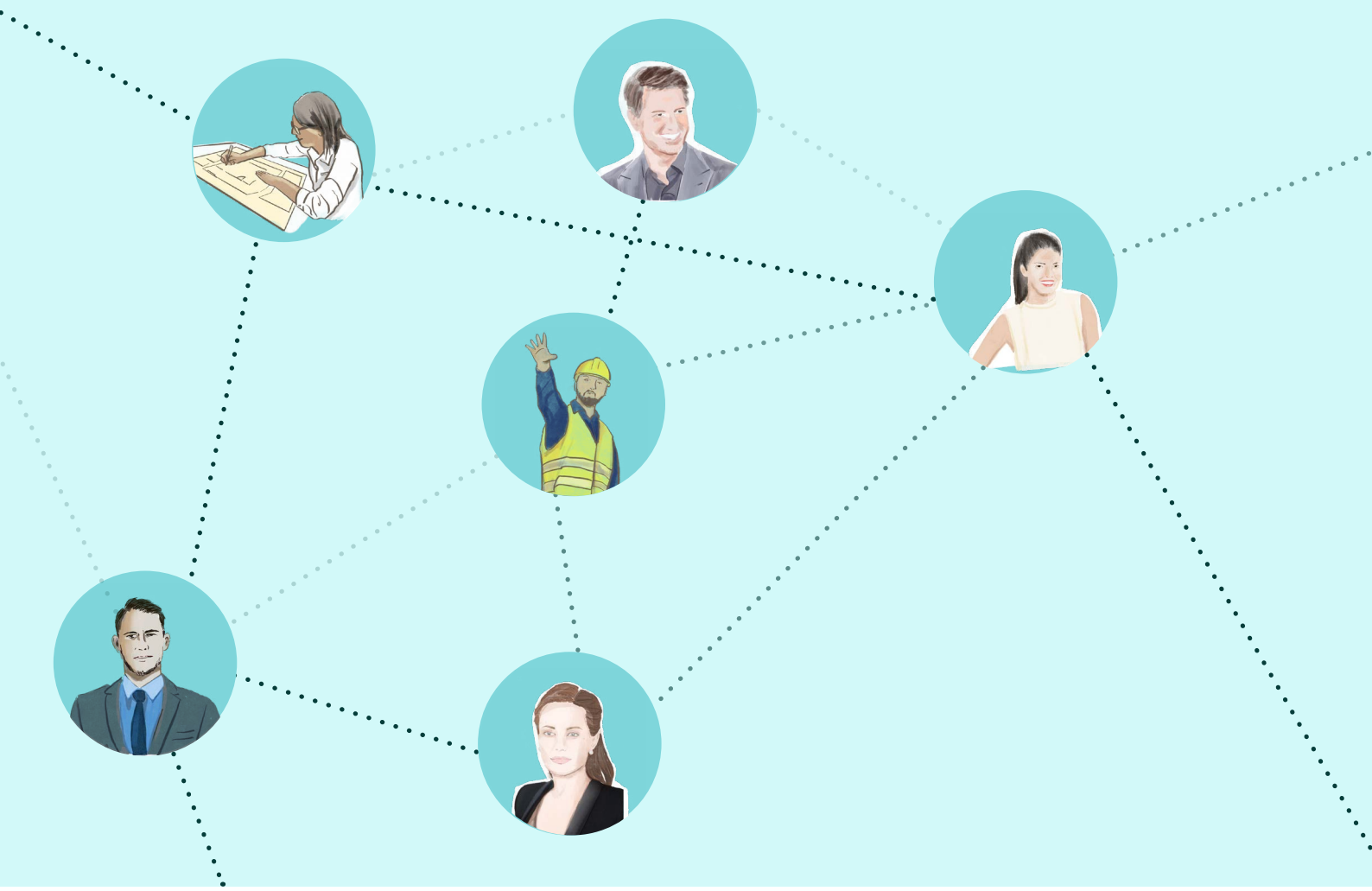
MSc Thesis in Strategic Product Design

Designing an Engagement Strategy to Improve Collaboration in the Construction Industry

Vivian Maretina
2021



TU Delft PHYSEE

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Designing an Engagement Strategy to Improve Collaboration in the Construction Industry

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MSc. Strategic Product Design
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“Things should be made as simple as possible, but not any simpler”

Albert Einstein

TU Delft working space

Acknowledgement

Dank u wel,

This master thesis is dedicated to Physee and other people who are working so hard to make the energy transition better in the future.

