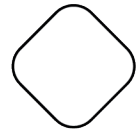

09 **APPENDIX**



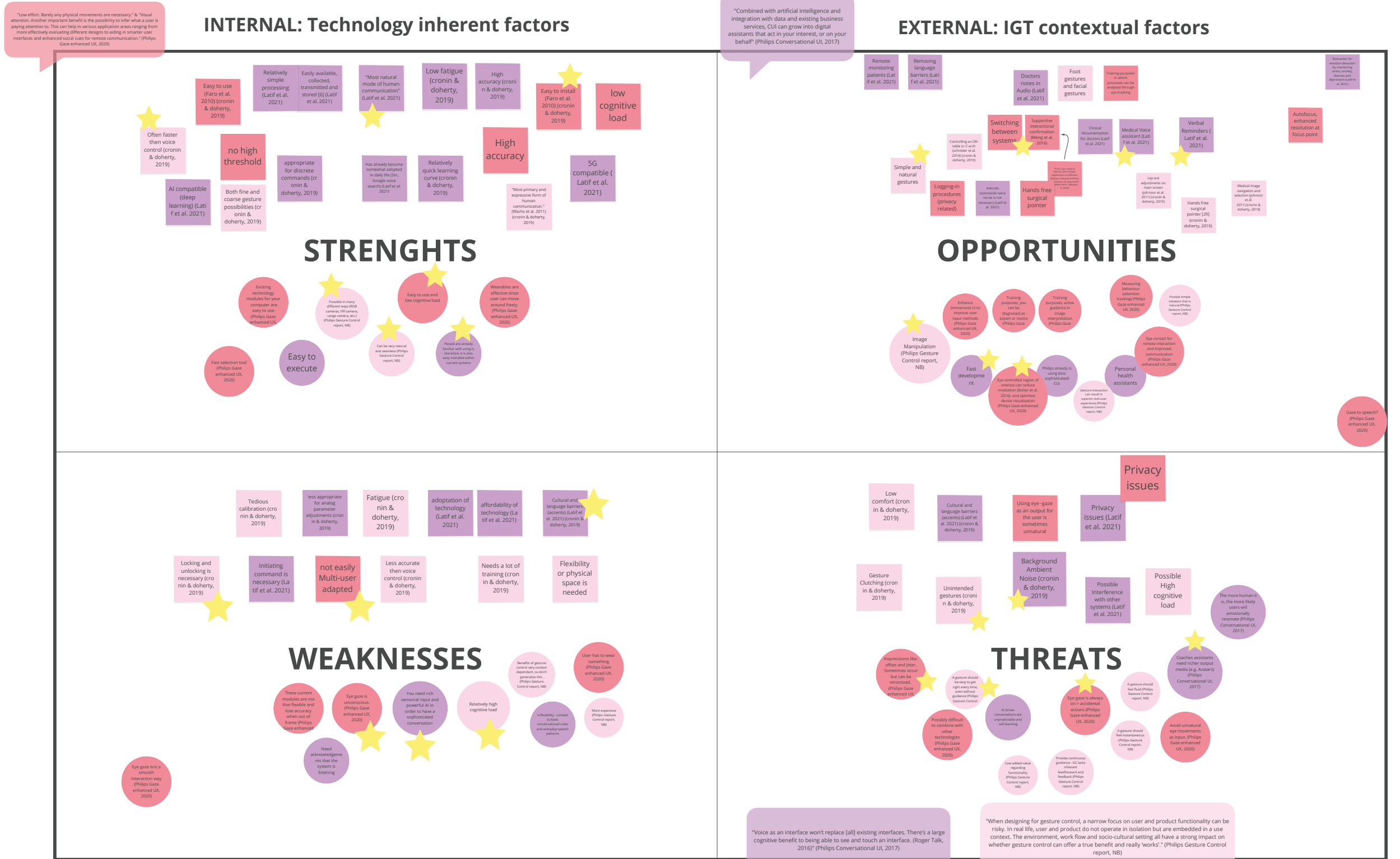
APPENDIX SETUP

- A. Touchless interaction SWOT analysis
- B. Creative trend research
- C. Explorative interaction analysis of PCI procedures
 - Gathering interactional touchpoints
 - Categorization interactional touchpoints
 - Insights and opportunities
 - Interview guide: Innovation expert
 - Mapping opportunity areas
- D. Established opportunity areas
- E. Value driver analysis
- F. Qualitative research setup
 - Interview guide: IGT doctors or specialists
 - Consent form Jack
 - Preparatory interview brief: Introduction into the topic
 - Visual setup of interview and workshop
 - Workshops results, quotes and insights
- G. Design guidelines analysis
- H. Ideation and brainstorm results
- I. Assessment of concepts based on value drivers
- J. Validation and assessment sessions
 - Presentation interview guide
 - Validation results and quotes
- K. Preliminary roadmap (Green-light)
- L. Assessment of concepts based on design guidelines
- M. Design implications
- N. Personal planning
- O. Personal reflection
- P. Graduation project brief

Appendix - A Touchless interaction SWOT analysis

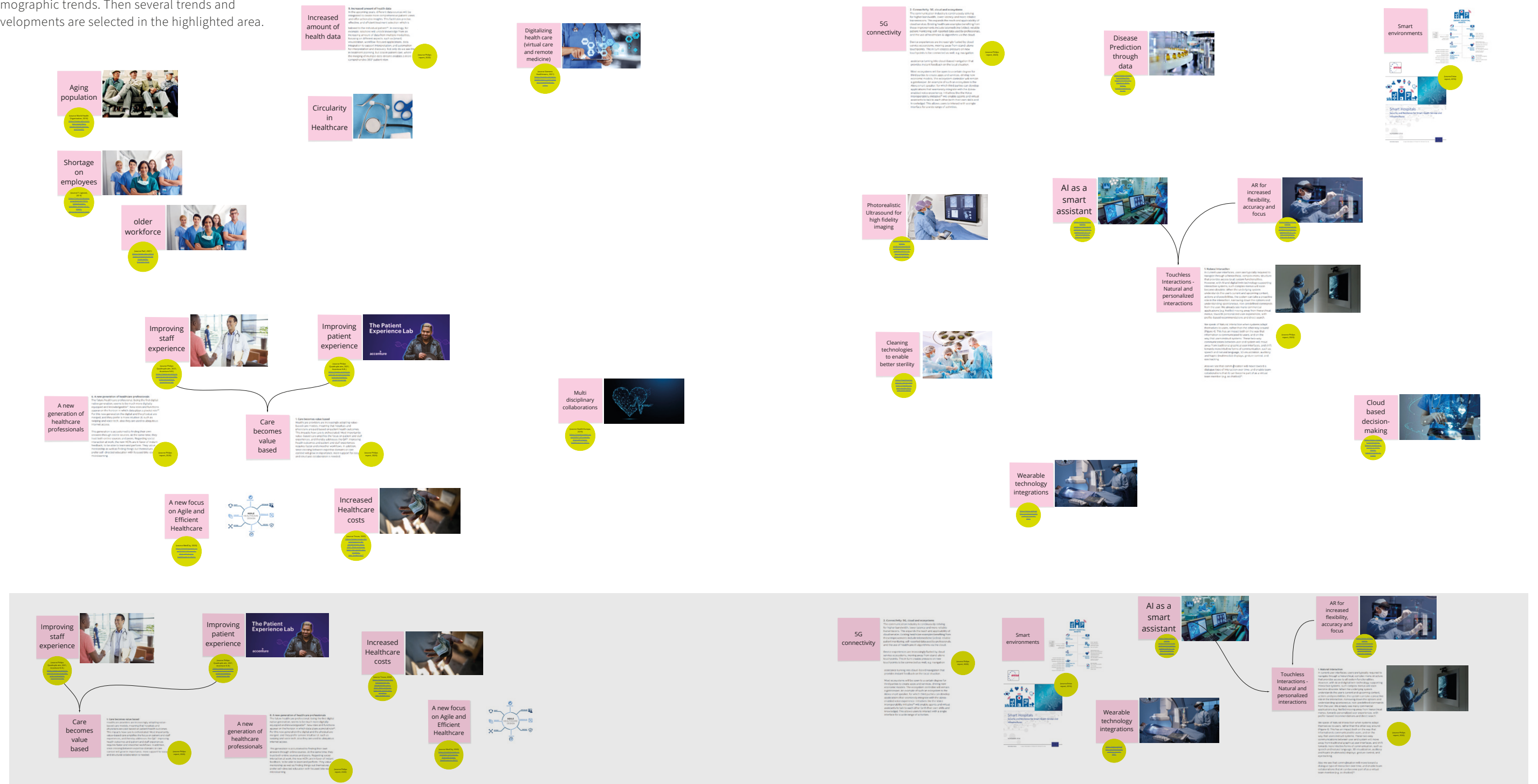
A full SWOT analysis is done by gathering properties and findings of these touchless technologies from literature and previous studies from Philips (see legend).

- from literature
- From Philips' previous projects
- Eye-gaze tracking
- Gesture sensing
- Voice control



Appendix - B Creative trend research

Creative trend research is done by diving into technological trends, healthcare trends and demographic trends. Then several trends and developments are selected in the highlighted area.



Appendix - C Explorative interaction analysis of PCI procedures

Gathering interactional touchpoints

Analyzing 3 PCI procedures by writing down all interactions, interesting quotes, contextual references and initial insights.

- 01 PCI procedure 4 March 2021 - Dr. Singh
- 02 PCI procedure 19 October 2020 - Dr. Jeremias & Ali
- 03 PCI procedure 18 August 2020 - Dr. Singh

PCI procedure Livestream:
<https://web.microsoftstream.com/video/1a75435f-0765-4576-8465-1eca9ed041c7?referer=https%3A%2F%2Fwww.gammar.com%2F>

Interaction touchpoints

Initial insights

PCI procedure Livestream:
<https://www.youtube.com/watch?v=2xibb1n6>

Interaction touchpoints

Initial insights

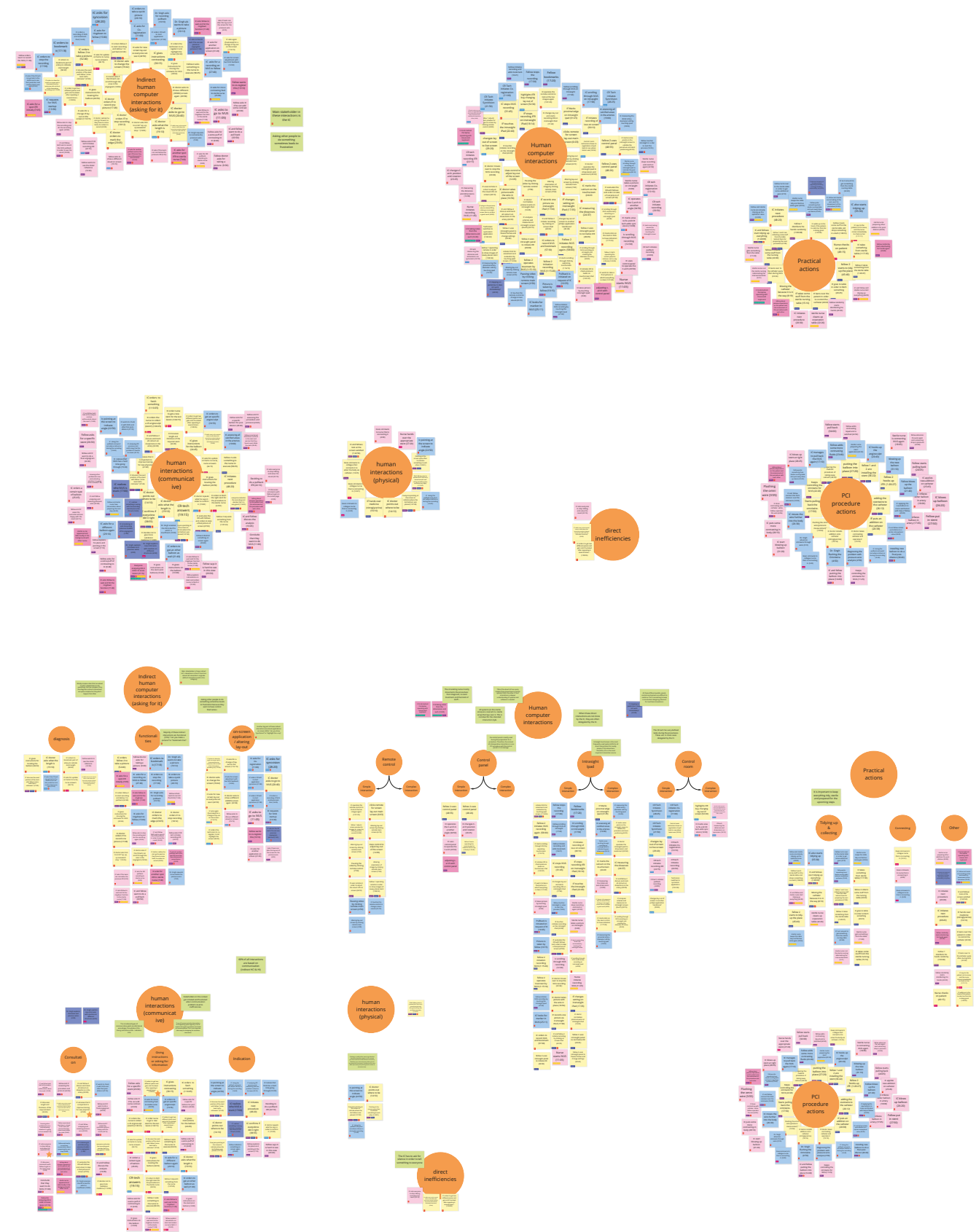
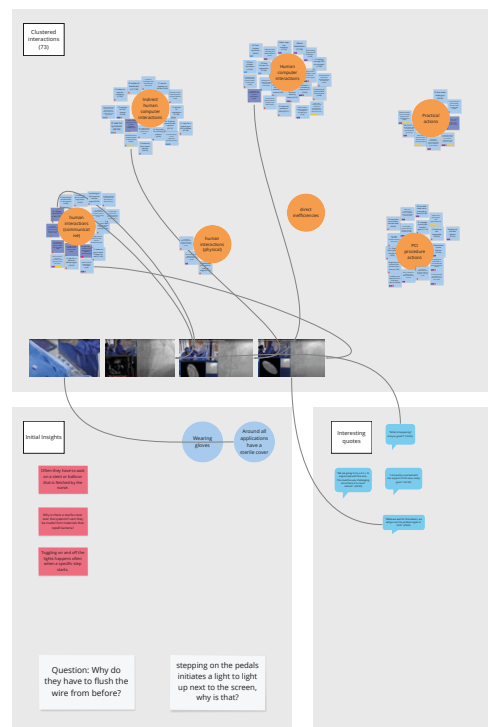
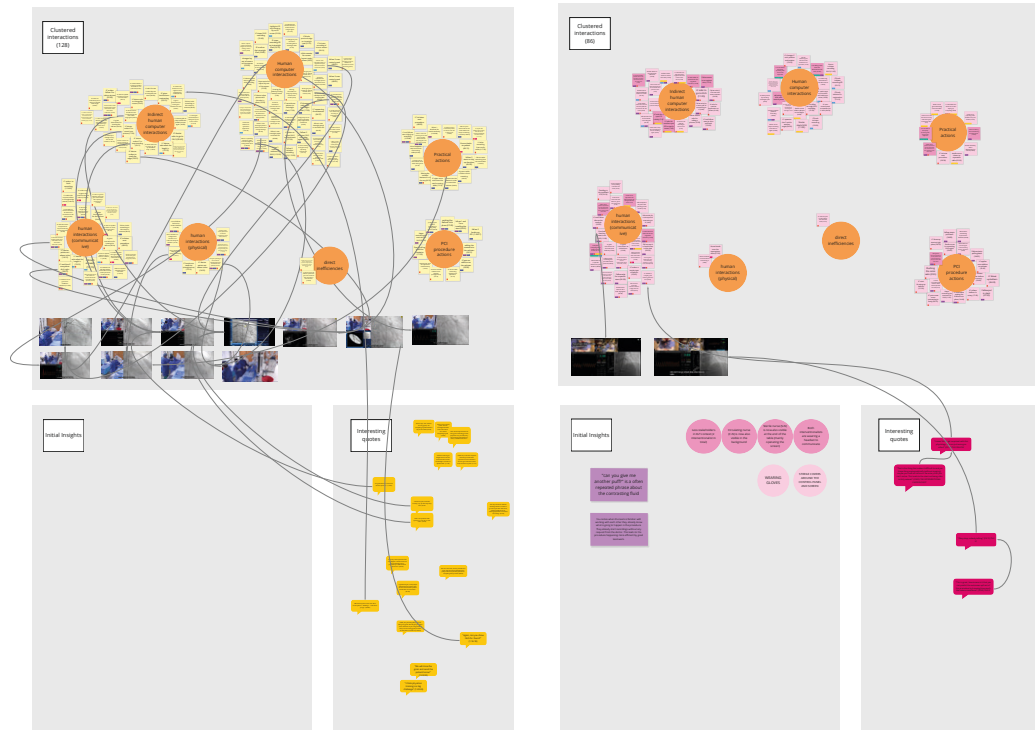
PCI procedure Livestream:
https://www.youtube.com/watch?v=kn4hECQW_Q

