the design (start phase: speak to people with plenty of experience, last phase: you don't have to speak to people with many experience)
The tool should initiate two-way conversations between participants in the group to learn about the relevant expertise of other participants	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner.	When you come with the concept, people would like to see the high level of detail, and they don't believe when you say that's impossible, they would like to see a proof. That's takes a lot of time. The trust of each other's expertise. Should Be open to be challenged. Keep a flexible mind	Challenge: take long to prove certain concept is not feasible, and distract you from your timeline. Barrier: give them a background, and more detail and the rational behind the concept. Open to the challenge.
the tool should support achieving alignment in the sweet spot of all the expertise, from engagement and imagination step	There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? Do you know why your partner think differently from you? And how do you deal with it?	Put a weighting behind each aspect. Which is depend on your budget. Have priority of each aspect. A certain constraint need to be respected or can be challenged. The risk assessment(medical, marketing, engineering), where you brainstorm all the potential risks, and give severity and occurrence weighting, and that guide your design a lot.	Risk assessment is very detail documents. Can have many conflicts. And then you have to a third part, like quality, manager, or technical design review.
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?	Very simple, introduce it at the early stage of the project. And let everyone agree the meaning of each steps in the circle.	

the tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?		

CO-DESIGN SESSION 5

Participant: Surgeon

Date: 2020/10/06

Design criteria	Scenario questions	What's your action? (medical staff)	Barriers and challenge of the action
The tool should encourage people make relevant assumptions about the group and others	What kind of assumption/ you would make before collaboration? What kind of assumption is relevant to the collaboration?	Clinical problem should be the central part to guide the discussion, it is hard to make assumption before you know each other, learn the background of people, what did they do before, what's their experience.	The expertise and knowledge of participants could be implicit,
The tool should help people develop realistic expectations of the different roles and expertise that exist in the group	You made some assumptions, you would like to know to what extend your assumption deviate from reality. What do you expect on the roles and expertise of other partners? What would you do to steer your expectation to the reality?	Get feedback to see if they understand, ask questions to explore where is the boundary of their expertise are. Keep validating if you are on the same page. Have a blame-free environment, so people can express their understanding without being blamed	Don't speak the same language, jargon,
The tool should initiate two-way conversations between participants in the group to learn about the relevant expertise of other participants	You are reviewing a bright idea of your partner, and contribute the perspective of your expertise: this idea is not very feasible according to my field of expertise, and we need to adjust it a bit. But it is hard to convince my partner.	Mention very explicitly. Then have a discussion	You don't want to hurt people's feeling. Maybe some person don't want to tell their idea quite often, if it could be dangerous, if you don't let your partner to evaluate the idea.

the tool should support achieving alignment in the sweet spot of all the expertise, from engagement and imagination step	There is decision needs to be made, but how to make sure the decision lie in the sweet spot of all the expertise in the group? Do you know why your partner think differently from you? And how do you deal with it?	Everyone evaluates the idea together based on their own expertise in a scale from 1-10, and give their opinions on improving the score	When you are afraid to hurt people's feeling, you won't the real score.
People should be willing to use the tool	My supervisor/partner/colleague give me a communication tool which can help me better communicate in doing projects, what trait of the tool would intrigue me to try?	A nice, friendly layout, intuitive, not time-consuming	
the tool needs to be used constantly to allow update the continuous development of the perceived expertise and roles in the group	what trait of the tool would encourage me to use it constantly?	A nice, friendly layout, intuitive, not time-consuming, time efficient, (should we fill in the app together), it become the process. Easily integrated to your daily work,	