Big thanks to my mentor, chair, and company mentor. I feel like I'm part of a family. Thank you, Sine and Jo for always caring, supportive, and responsive to my questions and thoughts. Thank you, Joris for being like my older brother in the company. Thank you for always being supportive, critical, and open. I am very fortunate to be on this graduation team.

I received a lot of support during the graduation in pandemic Covid time. I learned to be more patient, resilient, honest, and supportive. I am so lucky to get affection from groups of people and individuals.

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Lastly, and importantly, thank you for TU Delft and Justus en Louise TU Delft Excellence Scholarship to make my dreams come true.

Met vriendelijke groet,
Vivian

*architecture

Preface

I had less opportunity to have a contribution as an industrial designer in the construction industry, unlike other industries like finance, supply chain, or food. The construction industry is a grey area for industrial designers, vice versa. So when I heard of an opportunity for this project, I am delighted to work on it. I feel this is a challenging yet interesting project to work with as a designer. Working with Physee means I need to understand the construction industry a bit closer. Luckily, I had four architect housemates and a best friend who studies Construction Management which motivated me to work on this project. I also feel this project close to my life in Indonesia when I worked in my dad small store. My dad is a glass (for window) seller who cuts the glass by himself, and I like to observe his work with the glass. So I know a bit about glass, but in reality, I don't understand this industry at all.

Then, how did I get this opportunity?
A close friend of mine told me about Physee. I applied because I was interested in the project problem and the company. I always fascinated with the 'Sustainability' related project. I had an SPD Research project about designer's contentment (well, it has not published anywhere yet). The result showed that the more content, the better outcome will be. A designer can have contentment in their project either from the design outcome, process, or context. Working with Physee means that I will work with the Sustainability context, although the topic is not directly about sustainability. I want to know if I like to work on this project and share my reflection on the last chapter (Author's End Note).

Physee offers an organisational topic and communication problem as the graduation opportunity, which are my interests. Nevertheless, I also want to sharpen my knowledge and skill in Service Design and being a part of a company while doing the project.

I hope this graduation project can be valuable and inspiring for design, construction, and other industries to create a better impact.

About Author

I was graduated from Product Design, Institut Teknologi Bandung (ITB) in 2016 and enrolled Strategic Product Design (SPD) at TU Delft in 2019. I have always fascinated with the Netherlands innovation since she lived in Indonesia. I believe that TU Delft is the best place to study to pursue my dream as a multidisciplinary designer. During my study in SPD, I chose some entrepreneurship courses followed by culture and design courses. Hoping to be a future design leader.

This project is done during the pandemic Covid-19. This quote inspired me at the beginning of the project:

"The solutions to today's problems will lay the foundation for tomorrow's problem, ans so on.

True happiness occurs only when you find the problems you enjoy having & enjoy solving."

Mark Manson, 2016

Executive Summary

Background
The building construction industry is generally known as a procedural project with linear workflow and a traditional mindset. When a disruptive technology arises, the clients and partners face the challenge to understand the technology. In addition, their willingness to change is low.

PHYSEE, a technology company that offers smart engineering solutions for the global energy transition, wants to create an impact on the energy problem in the industry. As a technology-based scale-up company, PHYSEE has less power to influence the stakeholders in the market because they are in the development phase of their business.