Interaction touchpoints

Initial insights

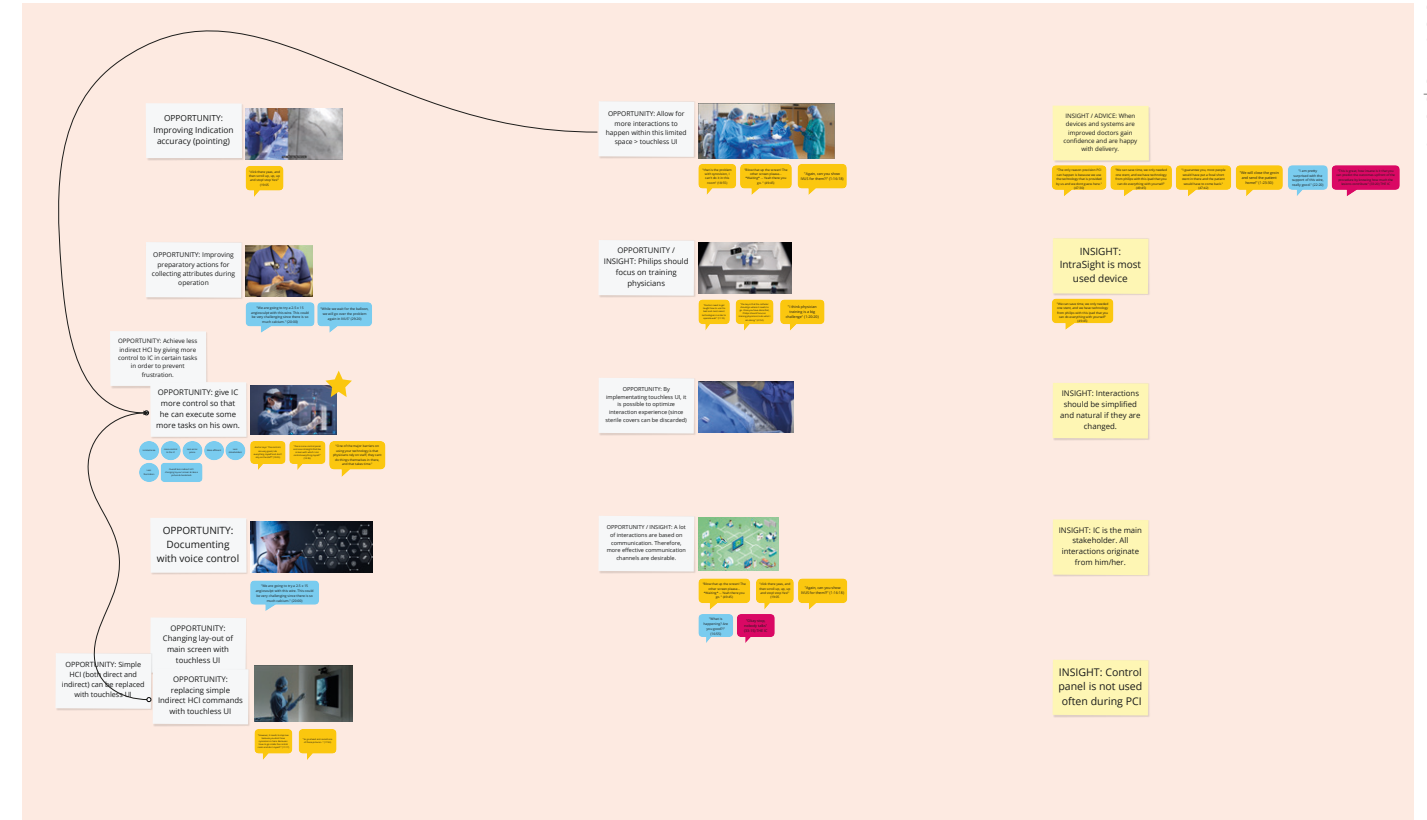
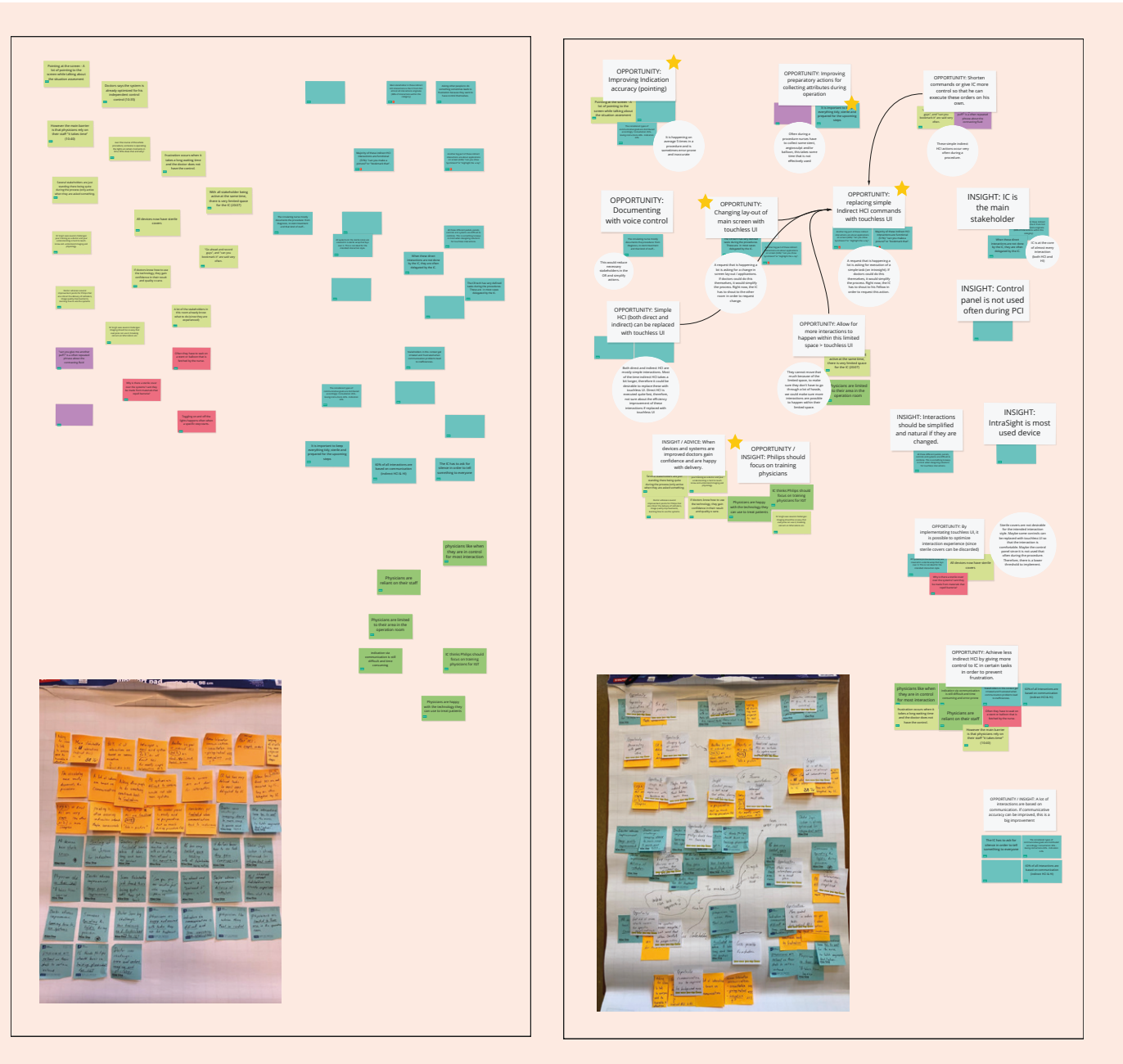
Categorizing interactional touchpoints

Interactional touchpoints are categorized to structurize all interactions happening in PCI



Gathering insights and establishing opportunities

Insights are clustered and combined to establish opportunities that can be further defined to preliminary opportunity areas



Interview guide Innovation expert

Interview Setup

Checklist for start:

- Interview leader: Victor Wijn
- Audio recording acceptance of interviewee
- Consent form needs to be explained.

Introduction (5 min)

- Thanks for your time.
- Tell something about yourself (interviewer), the project, and the last steps.
- The goal of this interview is to gain insights in the bottlenecks in interactions in the IGT context, the perspective on Touchless UI innovations and validate if defined opportunity areas are desirable. I will try to keep it as short as possible.
- Since you have done a lot of projects within the context of IGT, I think you will be an appropriate interviewee to help me gain a deeper understanding on this topic. I am just curious about your opinion or perspective.
- If something is not clear, be sure to interrupt me and ask questions
- The only thing that I was wondering is if I could audio-record this session. I will only use it for the content of my graduation project.

Start recording audio on phone

Introductory script

- Maybe you could quickly introduce yourself as well? ...
- Thanks so much, I have prepared some questions and some interactive discussion topics in Miro if that is possible.

Theme 1: General IGT & Innovation (5 min)

- Can you tell me a bit about your experience in IGT?
- With what kind of IGT related projects were you involved? Did you have a favourite
- What are several developments and innovations of the previous years of IGT? How do they add value?
- What are the most relevant improvements and why?
- What is your perspective on how the future of IGT looks?
 - o Why?
 - o How would that work?

Theme 2: Touchless UI (10 min)

Gesture Sensing

- Are you familiar with this technology?
- Have you ever researched it before in one of your IGT projects?
- Have you ever experienced it? What was your opinion about the interaction?
- What is important to keep in mind?
- What is your perspective on its potential for IGT procedures?

Voice Control

- Are you familiar with this technology?
- Have you ever researched it before in one of your IGT projects?
- Have you ever experienced it? What was your opinion about the interaction?
- What is important to keep in mind?
- What is your perspective on its potential for IGT procedures?

Eye tracking

- Are you familiar with this technology?
- Have you ever researched it before in one of your IGT projects?
- Have you ever experienced it? What was your opinion about the interaction?
- What is important to keep in mind?
- What is your perspective on its potential for IGT procedures?

Theme 3: Opportunities within PCI (25 min)

In order to identify key insights from a procedure in IGT, I analysed 3 PCI procedures and I documented all interactions happening during the operation. Also I captured images and wrote down quotes and insights. I captured all these insights into Miro in which I clustered my insight into several opportunity areas. I would like to have a discussion about my findings and directions. So I will share the link with you. Be sure to ask me questions when things are unclear or whatever.

Share Miro link

First, I will walk you through my analytic process. *explain my process*

- First of all, what do you think about my process?
- What do you think about the found opportunity areas, and why?
- How do you like the initial ideas I gathered?
- Do you have any feedback on this process?

I would like to map the opportunity areas in a schematic overview with you. (so lets go to Miro and order them accordingly to the axes)

- Why do we position this opportunity area here?
- If you had to choose a direction to focus on for the design process, what would it be and why? (it can be a combination of several ideas or opportunity areas)

Theme 4: Further Recommendations (10 minutes)

In 1,5 weeks I have my midterm in which I have to present my direction to my supervisory team and how I will continue my graduation project. I want to present my upcoming plans. I want to interview / organize several creative workshops with IGT doctors to derive design guidelines and maybe even some designs already.

- How would you design the workshop? What would you keep in mind? Why?
- Can you help me with getting in touch with these Interventional Cardiologists?

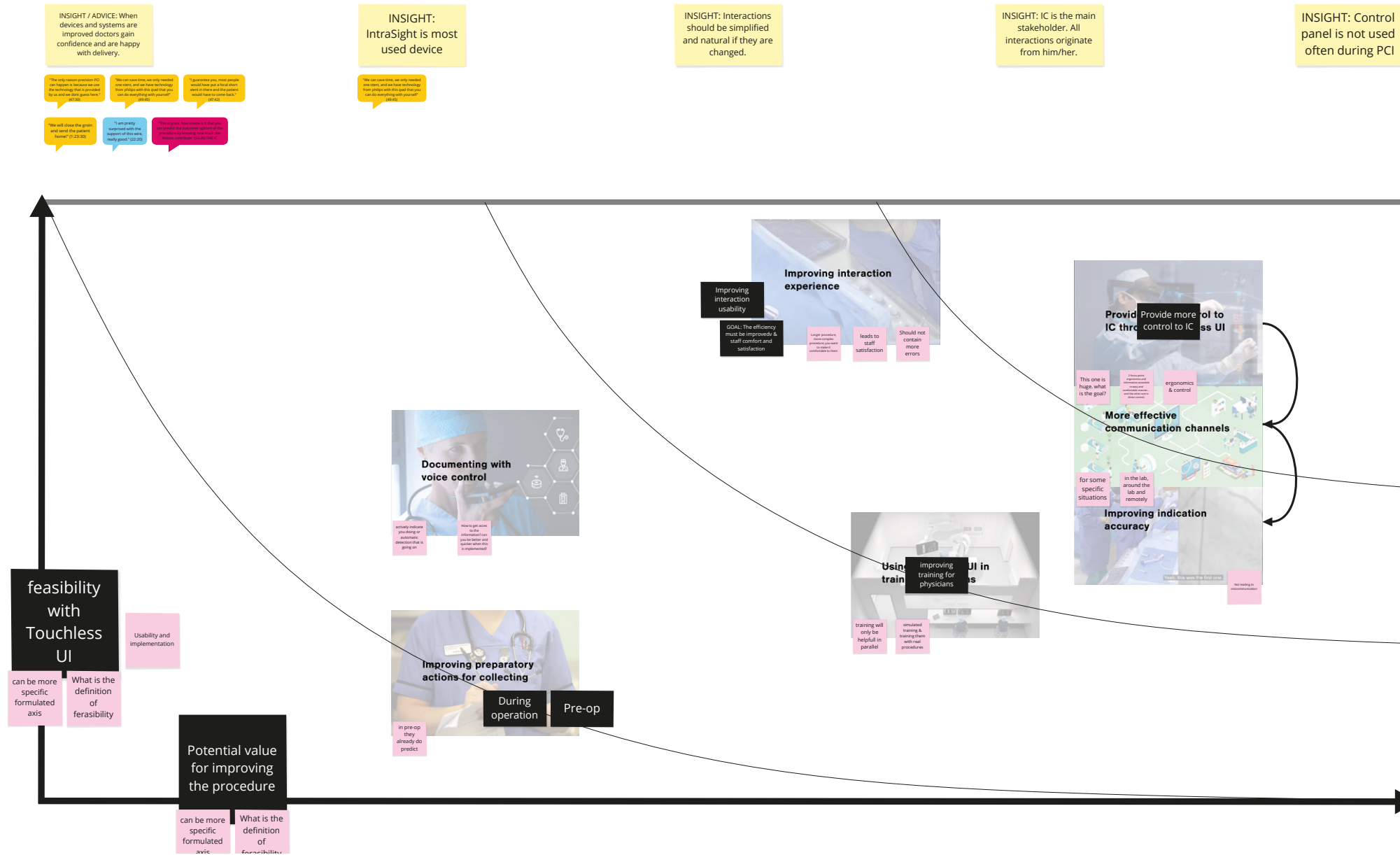
In the end, I want to have a implementation roadmap for Philips as a strategic design deliverable.