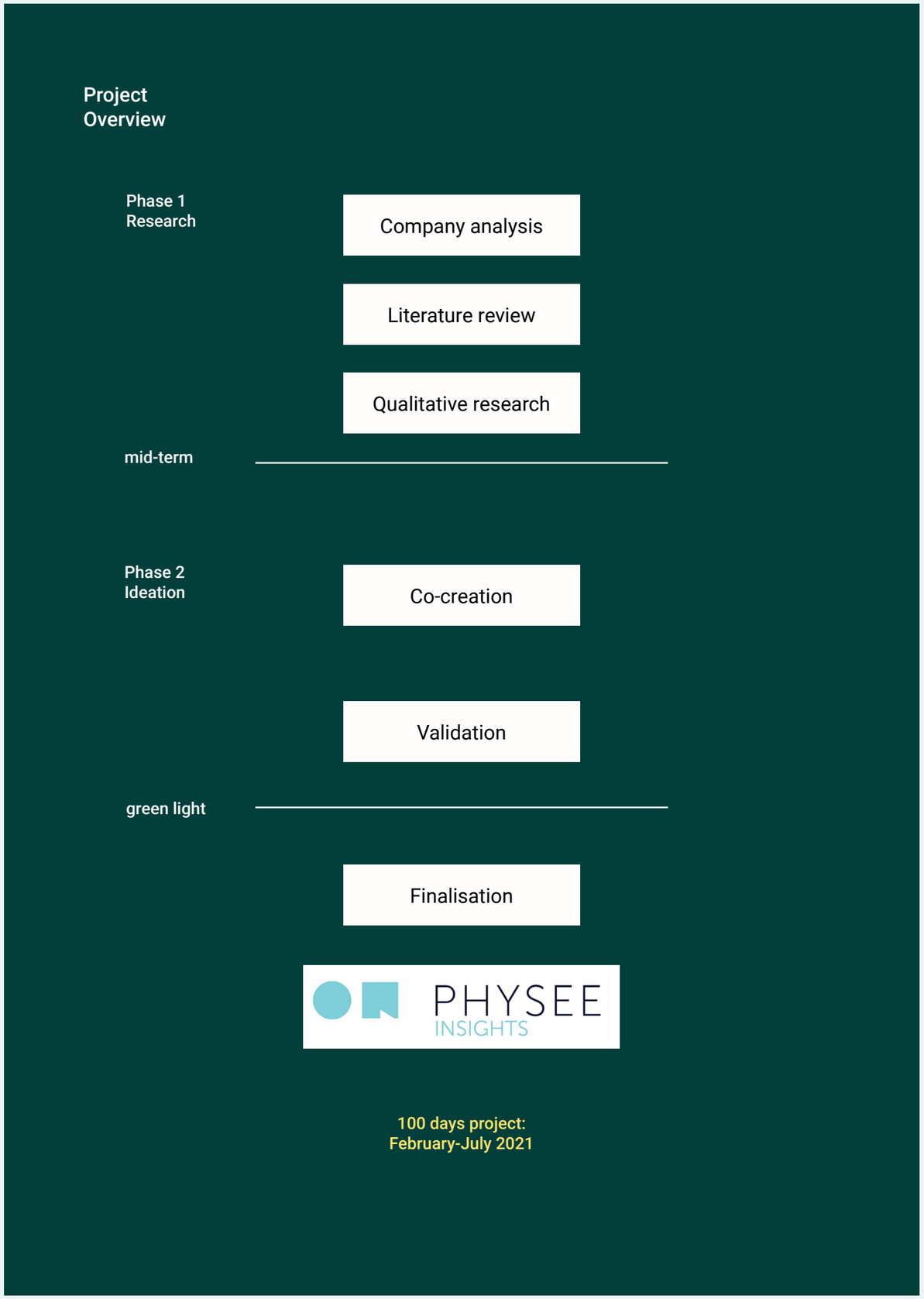
This master thesis aims to create an engagement with the stakeholders to embrace the new technology. The project is to investigate "what is the impact to the construction industry workflow (in this case facade industry)? How does the technology benefit their business?" Because of that, the main question for this graduation project is:
How could Physee communicate their strategy, value, and structure to the stakeholders and engage them in the process?

Method
The project process is very iterative using the Design Method by adapting the Double Diamond Service Design (British Design Council). Within the research phase of this research project, a literature review and qualitative research were carried out. Then, the analysis is conducted using some tools and co-creation is conducted to gather ideas.

Problem
Two problems are identified: information presentation and managing stakeholders' expectations. A design goal was created to solve these issues where Physee will design a service to inform the updated knowledge to stakeholders in a customized and collaborative way.

Result
The solution is called Physee Insight. The overarching strategy is divided into three main focuses: 1.) Enabling the knowledge source; 2.) Adaptive & modular knowledge; 3.) Showing competencies to larger audiences. Within the solution, there are 6 different ideas to achieve Physee's goal. The goal is to connect Physee and the world. The proposed strategy enables PHYSEE to speed up the process of engaging stakeholders, scaling up the information update in an easier way, and providing user-centric information.