8. Checklist for closure (5 min)

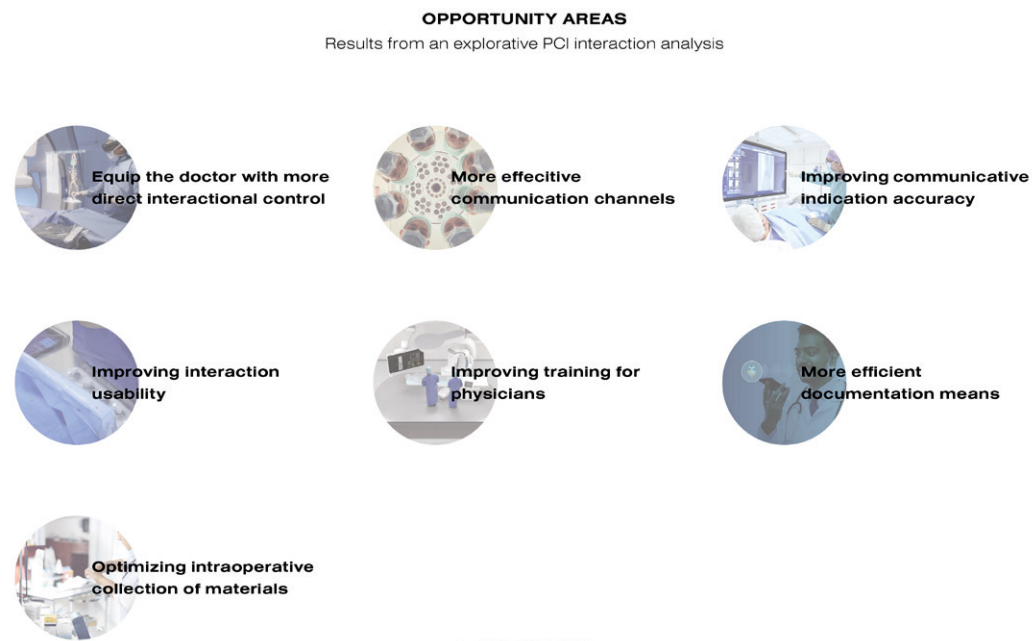
- Thanks for all your answers, do you still have anything to add or the feeling that something is missing?
- With that we came to an end of the interview. Thanks so much for your time and effort! I gained a lot of valuable insights and nuances.
- I am going to stop the recording now.
- Again, I am very grateful that you were willing to take time for my project!
- Have a nice day!

Mapping opportunity areas with innovation expert

With an innovation expert from Philips IGT the preliminary opportunity areas are mapped to assess value of this design direction.



Appendix - D Established opportunity areas



by VICTOR WIJN



OPPORTUNITY AREA

More effective communication channels

During the procedures in IGT, a lot of interactions are based on communication (60% of all interactions). Since the environment is so complex and chaotic with multiple stakeholders and noises everywhere, it is important that communication is effective. Sometimes communicative problems, lead to inefficiencies and frustration.

Insights from analysis

- 60% of all interactions are based on communication (indirect HCI & HI). Since all communicative interactions are happening very regularly, this is a significant topic to consider.
- The considered types of communicative goals are distributed accordingly: Consultation 35% - Giving instructions 43% - Indication 22%

"In the lab, around the lab and remotely, this opportunity could be very useful." - innovation expert IGT

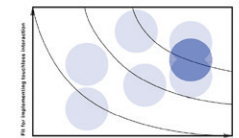
Value Proposition When communicative channels can be made more effective, it would lead to less miscommunications and enhance workflow in this complex environment.

Some initial ideas

- visual chatbox with direct messages
- better established channels
- the room recognizes and tracks stakeholder
- noise cancelling for OR

"Okay stop! nobody talks!" - Quote procedure 2 recording (33:15)

"Again, can you show IVUS for them?!" - Quote procedure 1 recording (1:16:18)



OPPORTUNITY AREA

Improving communicative indication accuracy

During the procedures in IGT, a lot of pointing happens in order to emphasize an indication on screen. During this communicative act, it can be concluded that some indication accuracy is lost, which makes this act error-prone. Since efficient and precise communication is such an important element within this context, it is very desirable to have indication capabilities that are powerful communication tools.

Insights from analysis

- Pointing for indication happens on average 5 times in a procedure and is inefficient, error-prone and inaccurate.
- When communicative human interactions happen, 22% of these are with the goal of indicating something.
- Since touching the screen is not possible because of sterility, several people are pointing at the screen while assessing the situation.

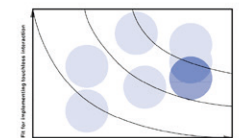
"You want to make sure that someone can actually see what you have in mind so that it does not lead to miscommunication." - innovation expert IGT

Value Proposition When systems and devices in IGT support higher indication accuracy, error-prone and inefficient communication can be minimized. This can result in significantly less time spend on clarification.

Some initial ideas

- eye-tracking pointer with indication on-screen
- pointing gesture with indication on-screen
- Multiple people point at the same time - colour
- Enhanced area of interest on-screen

"Click there yes, and then scroll up, up, up and stop! Stop, yes!" - Quote procedure 1 recording (19:05)



OPPORTUNITY AREA

Equip the doctor with more direct interactional control

A significant part (38%) of the human-computer interaction (HCI) is indirect and, therefore, based on communication. The majority of these indirect HCI commands are functional: "can you record?". However, sometimes these requests are time consuming, error-prone and sometimes leading to inefficiencies. The doctor even gets frustrated sometimes when he is not in control and actions of the staff take time.

Insights from analysis

- The doctor gets irritated and frustrated when communication problems lead to inefficiencies while he/she is not in control.
- Most indirect HCI's are functional requests like 'record IVUS pullback' or commands for on-screen applications like 'show SyncVision'. These are time-consuming, error-prone and sometimes leading to inefficiencies.

"There is a need to improve ergonomics and direct control of all interactions." - innovation expert IGT

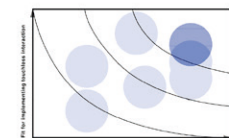
Value Proposition When the doctor is provided with more interactional control to do specific interactions himself, this will lead to more efficient, reliable workflow and possibly result in less necessary stakeholders.

Some initial ideas

- virtual staff that only helps when necessary
- minimize indirect HCI with touchless UI
- on-screen changes with touchless UI
- doctor can execute procedure on his own

"One major barrier on using your technology is that physicians rely on staff, they can't do things themselves in there, and that takes time." - Quote procedure 1 recording (11:15)

"Blow that up the screen! The other screen please... "Waiting"... Yeah there you go." - Quote procedure 1 recording (49:45)





OPPORTUNITY AREA

Improving interaction usability

The beautifully designed devices within the IGT operating room, are all covered up with sterile foil. This causes interactions styles that are not aligned with the way they were designed. Therefore, interactional comfort and usability can be improved with touchless interaction solutions.

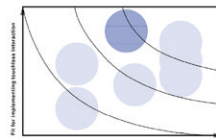
Insights from analysis

- All devices (in the sterile zone) are covered in a sterile wrap that lays over it. This is not ideal for the intended interaction style.

- When doctors know how to use new technologies, they gain confidence which results in better quality of care.

- The control panel is not used that often during the procedure. Therefore, there is a lower threshold to implement touchless UI.

"If you will be able to improve user satisfaction with touchless UI, this is really important for comfort of the doctor." - innovation expert IGT



Value Proposition When comfort and usability of interactions can be improved, this will lead to an increased staff satisfaction. It is important that all stakeholders are confident and at ease.

Some initial ideas

- o-arm adjustments with gestures
- anti-bacterial materials for devices
- hover over buttons



OPPORTUNITY AREA

Improving training for physicians

The biggest challenge according to the IC of the procedures that were observed, was training physicians to use the systems that Philips provides. Since physicians gain confidence and happiness when they are in control of the systems and devices, it is important to train them accordingly when innovations are implemented.

Insights from analysis

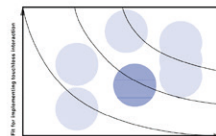
- Physicians are happy and confident with the technology they can utilize to treat patients better.

- Doctor addresses several improvement points for Philips that are critical: the delivery of catheters, image quality improvements, learning how to use the systems.

"I think physician training is a big challenge for Philips" - Quote procedure 1 recording (1:20:20)

"Doctors need to get taught how to use the best and most recent technologies in order to operate well." - Quote procedure 1 recording (11:10)

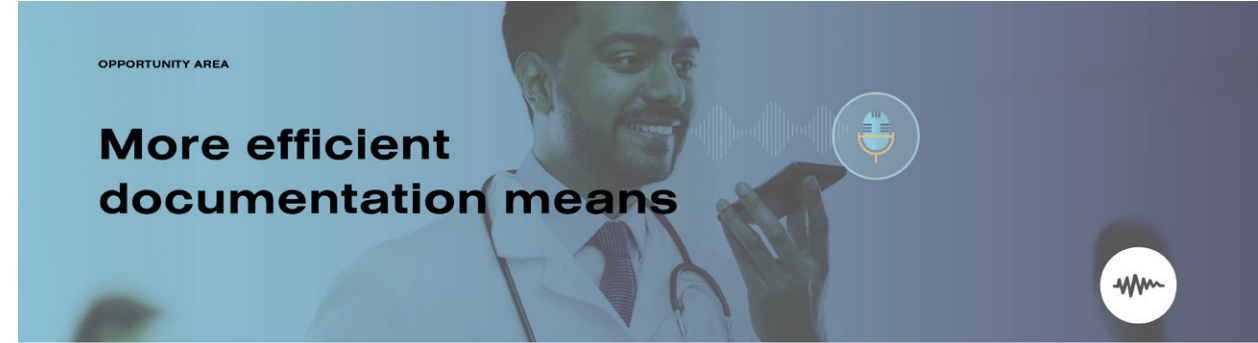
"If you teach how to do procedures via a simulation, that increases the learning curve. This results in medical students will be up to practice quicker" - innovation expert IGT



Value Proposition When training is improved the medical students are easier up-to-date with the newest innovations, but also gain a steeper learning curve to provide better care delivery with the newest systems.

Some initial ideas

- Philips IGT training experience centre
- AR training simulator with touchless UI
- Use eye-tracking to train physicians
- Analysis training and providing feedback



OPPORTUNITY AREA

More efficient documentation means

During the procedures in IGT, a lot of actions and important steps happen. Sometimes there is a circulating nurse documenting the most important actions during these procedure for example. However, often the doctor needs to document the procedure at the end of the day. This is very time consuming and can possibly be minimized with touchless UI.

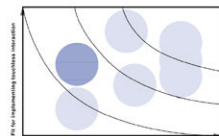
Insights from analysis

- The circulating nurse mostly documents the procedure: from diagnosis, to stent treatment.

- When communicative actions would be automatically documented, this would reduce necessary stakeholders in the OR and simplify actions.

"We are going to try a 2.5 x 15 angioplasty with this wire. This could be very challenging since there is so much calcium." - Quote procedure 3 recording (20:00)

"It is a very important opportunity to consider, however there is a big barrier of ambient background noise." - innovation expert IGT



Value Proposition Documenting with voice recognition would result in better clinical outcomes since more patients can be treated when this time is efficiently used.

Some initial ideas

- speech biomarkers or notes during PCI
- receiving realtime feedback
- replacing nurse with virtual assistant
- speech-to-text document.



OPPORTUNITY AREA

Optimizing intraoperative collection of materials

Several times during the procedures in IGT, the doctors asks the nurse to collect a stent, angioplasty or balloon. Often, this takes some time that is not effectively used. When a team is already familiar with working with each other, waiting time between these steps are minimized. When an efficient workflow can be maintained, without having these stalled moments, this is always desirable.

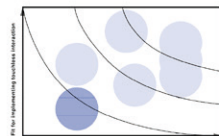
Insights from analysis

- It is important to keep everything tidy, sterile and prepared for the upcoming steps.

- Often during a procedure nurses have to collect some stent, angioplasty and/or balloon, this takes some time that is not effectively used.

"While we wait for the balloon, we will go over the problem again in IVUS" - Quote procedure 3 recording (29:20)

"Making more accurate predictions, would improve the time spend, but not so much the clinical outcome." - innovation expert IGT



Value Proposition When the workflow can be optimized by preparatory actions to prevent stalled moments from happening, this can result in less time spend on waiting on the staff.

Some initial ideas

- more effective prediction of stent
- indication instructions more upfront
- AI software that predicts and guides nurse

Appendix - F Qualitative research setup

Interview guide IGT doctor or specialists

Interview Setup - Doctors

Checklist for start:

- Interview leader: Victor Wijn
- Audio recording acceptance of interviewee
- Consent form needs to be explained.

Introduction (5 min)

- Thanks for your time.
- Tell something about yourself (interviewer), the project, and the last steps.
- The goal of this interview is to gain deeper understanding of the inefficiencies in interactions in the IGT context, the perspective on Touchless UI innovations and validate desirability of specific interactional needs. I will try to keep it as short as possible.
- Since you have done a lot of projects within the context of IGT, I think you will be an appropriate interviewee to help me gain a deeper understanding on this topic. I am just curious about your opinion or perspective.
- If something is not clear, be sure to interrupt me and ask questions
- The only thing that I was wondering is if I could audio-record this session. I will only use it for the content of my graduation project.

Start recording audio on phone

Introductory script

- Maybe you could quickly introduce yourself as well? ...
- Thanks so much, I have prepared some questions and some interactive discussion topics in Miro if that is possible.

PHASE 1 – General questions and answering SQs (15 min)

- Can you tell me a bit about your experience in Image-Guided Therapy?
- What are several developments and innovations of the previous years of IGT?
 - o How do they add value?
- What do you think of the complex environment of IGT? Explain please.
- What is your perspective on how the future of IGT looks?
 - o Why? How would that work?

Interventional cardiology

- What are the most relevant and biggest improvements over the years in IGT, interventional cardiology?
 - o Why?
- What is your perspective on inefficiencies / limitations within this context for interventional cardiology?
 - o Do you have ideas on how to tackle those problems?
 - o Why?
- Are there any other barriers present during procedures in Image-guided therapy, interventional cardiology?

PHASE 2 – Procedure of PCI and indirect HCI highlights validation (20 min)

In order to identify key insights from a procedure in IGT, I analysed 3 PCI procedures and I documented all interactions happening during the operation. Also I captures images and wrote down quotes and insights. I would like to have a discussion about my findings and directions. So I will share my screen with you. Be sure to ask me questions when things are unclear or whatever.

Share screen

First lets talk about the process of PCI. Talk through the general PCI experience flow. Within this experience flow, there are several highlights of indirect HCI.

- Extra information about situation from his/her perspective
- Feeling of doctor at that moment, and why?
- How efficient of inefficient is this (scale 1-10)? Why? What is it that makes it so (in)efficient?
- Would you feel like this can be improved, and why?

PHASE 3 – Introduction touchless interaction questions (20 min)

- What is important to consider when improving interactions in this context?
 - o Are there any parameters?
 - o Why?
- What are current interactions that you **really appreciate** in this context?
 - o Why?
- What are current interactions that you **do not appreciate** in this context?
 - o Why?

Since my project is based on implementing **Touchless UI** in this context, I have some questions about gesture sensing, eye-gaze tracking and voice control

- What is your perception of touchless UI?

Gesture sensing, voice control and eye-gaze tracking

- Are you familiar with these technologies?
- Would you like to use them in this context?
 - o Why?
- Have you ever experienced one or more of them?
 - o What was your opinion about the interaction?
- What is important to keep in mind for designing with these interaction technologies?
 - o Why?
- What is your perspective on its fit or potential for IGT procedures?
 - o Do you think these UI's can improve efficiency, and why?

Future considerations

- How do you see the future of these technologies in IGT?
 - o Why?
 - o What could be future consideration to take into account?

PHASE 4 – Value drivers in touchless interaction (20 min)

In order to implement these touchless UI in the way that is desirable for most doctors, it is important to gain an understanding of what is important for doctors in this complex environment. Therefore, I wanted to make a prioritization of value drivers for interaction within this context.