Key words: *Service Design; Stakeholders Engagement; Integrated Facade Industry; Scale-up company; Knowledge Management*



Reading Guide

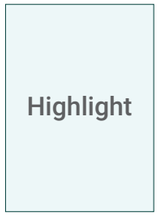
1. Cover page colours

The report presents the structured content of the thesis.

The cover page consists of 2 colours: Green and Yellow. Green indicates the Discover & Define process. At the same time, Yellow indicates Develop & Deliver process.

2. Important page

The content on the light blue page shows the highlight or remarks. If you have less time to read, make sure that you read this part.



3. Highlighted words

Yellow line under the words to emphasis the keywords.

4. Key take-aways in chapter 3 (Literature Review)

to emphasise the conclusion and/or next step after conducting the literature review. Example:

What does Physee offer?

Physee offers a similar multi-functional façade that integrates the sensors in the building. For more information, see chapter 2.3

5. Key take-aways page in the end of the chapters

The summary is mentioned in every end of the chapters (except chapter 1 & 8)

Glossary

Acronyms	Term	Description
SD	Service Design	is an interdisciplinary approach that focuses on the service that organisation provides to the user.
KM	Knowledge Management	is the process of creating, sharing, using and managing the knowledge and information of an organization.
	Start-up (company)	is a company or project undertaken by an entrepreneur to seek, develop, and validate a scalable business model.
PSS	Product-Service-System	are business models that provide for cohesive delivery of products and services.
	Facade	is generally the front part of exterior of a building.
	Integrated Facade	A system that takes into consideration the energy demands and environmental concerns at the same time in the facade building.
	Build environment	refers to the human-made environment that provides the setting for human activity, including homes, buildings, zoning, streets, sidewalks, open spaces, transportation options, and more.
BIPV	Building-Integrated Photovoltaics	an integrated photovoltaics modules into the building envelope (e.g. roof and facade).
RED	Real Estate Developer	Stakeholder who buy property or partner with landowners, then develop a plan for what to build or rebuild on that property.
IGU	Insulated Glass Unit	also reffered as a double pane glass.
	SmartSkin	A solution by PHYSEE that combines Product-Service-System (PSS) in the building which connected to the facade.
	Physeebility Check	A building analytic service by Physee.
	PHYSEEonairs	referred as the PHYSEE's employee.
	One Cycle Project	A process of the construction project in one phase from planning to execution to maintenance. It is also called as a project workflow.

Table of Contents

Chapter 1

Introduction

1.1 Background
1.2 Research Focus, Scope, & Problem Areas
1.3 Assignment (Design Scope)
1.4 Research Questions
1.5 Approach & Methodology

image source
Physee documentation

The first chapter explains the origin of the project. The context, initial problem, and approach are introduced.

1.1 Background

1.1.1 The emerging new technology in the façade construction industry

Physee is a technology company that offers smart engineering solutions for the global energy transition. Physee's solutions aim to activate existing materials, for undiscovered, sustainable impact. Roughly 90% of people's time is spent indoors, leading to the demand for better air quality and energy supply. Physee's mission is to develop smart and sustainable solutions that transform buildings into healthy and energy-positive ecosystems. By harnessing the sun's power and gathering data from the sensors, balancing energy production and consumption, transforming buildings into smart, powerful, and sustainable ecosystems. Physee is developing two different technologies for upgrading the functionality of glass, the Coatings technology and SmartSkin.

The value proposition of Physee has evolved from just producing clean electricity to the addition of smart sensors, energy storage, and climate control. It is because the façade construction challenges will keep evolving, and most of them are going towards sustainable construction processes and creating more comfortable buildings for the users (Klein, 2013). Physee embraces a new concept of the Integrated façade Product-Service-System business model. The introduction of the 'SmartSkin' concept complements the Coating technology benefits. SmartSkin is a smart and sustainable façade innovation that increases comfort and reduces a building's energy consumption by up to 25%. A SmartSkin is a façade that contains the products PowerWindows and SmartWindows. A PowerWindow generates energy, while a SmartWindow generates data. These 2 outputs can be used to intelligently control building systems like automatic blinds or ventilation. However, in the latest version, Physee wants to change the PowerWindows to another value proposition (chapter 2.3).