- First of all, taking into consideration interactions in Image-guided therapy, when can you do a good job? Why?
- What are nice interactions and why?

Now lets rank these value drivers in order of most desirable to least desirable for interaction in IGT. Why are these most desirable? Why are these least desirable?

PHASE 5 – Closing questions and evaluation (5 min)

- Are there any other problems that you experience in IGT context?
- Do you have any further recommendations for this study?
- So you maybe have any questions for me still?

Checklist for closure

- Thanks for all your answers, do you still have anything to add or the feeling that something is missing?
- With that we came to an end of the interview. Thanks so much for your time and effort! I gained a lot of valuable insights and nuances.

I am going to stop the recording now.

- Again, I am very grateful that you were willing to take time for my project!
- Have a nice day!

Consent form setup

Consent Form Graduation Project research Victor Wijn

To be filled in by the research participant

Yes

TAKING PART IN THE STUDY

I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in this study involves answering questions about my perspective and experiences and doing several exercises on an interactive platform named Miro.

I agree to the interview being video- and/or audio-recorded. These fragments will be transcribed to text and all data will be anonymized during this study. The recordings will be destroyed after finishing this study (August 2021).

USE OF THE INFORMATION IN THE STUDY

I understand that (personal) information I provide will be used for a report about the conducted interview study, will not be shared beyond the graduate researcher and involved supervisors and will be fully anonymised.

I agree that my information can be quoted in research outputs. I understand that these quotes will generally be anonymized, however they can contain my name if I give consent in a later stage.

I understand that information like anonymized transcripts and recordings will be stored in a secured online environment that administers safeguarded access.

SIGNATURES

[Insert name here]	DD-MM-YYYY	
_____ Name of Participant	_____ Signature	_____ Date

To be filled in by the researcher

I have accurately informed the potential participant of my study and, to the best of my ability, ensured that the participant understands what he/she is freely consenting.

Victor Wijn	01-05-2021	
_____ Name of Researcher	_____ Signature	_____ Date

Study contact details for further information:
 Victor Wijn +316 129 821 64 v.wijn@student.tudelft.nl

Consent form signed example - Jack Jakimowicz

Consent Form Graduation Project research Victor Wijn

To be filled in by the research participant

Yes

TAKING PART IN THE STUDY

I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

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SIGNATURES

[Insert name here] YYYY	DD-MM-YYYY	
<i>J. Jakimowicz</i> Name of Participant	<i>[Signature]</i> Signature	<i>05 05 2021</i> Date

To be filled in by the researcher

I have accurately informed the potential participant of my study and, to the best of my ability, ensured that the participant understands what he/she is freely consenting.

Victor Wijn	01-05-2021	
_____ Name of Researcher	_____ Signature	_____ Date

Preparatory interview brief: introduction into the topic

Interview Project Brief – Victor Wijn



First of all, thanks for being open to supporting my project and taking the time to answer some questions and share some insights. In order to give an initial idea of the subject that I want to interview you about, I created this Interview project brief. This contains some initial info about the subjects considered in this interview.

*Kind regards,
Victor Wijn*

Project introduction Image-guided Therapy

This graduation project focuses on exploring the technological possibilities of touchless interactions in the medical environment of Image Guided Therapy. In this medical environments, touch-based interaction such as physical controls, touch screens and mouse is often problematic when the hands are busy treating the patient. Or in other cases that have to do with hygiene constraints. This results in inefficiencies and errors caused by colleagues doing the interaction, strict cleaning protocols, and/or wearing gloves etcetera.

There is a lot of development in possibilities with User Interaction (UI) techniques like: Eye-gaze, Speech interaction and Gesture sensing. When these can be combined efficiently, it is expected that this provides good alternatives for certain situations. This way, there is room for a broad spectrum of new possibilities in the area of innovative interaction solutions in a hospital. Since a hospital is a very broad context, this project will mainly focus on the possibilities in a specific use case (Percutaneous Coronary Intervention (PCI)) during Image-guided therapy (IGT). This is a relatively new surgical domain that focuses on minimal invasive surgery.

Since this is a multi-user environment, it contains a lot of equipment and there are a lot of different stakeholders and manufacturers, this context is quite complex. A lot is happening at the same time and everything has to be sterile due to the earlier mentioned hygiene constraints. However, this complexity allows for good opportunities to improve the performance of the execution of medical procedures happening in IGT with touchless interaction technologies.

I added some pictures to get a bit more of a visually substantiated idea of the context and different subjects of this interview (see pictures below and on the next page).





During this interview I will also be addressing touchless technologies. We will be assessing certain value drivers for important interaction elements for actually using these techniques. A brief description of the technologies are given below.

Voice control

Nowadays interest into speech oriented technology is growing, leading to more and more research into the topic of using speech technology for interaction. In general, speech is the most natural mode of human communication. Latif et al. (2021) state that "it provides information about linguistic content and para-linguistic states and traits". Linguistic content contains information about the message that is transmitted. Para-linguistic content however, contains information about the speaker itself (identity, gender, emotion and age). In emerging voice control applications, recording with AI techniques like deep learning algorithms are increasingly significant to provide appropriate interaction possibilities.



Gesture sensing

Gesture sensing is also an increasingly popular technology to implement into products. By providing seamless and natural control without physically touching a product or system, users in healthcare can maintain sterility, speed-up processes or interact with systems while hands-busy (Cronin & Doherty, 2019). Sometimes it is even possible to interact with a system from a longer distance. Often these movement-based interactions are recorded via cameras or inertial sensors. Several studies claim that it has potential value for specific use-cases in human computer interaction systems in medical contexts (O'Hara et al. 2014; Cronin & Doherty, 2019; Mewes et al. 2016).



Eye-gaze tracking

Eye-gaze tracking is another technology that is an increasingly often implemented technology in a lot of different applications. The idea behind eye-gaze tracking is that you interact with systems through movement of your eyes. Often this fine movement is recorded and measured with a camera(s).



Value drivers for interaction

From these novel UI technologies certain value drivers can be identified that are important to consider when looking at interactions that doctors have in these complex environments during IGT. Several 'Value Drivers' are named below that are most important to consider when looking at interactional qualities. These value drivers are originating from clusters of interaction qualities found in literature and previous studies from Philips.

Accurate interactions

Reliable interactions

Natural and seamless interactions

Durable interactions

Simple interactions

Efficient interactions

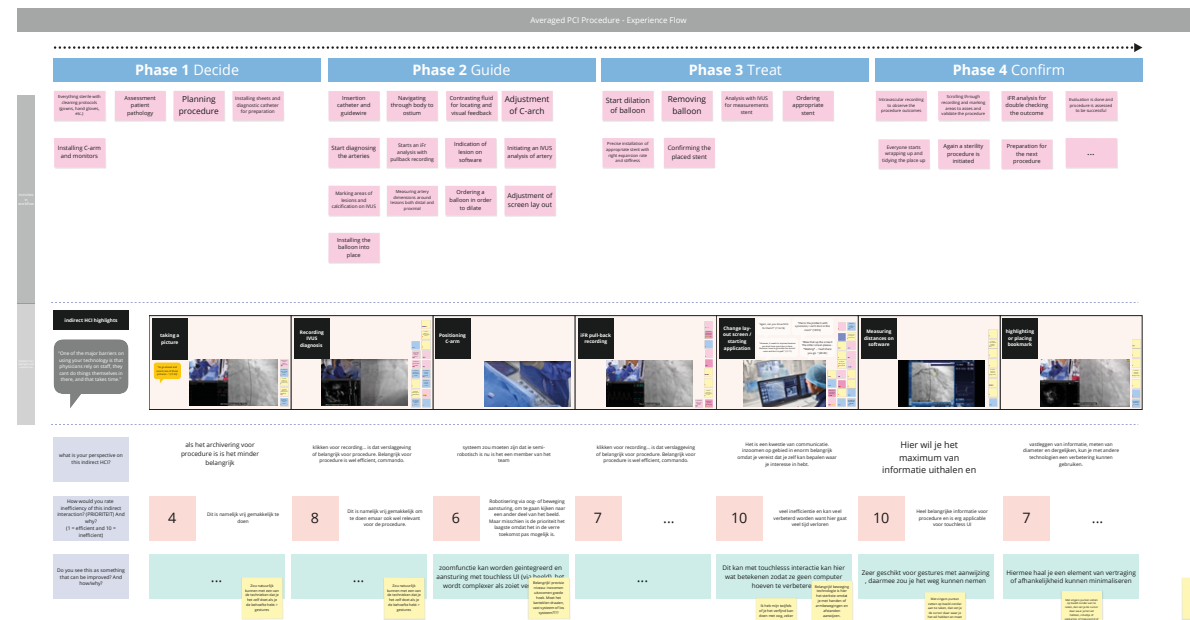
Future-proof interactions

Flexible interactions

Workshop results, quotes and insights

Validation of the opportunity scope with Jack Jakimowicz

Most interesting quotes and insights during the analysis of the interviews/workshops.



Prioritization of value driver for implementing touchless UI in the cathlab - from the perspective of 4 IGT doctors or specialists.

The different perspectives give interesting insights: Expert on minimally invasive surgery, Clinical application specialist and 2 ex-vascular surgeons



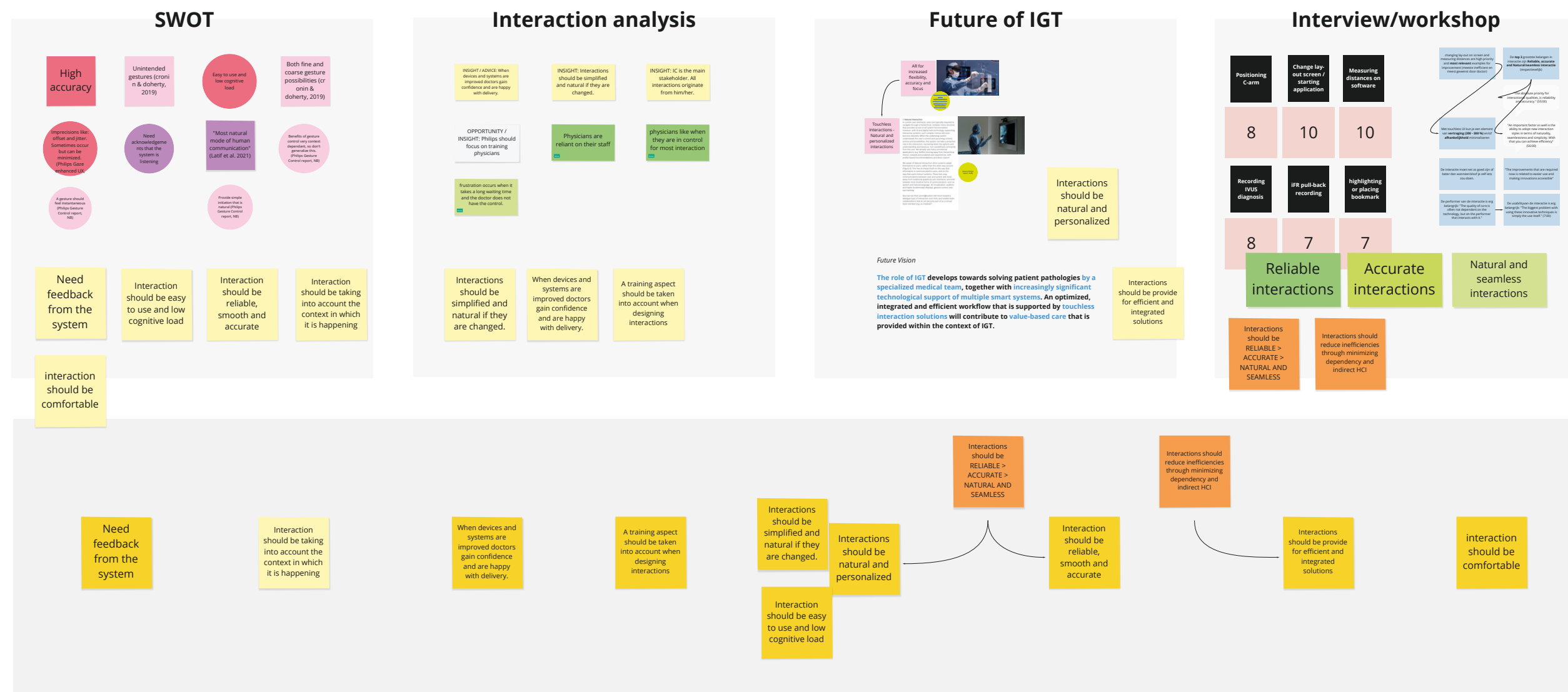
Quotes and Insights:

- "The biggest problem with using these innovative techniques is simply the use itself" (17:20)
- "The relevance of more efficient care is a key, image-guided therapy allows for solutions." (18:00)
- "The interaction should be natural, reliable and most of all, the doctors have to use the procedure and direct view." (18:50)
- "The biggest frustration of doctors is that they are not used to the technology. They should be trained." (19:40)
- "The workflow and capabilities in IGT in hospitals is very different per hospital." (19:40)
- "The quality of nurses is also very different in hospitals, some nurses already know what to do." (19:50)
- "Every interaction should be reliable and accurate. That is the most important." (19:50)
- "If it fails at the doctor, it does not have to put any effort into the interaction, it is preferable." (20:20)
- "The younger generation cardiologists are more open to new technologies." (20:30)
- "The integration of all technologies is something really important to happen more and more." (21:30)
- "The most important thing is that the doctor has to be able to use the technology." (17:20)
- "The biggest frustration of doctors is that they are not used to the technology. They should be trained." (19:40)
- "The workflow and capabilities in IGT in hospitals is very different per hospital." (19:40)
- "The quality of nurses is also very different in hospitals, some nurses already know what to do." (19:50)
- "Every interaction should be reliable and accurate. That is the most important." (19:50)
- "If it fails at the doctor, it does not have to put any effort into the interaction, it is preferable." (20:20)
- "The younger generation cardiologists are more open to new technologies." (20:30)
- "The integration of all technologies is something really important to happen more and more." (21:30)

Appendix - G Design guideline analysis

Initial Design guideline analysis

based on SWOT the interaction analysis, Future of IGT and the interview abd workshop with Jack Jakimowicz



Appendix - H Ideation and brainstorm results

Improving communicative indication accuracy

- eye-tracker pointer with indication onscreen
- pointing gesture with indication onscreen
- multiple people point at the same time + colour
- enhanced area of interest onscreen

More effective communication channels

- Visual chatbox with direct messages
- better established channels (headsets)
- the room recognizes and tracks stakeholders
- noise cancelling in the OR

Equip the doctor with more direct interactional control

- Virtual staff members that only help when necessary
- minimize indirect HCI with touchless UI
- on-screen changes with touchless UI
- doctor will be able to perform the procedure on his own

Improving interaction usability

- Cam adjustments with gestures
- anti-bacterial materials for devices
- hovering over buttons

Improving training for physicians

- Philips IGT training experience centre
- AR training simulator with touchless UI
- use eye-tracking to train physicians
- Analysis training and providing feedback

Documenting with voice control

- speech biomarkers or notes during PCI
- receiving real-time feedback
- replacing nurse with virtual assistant
- speech-based documentation

Optimizing actions for intraoperative collecting

- more effective prediction of stent
- indication instructions more upfront
- AI software that predicts and guides nurse

INSIGHT / ADVICE: When doctors are in a room and improved doctors get confidence and are happy with history.

- This only works if the doctor is in the room and the patient is in the room.
- The doctor should be able to see the patient's history.
- The doctor should be able to see the patient's history.
- The doctor should be able to see the patient's history.
- The doctor should be able to see the patient's history.
- The doctor should be able to see the patient's history.

INSIGHT: IntraSight is most used device

INSIGHT: Control panel is not used often during PCI

INSIGHT: IC is the main stakeholder. All interactions originate from here.

INSIGHT: Interactions should be simplified and reduced if they are changed.

115 IDEAS

Improving communicative indication accuracy

More effective communication channels

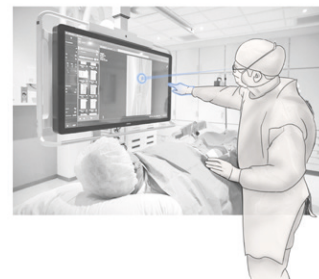
Equip the doctor with more direct interactional control

<p>TEAM A Volker Jelle Surijot Monique</p>	
<p>TEAM B Victor Vincent Abraham Sreedhar</p>	
<p>TEAM C Niels Daan Ronald Jenny</p>	

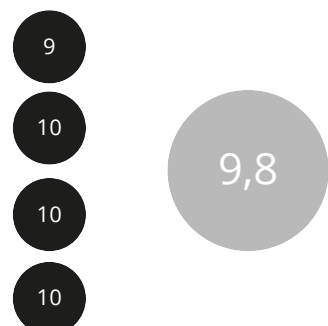
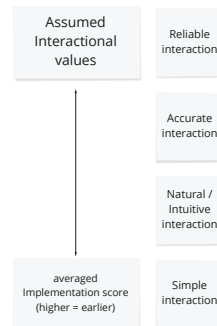
Appendix - I Assessment of concepts based on value drivers

For the synthesis of the concepts, every concept is assessed with the 4 most important value drivers to create an order for implementation.

Since the value drivers were about the implementation of touchless UI, the higher scoring concepts can be implemented earlier.



Eye-indication pointer



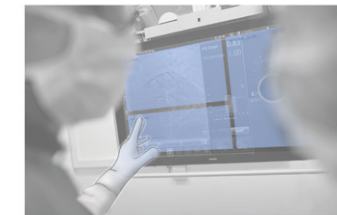
Virtual Assistant



Visual IGT chatbox



Visual Log



Screen manipulation



other Service proposition ideas	e-learning pointer	Alignment sessions with all suites	New training labs for every hospital	Noise-cancelling trainings lab	e-learning assistant	touchless interaction experience session	introduction session of avatar to doctors	e-learning chatbox	e-learning logging file	e-learning usability touchless interaction	touchless interaction workshops
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Possible development of concept over the years	possible development could be that it is able to track multiple people - also zoom in when that is desirable by pinching with your hand	possible development could be that It will be a hologram that actually interacts with you when you need in, in stead of asking for it.	possible development could be that People would only see messages for themselves with hololens or google glasses.	possible development could be that logging file is automatically translated to an operation procedure logfile for a lot of efficiency.	possible development could be that more and more functionalities like this will be added in this interactional language.
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Appendix - J Validation and assesment sessions

Interview & presentation guide for Validation sessions

Text of Brief presentation – Atul validation 15th June

Welcome & Content

- Thanks for being here
- My name is Victor, Student TU Delft, Graduate Intern at Philips XD
- Working with Pei-Yin and Volker on touchless UI innovations in the Cath lab
- I will give a really short presentation and after that I have a small interactive workshop to validate current outcomes of my project

Opportunity definition

- My project is about delivering a strategic roadmap for implementation of touchless UI with a focus on PCI procedures (as carrier case) to improve workflow.

Literature review

- When diving into the literature
- There are several limitations and complexities that: interrupt workflows, decrease efficiency, produce inaccuracy and errors > due to sterility limitations
- This is where touchless UI provides valuable solutions
- Techniques like eye gaze, voice control and gesture sensing are developing fast and the technologies considered in this project.

Interaction analysis

- Through this literature analysis, creative trend research, future visioning I decided to do an observational study of interactions in the Cath lab.

[MIRO]

Design vision

- READ

[SHARE MIRO LINK VALIDATION BOARD]

Concepts

- This is a brief and visual overview of the concepts considered in this graduation project.
- Eye- indication pointer: Recognizes gestures and indication POI on screen to improve communication.
- Visual live captioning: Records what is said and visually displays it to minimize miscommunication and errors .
- Visual procedural reference log: Records what is happening during procedure so everyone can scroll back to see what is meant / highlighted.
- Screen manipulation: Operating screen adjustments through gestures by looking at an area on the screen.
- Virtual assistant: Assistant that executes tasks to provide guidance at certain moments to improve workflow and dependency on staff.
- How do these concept come together? How are they aligned?

[START MAPPING THE OPPORTUNITIES ON AXIS]

QUESTIONS

- Name examples of barriers and name examples of potential value in quadruple aim.
- What is the expected concrete value for this concept?
- What are the expected barriers for implementing this concept?
- Asking why certain things are placed somewhere
 - o Why are those barriers for implementing higher?
 - o Why is the potential value higher of this concept?

[MOVE TOWARDS ROADMAP]

Roadmap

- This is a preliminary result of the roadmap that is established in this project.
- Horizontally, you can see the different time-paced horizons.
- Vertically, you see the different parameters that are worked out at the moment.

Horizons explanation

- This results in a step by step progression of three horizons.
- Horizon 1: Reinforcing the connection with technology
 - o Mainly about improving the technological infrastructure and communication within the cathlab. This will result is less miscommunications and errors
- Horizon 2: Aligning stakeholders and improving workflow through technology
 - o Mainly about aligning stakeholders to (re)act and communicate only when necessary leading towards an improved workflow. Therefore, less indirect HCI is necessary.
- Horizon 3: Optimization of workflow through merging innovations with teamwork
 - o Mainly about bringing together and integrating all UI innovations to optimize workflow, no indirect HCI is necessary anymore.

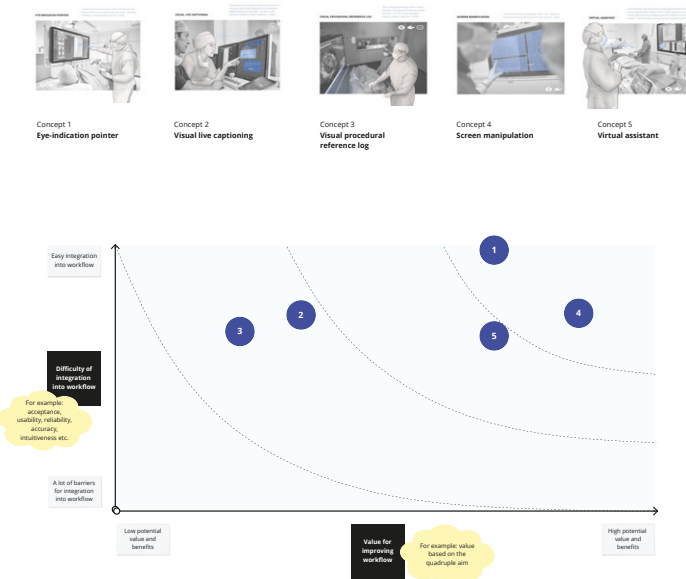
QUESTIONS

- What is your first impression about this? And why?
- What is your opinion about the **time-pacing** of the horizons? Why?
- What do you think of the **service propositions**?
- Do you think it can be **in line with Philips' strategy**? Why?
- What do you expect what is necessary to **embed** such a roadmap into **Philips' organization**?
- Would you think this roadmap is **transferable to other suites** to be applied there as well?
- What would be the **main barriers and values** of implementing these concepts in this way?
- Are you missing certain topics that you are wondering about?

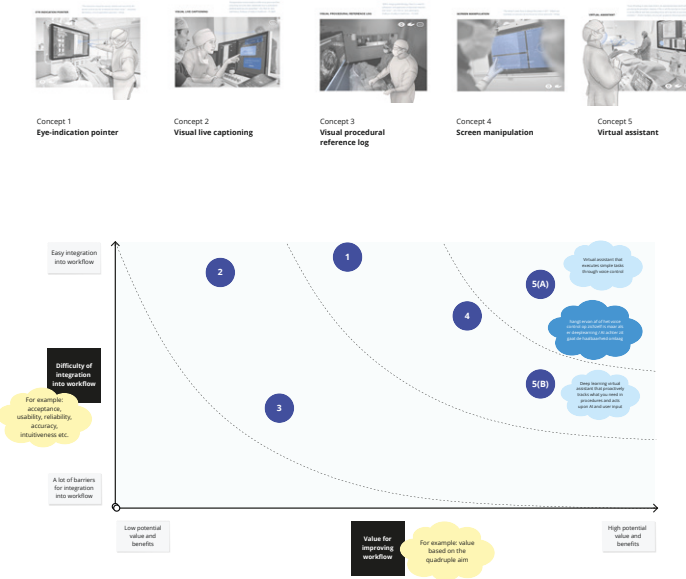
Validation results and quotes

First concepts are mapped on two axis: X - value for improving workflow and Y - Ease of integration into workflow. The order of validation is Atul and then Niels.

Concept mapping

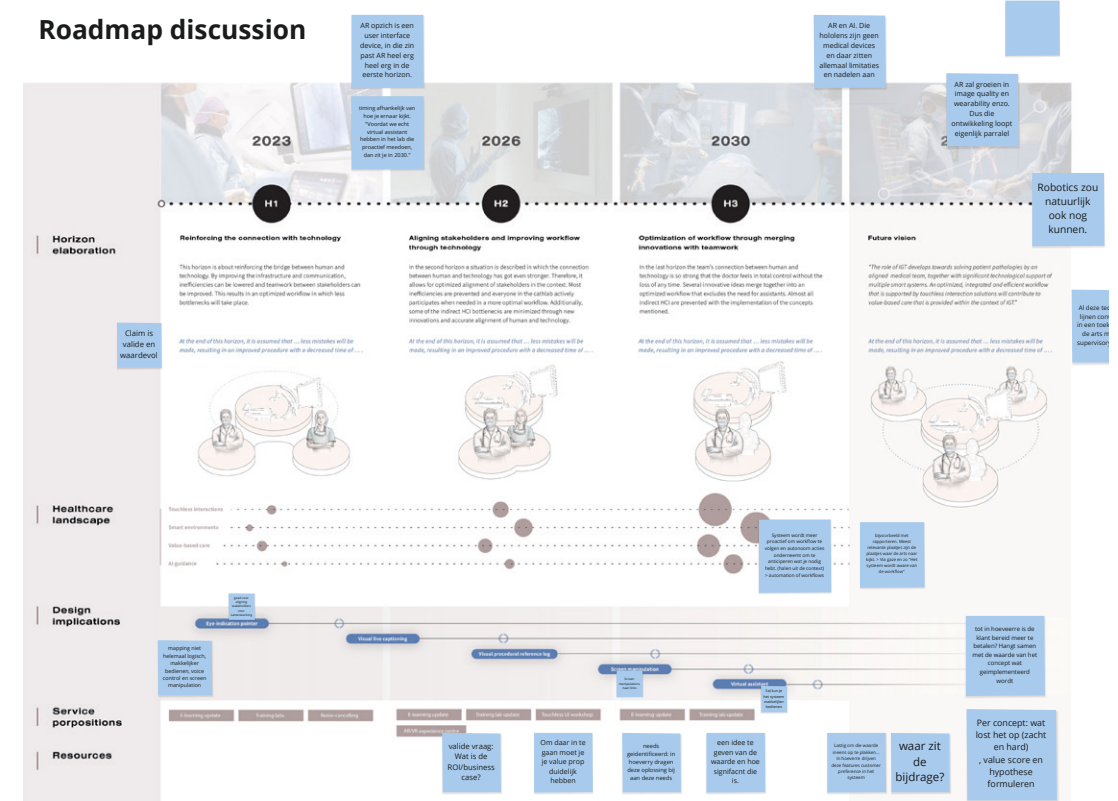


Concept mapping

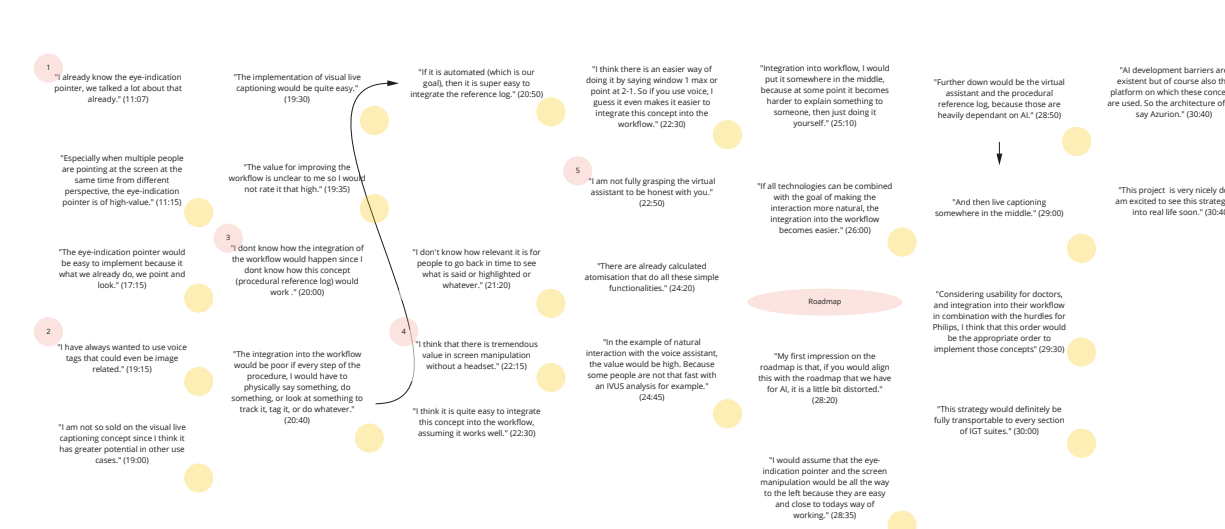


Feedback on the roadmap and on specific parameters of the roadmap to gain insights into additions for the strategy.

Roadmap discussion

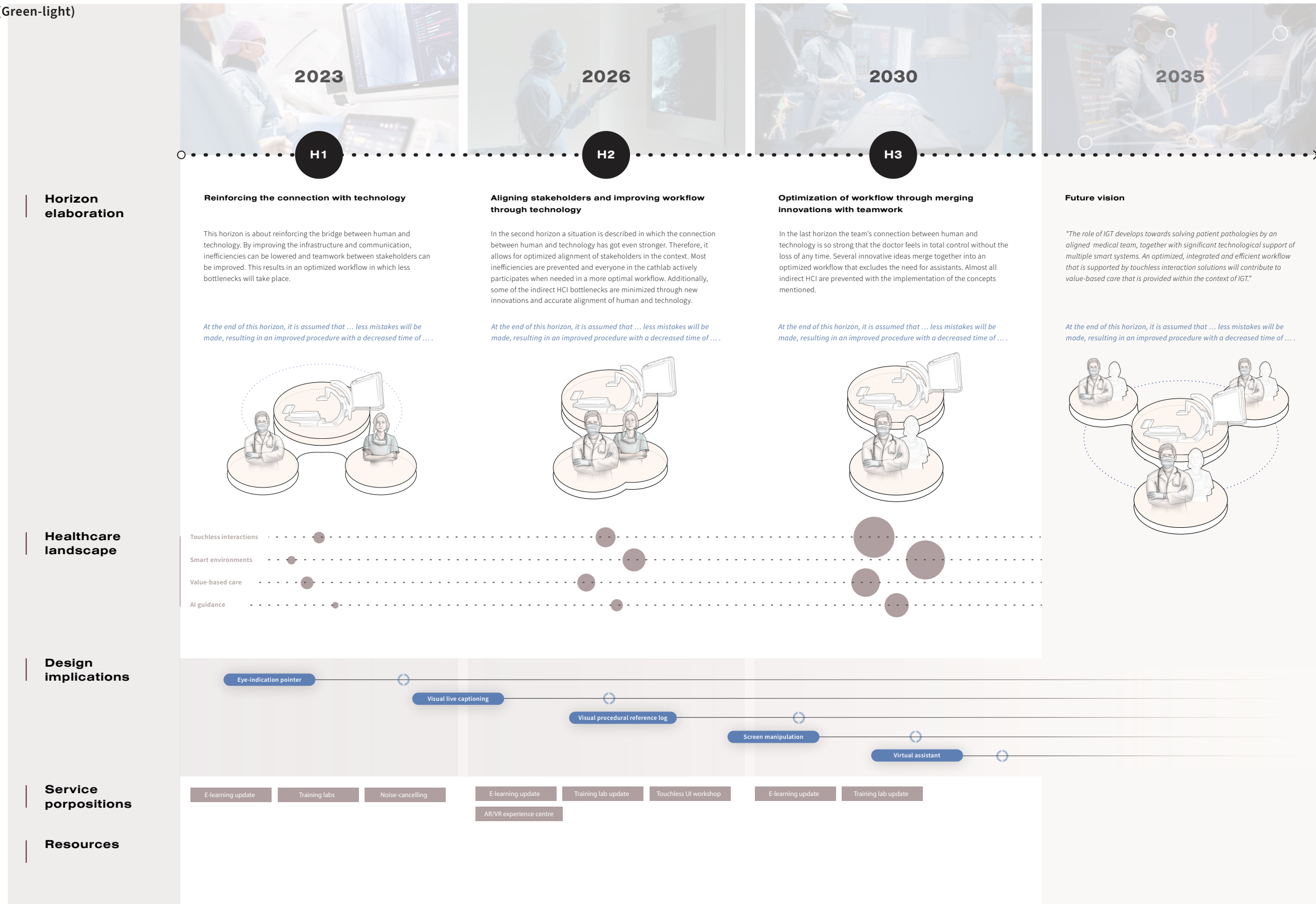


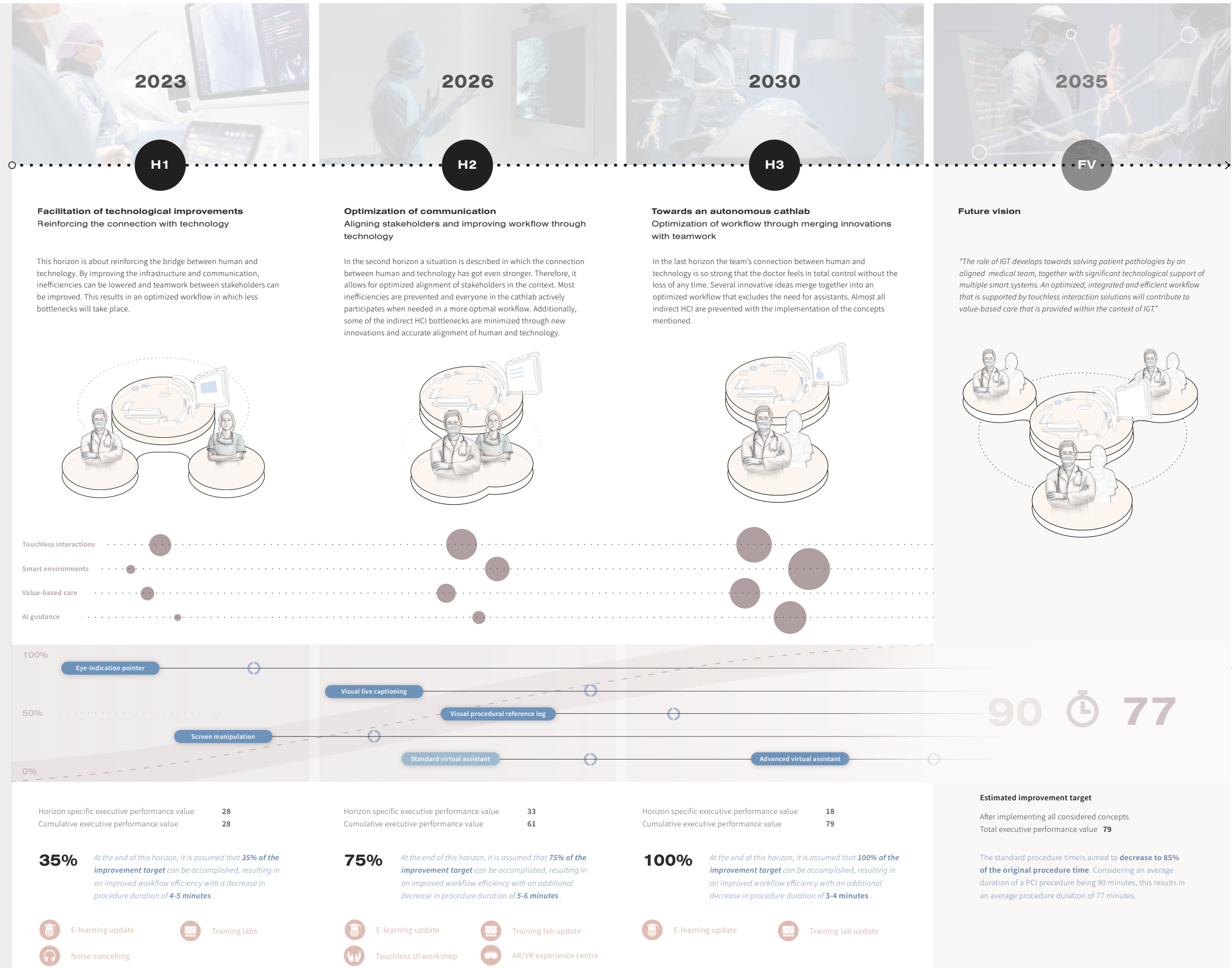
Interesting quotes from Atul and Niels



Appendix - K Roadmap

Preliminary roadmap (Green-light)

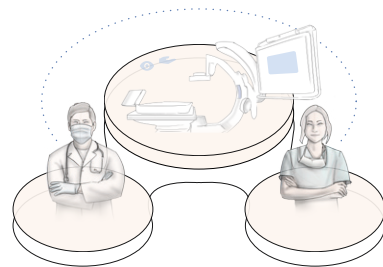




Horizon elaboration

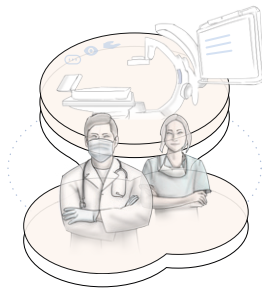
Facilitation of technological improvements
Reinforcing the connection with technology

This horizon is about reinforcing the bridge between human and technology. By improving the infrastructure and communication, inefficiencies can be lowered and teamwork between stakeholders can be improved. This results in an optimized workflow in which less bottlenecks will take place.



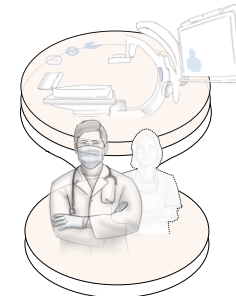
Optimization of communication
Aligning stakeholders and improving workflow through technology

In the second horizon a situation is described in which the connection between human and technology has got even stronger. Therefore, it allows for optimized alignment of stakeholders in the context. Most inefficiencies are prevented and everyone in the cathlab actively participates when needed in a more optimal workflow. Additionally, some of the indirect HCI bottlenecks are minimized through new innovations and accurate alignment of human and technology.



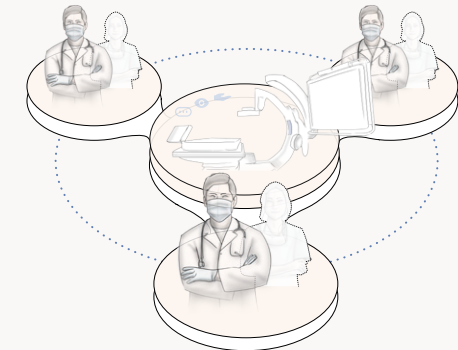
Towards an autonomous cathlab
Optimization of workflow through merging innovations with teamwork

In the last horizon the team's connection between human and technology is so strong that the doctor feels in total control without the loss of any time. Several innovative ideas merge together into an optimized workflow that excludes the need for assistants. Almost all indirect HCI are prevented with the implementation of the concepts mentioned.

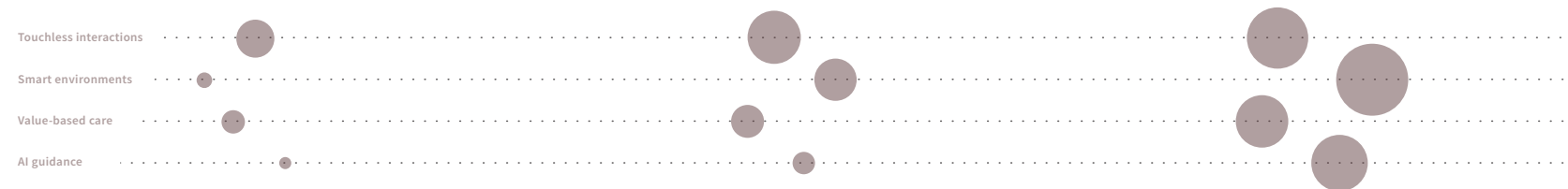


Future vision

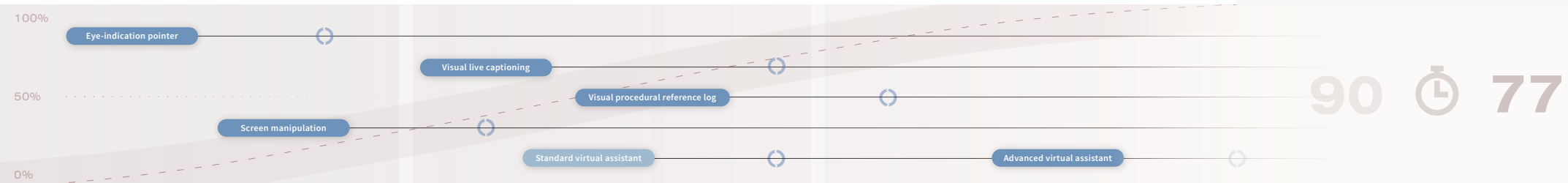
"The role of IGT develops towards solving patient pathologies by an aligned medical team, together with significant technological support of multiple smart systems. An optimized, integrated and efficient workflow that is supported by touchless interaction solutions will contribute to value-based care that is provided within the context of IGT."



Healthcare landscape



Design implications



Estimated value

Horizon	Horizon specific executive performance value	Cumulative executive performance value
H1	28	28
H2	33	61
H3	18	79

35% At the end of this horizon, it is assumed that 35% of the improvement target can be accomplished, resulting in an improved workflow efficiency with a decrease in procedure duration of 4-5 minutes.

75% At the end of this horizon, it is assumed that 75% of the improvement target can be accomplished, resulting in an improved workflow efficiency with an additional decrease in procedure duration of 5-6 minutes.

100% At the end of this horizon, it is assumed that 100% of the improvement target can be accomplished, resulting in an improved workflow efficiency with an additional decrease in procedure duration of 3-4 minutes.

Estimated improvement target






After implementing all considered concepts
Total executive performance value 79

The standard procedure times aimed to decrease to 85% of the original procedure time. Considering an average duration of a PCI procedure being 90 minutes, this results in an average procedure duration of 77 minutes.

Service porpositions

- E-learning update
- Noise-cancelling
- Training labs
- E-learning update
- Touchless UI workshop
- Training lab update
- AR/VR experience centre
- E-learning update
- Training lab update

Appendix - L Assessment of concepts based on design guidelines

Assessment of the concepts on design considerations	Assesment of concepts on design considerations									
										
Design considerations	Eye-Indication pointer	9	Virtual Assistant	8,7	Visual IGT chatbox	8	Visual Log	6,1	Screen manipulation	8,9
There should be an immediate value noticeable in this interaction	10	I think this is easily recognized as one of the most valuable and simple concepts	10	I think doctors would understand why this is valuable when you are dependant on inexperienced staff	6	I dont know if doctors directly understand what the vale is of this technology until they know. Until they encounter a miscommunication or error.	3	It is not directly valuable to doctors since they do not realise that it would be beneficial to have a real time logging application	10	I think doctors recognize this as one of the main barriers that is now tackled
The interaction should be comfortable for the user	10	This is exactly what they normally do	8	sometimes you have to think for a bit but overall I think it does not fatigue the doctors	9	You can either look at your screen or not, therefore the effort and comfort is very positive	8	sometimes you have to think for a bit but overall I think it does not fatigue the doctors	7	You have to actually do gestures to operate with the system, however I think that these are minimal effort gestures that are still quite comfortable.
The system should provide feedback	8	You get immediate feedback from pointing at the screen	7	There is an icon and signal that provides feedback for the user that the device is listening, however, with voice devices this is always difficult with initiation and deactivation	10	the whole concept is providing actual feedback	5	It is hard to provide feedback when you are doing gestures so there should be some kind of initiation signal	7	It is hard to provide feedback when you are doing gestures so there should be some kind of initiation signal. However, with this concept, there is an indication on screen of an Area Of Interest.
possibility to fall back on standard procedure?	10	Yes automatically, however, this will not matter really	10	yes there is but you dont want the voice assistant to keep listening for unintended commands	10	You can always shut it off	10	You can always shut it off or simply not use it.	10	You can always shut it off and just fall back on your healthcare team
The system should be easily integrated into the systems of cathlab	10	Very easy implementation with cameras, not much has to happen in order to implement this	8	I guess it is fairly easy, however, there should be very complex software that can be used at all times which could make it more complex integration	6	Noise interference is a known problem for concepts like these, therefore, it could be difficult to integrate it into the cath lab.	4	This registers voice, eye-gaze and gestures so the integration with the system will become more complex and cause some barriers	10	Very easy implementation with cameras, not much has to happen in order to implement this
Is it tackling relevant problems / opportunities?	7	Yes in a way it does. It improves a very specific kind of communication which has a lot of occurrences in a procedure	8	Yes it decreases the dependency on staff that makes mistakes and is inefficient. This is recognized as one of the biggest frustrations of doctors	8	I still think miscommunications are a big problem in the cath lab, there it is relevant to optimize communication	5	It only improves the referencing of what is done, this problem was not defined in my analysis, however, still could be useful	10	Yes this is also recognized as one specific situation in which you often have to wait for a long time on your technician or other staffmember to adjust this.
Is there room for rapid development in this concept?	8	I guess it could improve in a multi-user sense. Also that a virtual screen would appear in front of the necessary stakeholders. not much more I think	10	This technology can improve quite a bit since it fully relies on the newest technologies that keep improving.	7	I guess the technology behind this system could improve, but also the visual layout and presentation: on screen, on window, as a hologram, on the wall	8	Maybe this concept could log medical files in a later stage so that doctors don't have to do this. Then it would already pick the best photos and highlights the used angiosculpts and so on,	8	Maybe this technique could be applied on more modalities, however, the technology can improve but not much else

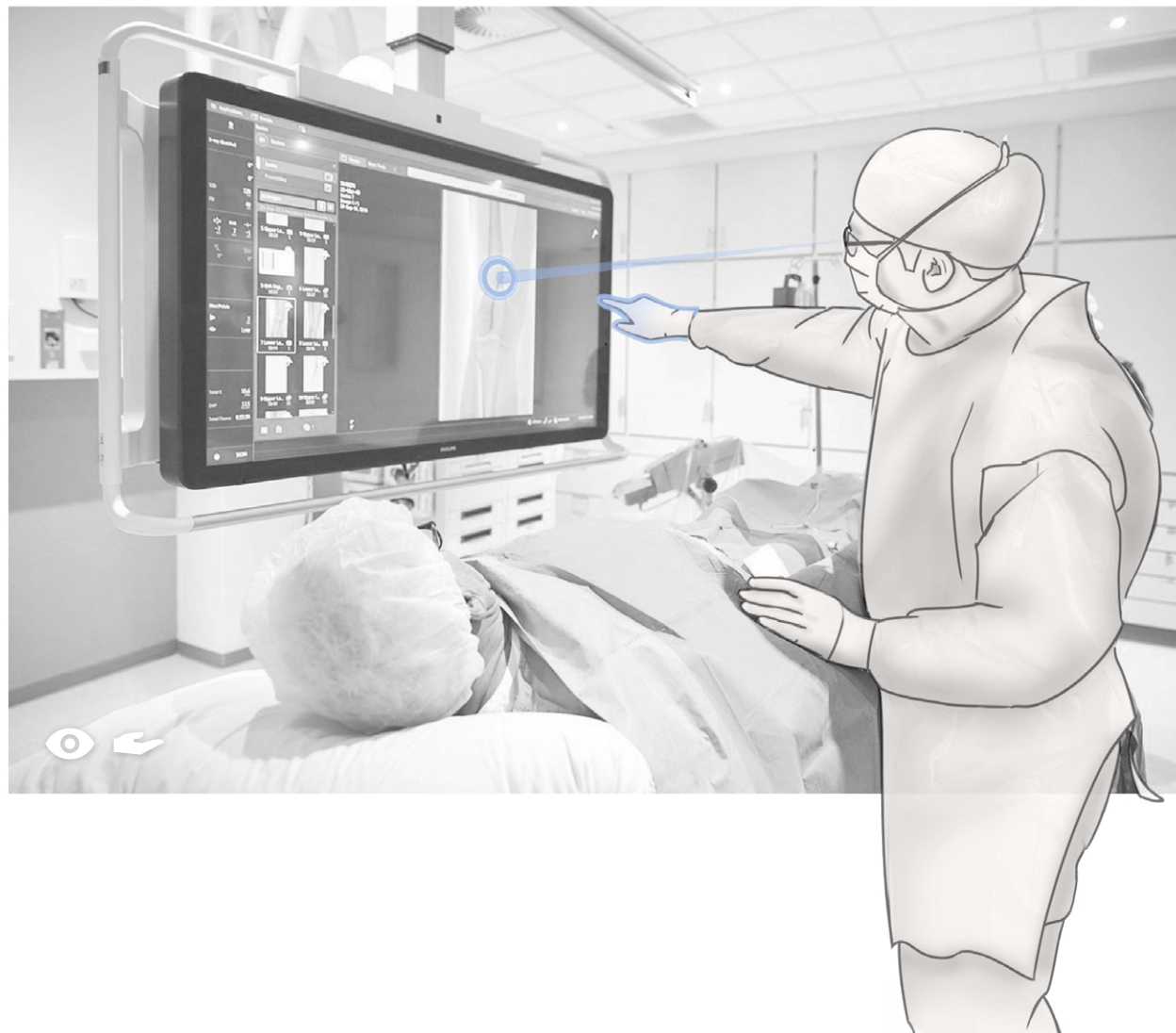
Assesment of concepts on design requirements

Assessment of the concepts on design requirements	Eye-Indication pointer		Virtual Assistant		Visual IGT chatbox		Visual Log		Screen manipulation	
Design requirements										
	8,9		8,2		7,9		6,6		9,2	
reducing indirect HCI and minimizing dependency on staff	4	In a way it minimizes the dependency since less inefficient repetition is happening	10	It literally replaces action that staff would do	5	Again it allows for less miscommunication and therefore inefficient repetition	4	minimally, since now they don't have to ask again what is done or what is meant	10	It literally takes over one of the main inefficiencies caused by dependency on staff
The interaction should be reliable	10	This interaction is expected to be very reliable since you initiate it very consciously	6-9	Depends on the development of AI algorithm and commands (therefore, a range)	9	Very reliable since it is quite easy to record what is said and process that to text	8	I could imagine that recording everything can be quite complex, therefore, is is not maximally reliable	9	Easy interaction so not much can go wrong if doctors are trained properly.
The interaction should be accurate	10	This is a very accurate combination of technology that results in very accurate communication	6-9	depends on the speech - to - text technique, AI algorithm behind the assistant and the commands given.	8-9	depends on the speech - to - text technique, AI algorithm behind the technology	9	It should work very accurate since proper techniques are used that require a lot of accuracy	10	There is buffer for offset and therefore, you should always get accurate results
The interaction should be natural and seamless	10	This is literally something that we already do when we indicate something	7-10	depends on the type of communication: specific commands (7), conversation (10)	9	This is also what already happens in the context of the cath lab	7	going back in time to see what is logged is maybe a bit less natural but the rest is subconsciously tracking of input.	9	The interaction style is something that feels familiar, therefore it is very natural.
The interaction should be simple	10	Very simple interaction that everyone is familiar with	7	maybe some cognitive load emerges when using this technology since you have to think about what you are going to say	8	The thing you do is talk, that is simple, however the reading aspect makes it not maximally simple	5	I think this will be somewhat complex to use since it gives a wide range of information and interaction options.	8	The interaction itself is expected to be quite simple.
	8,9	9	8,2	8,7	7,9	8	6,6	6,1	9,2	8,9
	Eye-Indication pointer		Virtual Assistant		Visual IGT chatbox		Visual Log		Screen manipulation	

Appendix - M Design implications

"The interaction should be natural, reliable and most of all, the doctors have to see the immediate and direct value." – Annemiek Monhemius, Clinical application specialist – Philips.

EYE-INDICATION POINTER



VISUAL LIVE CAPTIONING

"Intraoperative communication is often error-prone and time consuming since the other stakeholder has to understand perfectly what you are requesting." – Em. Prof. dr. Jack Jakimowicz, Professor of safety in healthcare – TU Delft.



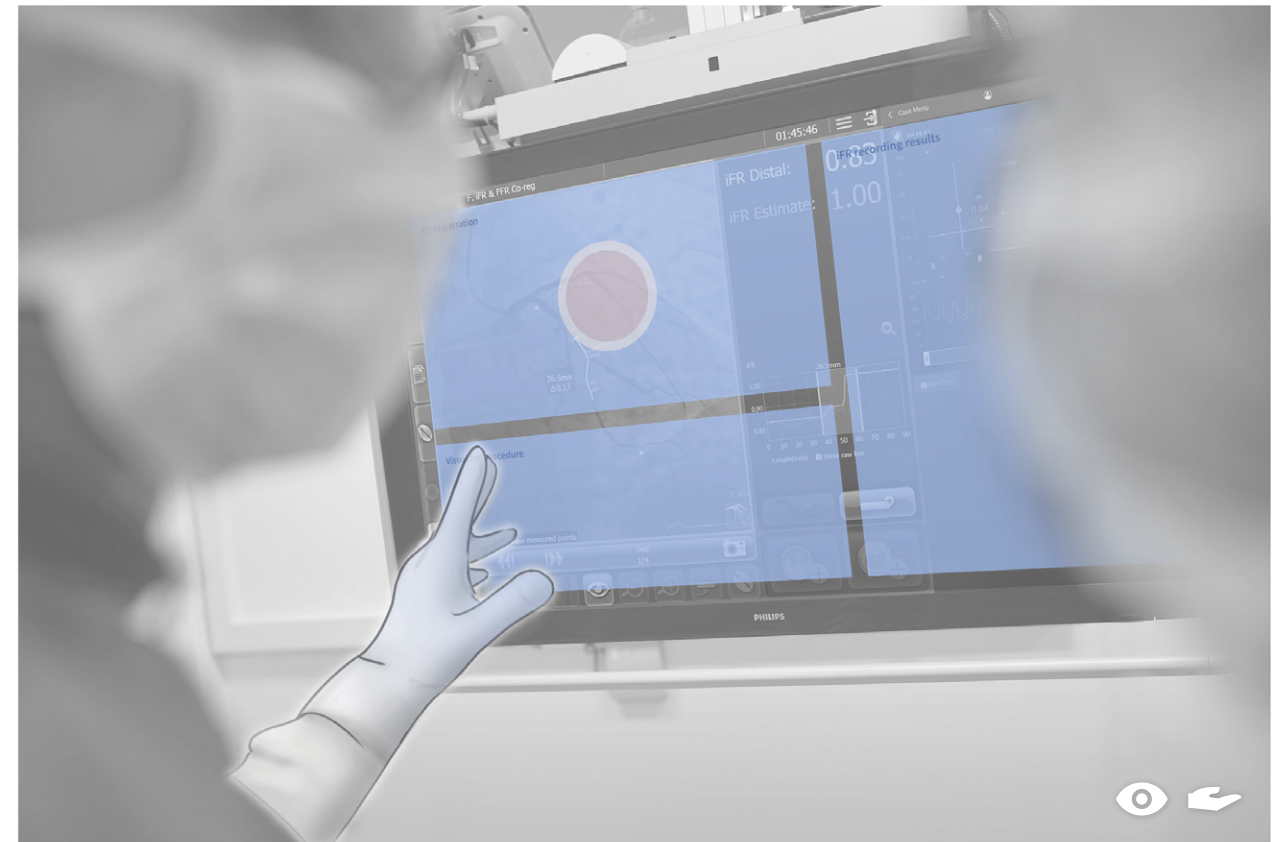
"Within Image-guided therapy, there is a need for refinement and application of improved materials and tools." – Em. Prof. dr. Jack Jakimowicz, Professor of safety in healthcare – TU Delft.

VISUAL PROCEDURAL REFERENCE LOG



SCREEN MANIPULATION

"The doctor's main focus is always the screen in IGT." – Robert van Overbeek, Ex-vascular lab technician & Clinical specialist – Philips.



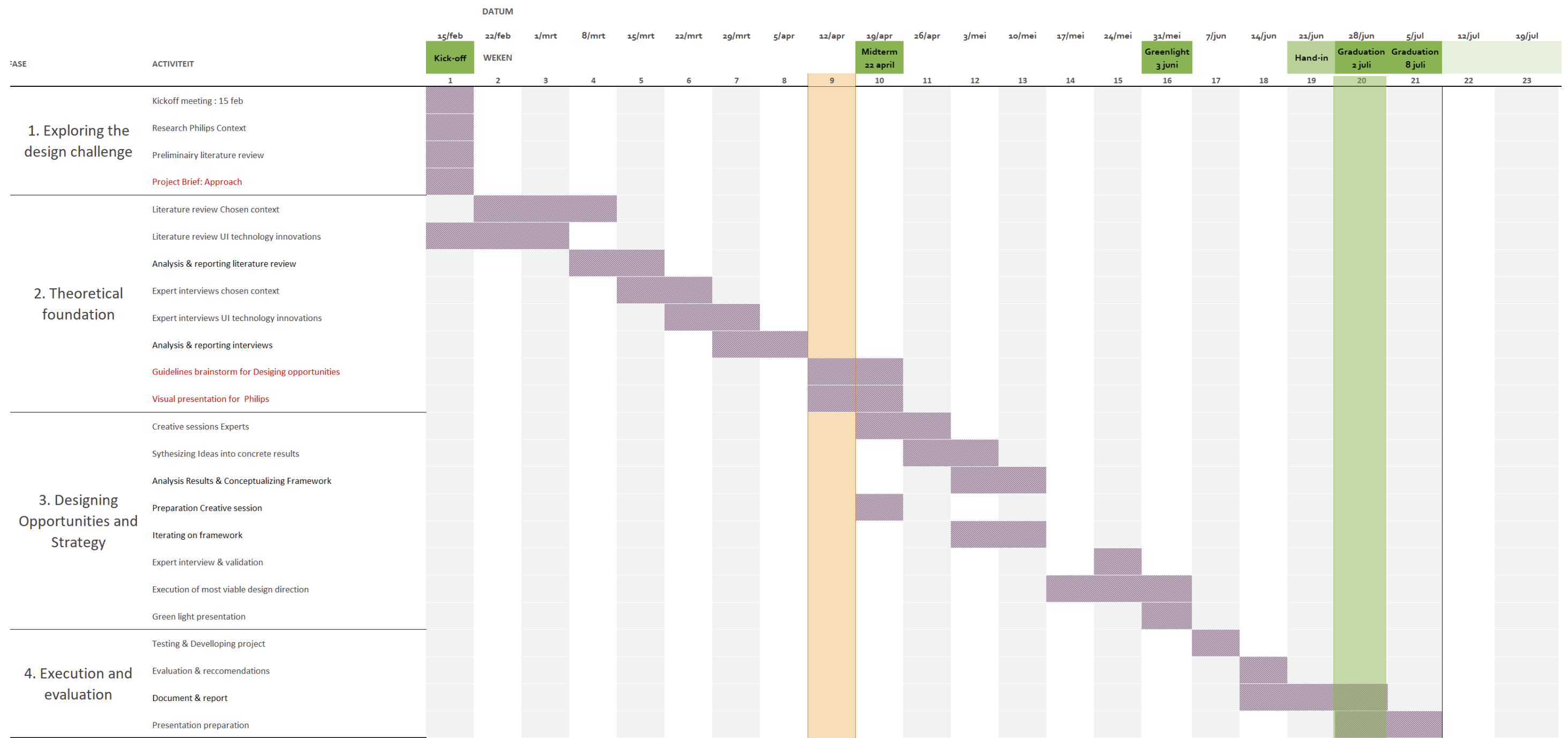
"In an OR setting in most cases there is an experienced team which will assist you during the procedure. However, if this is not the case due to circumstances it can be difficult and time-consuming if you can't rely fully on your team members." – Kirsten Huntjens, Ex-vascular surgeon & Clinical specialist - Philips.

VIRTUAL ASSISTANT

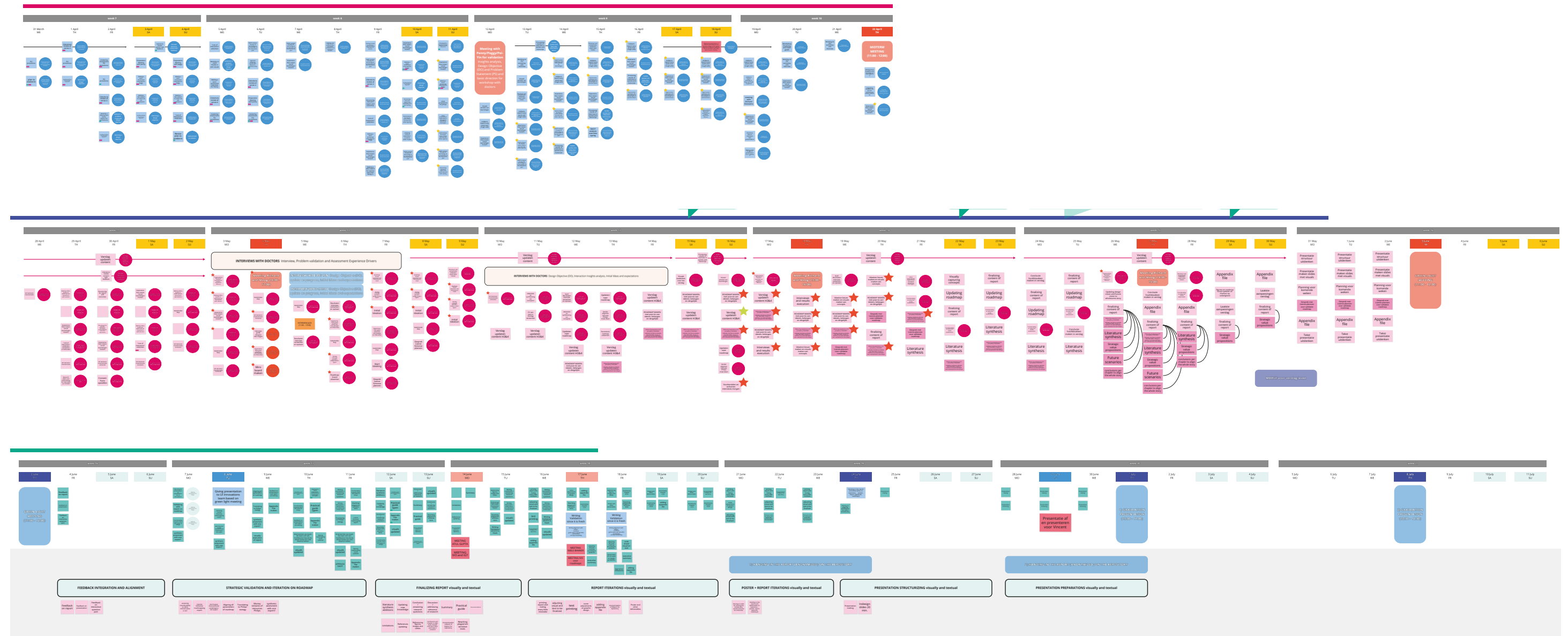


Appendix - M Personal planning

Initial planning overview



Day-to-day planning schematics from Miro



Appendix - N Personal reflection

At the end of this project, it is appropriate to write a personal reflection of this project to address what I have learned and developed in the past 20 weeks. So, looking back at this project I can see that I have developed in both professional and personal ways. Building on to the foundation of knowledge and experience that I have gained in the past six years, certain personal goals are definitely achieved. I am very grateful for the position in which Philips (and my coach) gave me the freedom and grips to develop myself in a professional environment. It was an environment in which I was not afraid to make mistakes and was open for feedback to improve myself and my project. In this reflection, I will look back at the initial personal learning objectives, that are defined in the graduation proposal. Also, I will address several other learning objectives that were not defined at the start of this graduation project.

Personal learning objectives

During the initial phase of this graduation project, I wrote down some learning objectives that I was aiming to achieve in order for me to set development goals. These objectives are discussed and reflected on below.

01 Understanding of technologies and the implementation into a complex medical design context

"I want to understand how combinations of UI techniques can be implemented in practice. During this project I want to get more familiar with a step further: implementation in practice. Especially with new technologies like these."

This learning objective is definitely achieved. I gained a very deep understanding of all touchless UI technologies and how they are supposed to be used in design. By reading a lot of literature, watching videos, doing AR experiments myself and talking to people about it, a thick understanding is established. Additionally, for the most part, I understand the

complex context of IGT very well. Considering the level of design integration that this project is scoped on. Integrating new innovations in contexts like takes a lot of time, is very complex and consideration of the end-users.

02 Strategically substantiation of a roadmap

"I want to obtain a deeper understanding on how to make such a roadmap strategically substantiated. This will help me make this project more valuable. Additionally, it will help me in the future when I am working on similar projects in practice."

The learning objective mentioned above is something that has always been difficult. When is something strategic? Well, for this graduation project I have definitely gained experience in establishing strategically substantiated deliverables. For example, taking into account Philips and aligning the roadmap to their strategy, (future) needs, and goals in order to make a business case, made this roadmap strategically substantiated.

03 Operating in a professional company

"I want to understand how these innovation projects are setup in a big professional company. I have always been interested in the implementation of innovative technologies. Understanding how this works in a corporate structure, will be insightful."

Philips providing me with the business infrastructure, company office and the nice colleagues has definitely given me initial insights and experience in ways to operate in a professional company. Managing projects, setting-up meetings, organizing brainstorm sessions, company structure, etcetera are examples of things that gave me in idea on how innovation projects are set up in Philips.

04 Communicating my project

"I want to learn to communicate my design process in a clear way for corporate (non-)designers."

The personal learning objective above is something that I have learned quite well during the course of this project. By talking to a lot of different stakeholders and asking them for feedback, gave me a wide range of listeners. I adjusted my text and presentations to the audience. This gave me more confidence in my project and also awareness of the gaps within this project.

05 Reflection and making design decisions

"I want to learn how to reflect and make clear, deliberate decisions in order to achieve my initial goal. This is all about good project management. This can lead to a better results and clear communication. It will result in me being confident in the design decisions that I make."

The objective mentioned above has always been a topic of attention for myself. During the course of this project, I think this improved quite a bit. I was able to deal with critical feedback, reflect on my own process, make adjustments to my design process and make deliberate design decisions that increased the quality of my project. Therefore, I gained a lot of confidence in myself regarding managing my own project. However, I do think that this will always be something for me to keep improving.

Other learnings

During the course of this project I used Miro for everything. This programme allowed me to manage my project extremely effective. Making day-to-day planning, making a structure for the report, doing analyses, conducting interviews, analysing results, ideation sessions, setting up the roadmap, etcetera are examples of what Miro enabled me to do. The visual representation that it provides works really well for me. I think I can call myself a Miro expert at this point!

Due to that programme, I was able to be really consistent and conscious about my planning. I think that this is also the reason that I was able to execute this project so efficiently. Scheduling and preparing meetings with a planning made me confident in managing and leading that meeting towards a successful conclusion.

Because of the multiple presentation that I had to give at Philips, I think that I got better at doing this as well. I am aware of elements for improvement regarding presentation skills, however, I think I gained a lot of experience by doing it so often.

In general, I must say that one of the biggest learnings of this graduation project was my professional confidence. Graduation in times of a pandemic is sometimes difficult, especially when you are doing an individual project. Before starting this opportunity, I was quite insecure about my capabilities as a student, as a colleague, as a manager of myself, and as a designer. However, this project really helped me understand what I am good at, that I can trust myself with it, where my value lies, and so on. Therefore, I am very grateful for the supervision that I got by always giving me the feeling of trust that you have in me and my project. Thank you.

Kind regards,
Victor Wijn



Appendix - O Graduation project brief

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name <u>Wijn</u>	Your master programme (only select the options that apply to you):
initials <u>V</u> given name <u>Victor</u>	IDE master(s): <input type="radio"/> IPD <input type="radio"/> Dfl <input checked="" type="radio"/> SPD
student number <u>4369564</u>	2 nd non-IDE master: <u>-</u>
street & no. _____	individual programme: _____ (give date of approval)
zipcode & city _____	honours programme: <input type="radio"/> Honours Programme Master
country _____	specialisation / annotation: <input checked="" type="radio"/> Medisign
phone _____	<input type="radio"/> Tech. in Sustainable Design
email _____	<input type="radio"/> Entrepreneurship

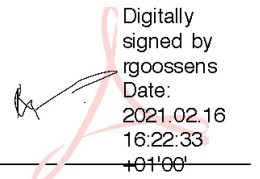
SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair _____ dept. / section: _____	<p>Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.</p> <p>! Second mentor only applies in case the assignment is hosted by an external organisation.</p> <p>! Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.</p>
** mentor _____ dept. / section: _____	
2 nd mentor _____	
organisation: _____	
city: _____ country: _____	
comments (optional) _____	

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair _____ date 16 - 02 - 2021 signature  Digitally signed by rgooossens Date: 2021.02.16 16:22:33 +0100

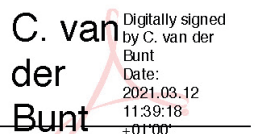
CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 30 EC YES all 1st year master courses passed

Of which, taking the conditional requirements into account, can be part of the exam programme 30 EC NO missing 1st year master courses are:

List of electives obtained before the third semester without approval of the BoE _____

name _____ date 12 - 03 - 2021 signature  Digitally signed by C. van der Bunt Date: 2021.03.12 11:39:18 +0100

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)? APPROVED NOT APPROVED
- Is the level of the project challenging enough for a MSc IDE graduating student? APPROVED NOT APPROVED
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

comments: - also approved for Medisign - suggestion to change the title into: A roadmap towards touchless interaction during image guided therapy (IGT)

name _____ date 29 - 03 - 2021 signature _____

A Roadmap towards Touchless Interaction during Image-guided Therapy project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 15 - 02 - 2021 end date 09 - 07 - 2021

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

This graduation project focuses on exploring the technological possibilities of touchless interactions in a medical environment. Examples of these medical environments are; during surgery in an Operation room (OR), during Image Guided Therapy (IGT), on the Intensive Care Unit (ICU), in the Emergency Department and areas with contagious diseases, such as COVID. In these medical environments, touch-based interaction such as via keyboard and mouse is often problematic when the hands are busy treating the patient. Or in other cases that have to do with hygiene constraints. This results in inefficiencies and errors caused by colleagues doing the interaction, strict cleaning protocols, and/or wearing gloves etcetera.

Philips is exploring touchless interaction to minimize these addressed issues. An example that can be given is that Philips is exploring Mixed Reality. However, this technology is still quite advanced and complex which makes it less applicable in several situations. Therefore, Philips is exploring alternative solutions to tackle this problem. There is a lot of development in possibilities with User Interaction (UI) techniques like: Eye-gaze, Speech interaction and Gesture sensing. When these can be combined efficiently, it is expected that this provides good alternatives for certain situations. This way, there is room for a broad spectrum of new possibilities in the area of innovative interaction solutions in a hospital.

Since a hospital is a very broad context, this project will mainly focus on the possibilities in a specific use case during Image Guided Therapy (IGT). This is a relatively new surgical procedure that allows for a lot of minimal invasive surgery techniques. The technology provides clinical solutions in nine different 'suites': a coronary suite, a vascular suite, a neurological suite, a oncology suite, etc. . The value of this medical innovation lies in all the aspects of the Quadruple Aim of Philips: the improved quality of care, the improved patient experience, the reduced costs, and the improved experience of the medical staff. Since this is a multi-user environment, it contains a lot of equipment and there are a lot of different stakeholders and manufacturers, this context is quite complex. A lot is happening at the same time and everything has to be sterile due to the earlier mentioned hygiene constraints. However, this complexity allows for good opportunities to improve the performance of the execution of medical procedures happening in IGT.

The stakeholders in these context are mainly, multiple doctors and nurses, and in most cases one patient. This patient are usually seriously ill and in need of specialized care or surgery.

The aim of this graduation project is to map opportunities and barriers of combinations of touchless interaction solutions in a specific context. Therefore, it is important to document a strategic foundation so Philips can use this knowledge as guidance to develop their technical capabilities to exploit these UI innovations as strategic implementations. This way, they can improve their design solutions and drive innovation for touchless interaction in medical environments.

space available for images / figures on next page

introduction (continued): space for images



image / figure 1: Future Vision of Image Guided Therapy with Mixed Reality - Philips



image / figure 2: Current surgical process in an IGT context with Azurion - Philips

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Since very strict hygiene constraints limit the performance of the healthcare staff in these medical environments, a lot can be improved on the procedures that the healthcare staff execute. This relates to one of the aspects of the Quadruple Aim of Philips. I would like to focus on improving the staff performance within the IGT context. An improved staff performance adds value for Philips but also for healthcare in general. This leads to the following research question:

How can the healthcare staff be supported by combining touchless interaction solutions, during surgery in an IGT context, to improve performance?

This research question could be divided into several sub questions. This helps structuring the overarching research goal into several specific subjects.

- SQ1: How can the performance of the healthcare staff be improved?
- SQ2: How can touchless UI interaction solutions optimally be combined and applied?
- SQ3: How does surgery work in an IGT context?

The design goal is having a strategic foundation that can deliver concrete insights and provide guidance in implementation possibilities of these touchless UI innovations in this healthcare domain. Several difficulties in this project are: healthcare related restrictions that should be taken into account and analyzing the complex workflow of these procedures.



ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This project will explore the possibilities on how to improve the performance of healthcare professionals in IGT, through implementation of touchless UI technologies. A strategic document (roadmap) will be designed based on input from various stakeholders. This will provide guidance to prioritize innovation activities.

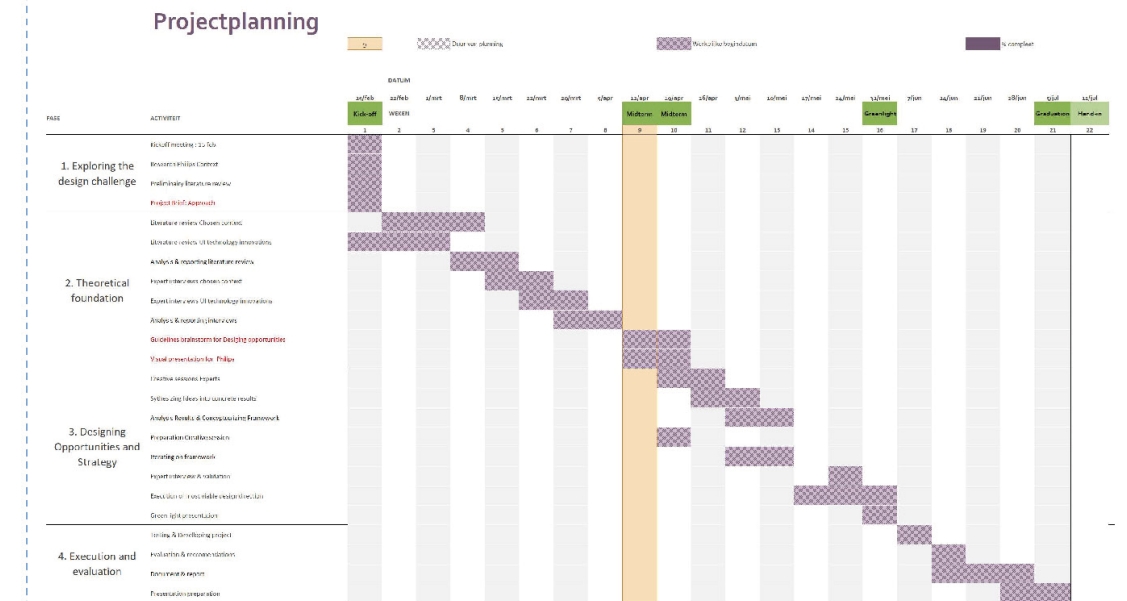
In my literature review, I will explore the strengths and challenges of the UI technologies in order to get an idea of the possibilities to improve the experience of the staff in a healthcare setting. Resulting in an overview on how these technologies may support each other. Additionally, the medical context has to be explored and taken into account in order to synthesize the findings.

Armed with good examples from the literature review, I will investigate what the opportunities and barriers are to integrate these interaction technologies into Philips' solutions. By conducting interviews and/or hosting creative sessions, I will creatively explore these possibilities to tackle specific problems found in the literature review. These results will be synthesized into a strategic roadmap to implement touchless interaction. Elements that are addressed in this document are, for instance: opportunities, barriers, stakeholders, resources, integration possibilities and direct value. In the future, it would allow for efficient touchless interactions that minimize the limitations of hygiene constraints. Therefore, this project will result in a deliverable that drives innovation for better healthcare.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 15 - 2 - 2021 9 - 7 - 2021 end date



The planning made in Excel includes 4 main stages: 'Exploring the design challenge', 'Theoretical foundation', 'Designing opportunities and strategy' and 'Execution and evaluation'. In the first phase, I will explore the graduation assignment by doing literature research and simple interviews with people that are knowledgeable in this field. I want to achieve a better foundation of knowledge about subjects in this assignment: teamwork efficiency, IGT context and UI technologies.

In the second phase, the literature review will be finished and a lot of in depth knowledge is gathered and reported. In this phase, I will be doing a lot of academic reading but also in-depth interviews with experts. At the end I want to conclude several guidelines to facilitate my designing process in the upcoming phase.

In this third phase, it will mostly be about synthesizing all the data into ideas and capturing them in a framework that is validated by experts. Additionally, I want to elaborate on one of these viable directions in order to give an idea of what is possible with this strategic foundation.

In the last phase, I will document everything into a report and clear story for a presentation. In order to successfully finish this project, there will be an evaluation and further recommendations.

When I take into account the holidays during this academic semester, I will spend a total 21 weeks on this project in order to meet the 100 day guideline.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, Stick to no more than five ambitions.

During my bachelor degree at the TU Delft I discovered the medical design context that I was most passionate about. That was during my Biomedical Engineering minor which really interested me. Therefore, I knew I wanted to continue working on design projects related to healthcare. Applying for a Medesign specialization during my master programme SPD, allowed me to work on several interesting health related topics. I quickly noticed that the Healthcare context is a very relevant and fitting environment for new ideas and innovation. Additionally, I think it will always be desired to improve care. Thus, I aimed to graduate by combining Strategic Design with Healthcare. When a very interesting opportunity was provided to me by the company Philips, I knew that I had to take it.

In order to develop myself during this project, I formulated the following learning objectives:

Project learning objectives:

01 Understand how combinations of UI techniques can be implemented in practice. During this project I want to get more familiar with a step further: implementation in practice. Especially with new technologies like these,

02 Obtaining a deeper understanding on how to make such a framework strategically substantiated. This will help me make this project more valuable. Additionally, it will help me in the future when I am (hopefully) working on similar projects in practice.

03 Understand how these innovation projects are setup in a big professional company. I have always been interested in the implementation of innovative technologies. Understanding how this works in a corporate structure, will be insightful.

Process learning objectives

01 Learn to communicate my design process in a clear way for corporate (non-)designers.

02 Learn how to reflect and make clear, deliberate decisions in order to achieve my initial goal. This is all about good project management. This can lead to a better results and clear communication. Also, it will result in me being confident in the design decisions that I make.

In order to achieve these learning objectives and a good result, I will need some guidance. With my supervisory team I would like to talk about questions I have and other things on my mind related to the design process. I know that sometimes, I find it difficult to define an individual project (scope, analysis, problem, planning, etc.). Therefore, it would be nice to have regularly scheduled meetings where I can give updates and my thoughts on the project.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.