1.1.2 Managing the stakeholders in the integrated façade industry

As the business model evolves, the involvement of stakeholders has a huge implication. Larger incumbents in the construction and real estate sector joined as critical stakeholders. The expansion to new partners, including glass manufacturers, real estate companies, building designers, and e-installer, made it possible to deliver the new integrated facade concept. The transition towards a circular business model leads Physee to many new partners other than the commercial and technical enterprises. As a company that has sustainability goals, Physee needs to inform the construction activities by new resources of knowledge and expertise. In addition to that need, (Shelbourn, 2008) explains that one of the key factors in making construction projects more sustainable is overcoming obstacles of capturing and managing the knowledge required by the project teams.

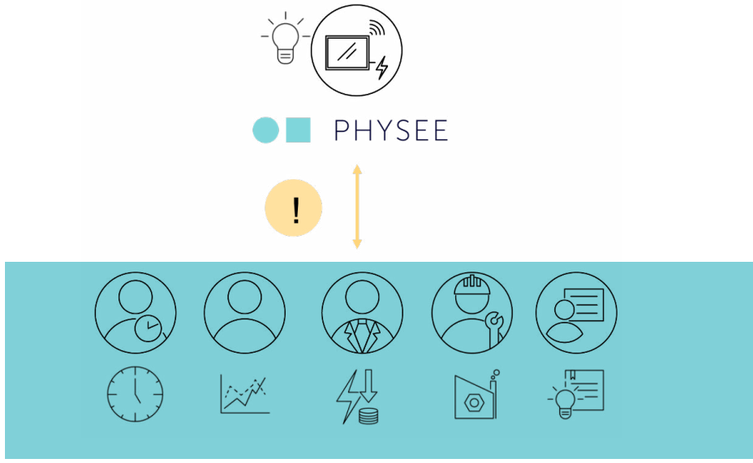


Figure 1. Research gap

Engaging and managing the stakeholder have become more critical with specific systems and approaches to align with them and integrate the message. Besides, the number of clients keeps increasing year-by-year and globally spread. In the façade design and construction process, there is fragmented involvement of the stakeholder's actions (Klein, 2013). The flow-through from company strategy, values, and structure/processes affects vital stakeholders, which also influences the key outcomes the company is looking for (Scholes & Clutterbuck, 1998).

1.1.3 A communication tool

The starting point of this project is when the marketing team at Physee wanted to develop a "PHYSEE Academy" service (the initial assumption is to design an online platform) to offer documentation of the technologies and, more specifically, inform and train the people who need to interact with the technologies. This platform is so far nonexistent and offers the opportunity to design. The user groups are divided into four (figure 2): Physee employees (Marketing, Sales, New Business), partners (glass industry, contractors, e-installers, BMS suppliers, data-engineers, real estate developers, architects), technology suppliers and the customers (house owners and building manager tenants). However, it might be more fruitful to investigate a two-way communication engagement in this master thesis to enable collaboration.

1.2 Research Focus, Scope, & Problem Areas

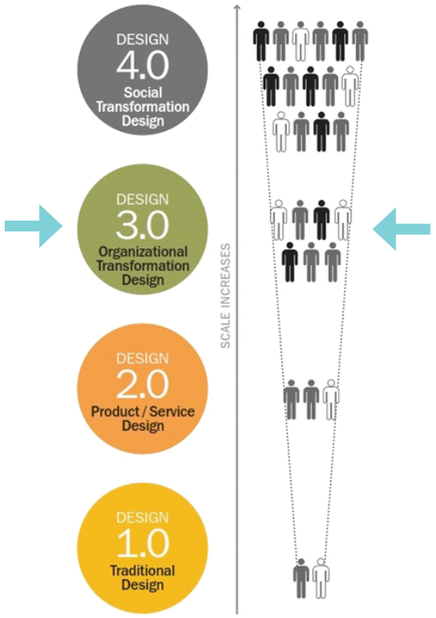


Figure 2. Design Domains (Jones, 2014)

1.2.1 Research focus

This research focuses on translating a company's value into a communication strategy to stakeholders in the construction industry. The construction industry is a traditional industry that has fragmented works between the stakeholders. Therefore, there is a challenge to communicate the newness of technology in the market to this industry. Moreover, to engage the stakeholders to collaborate with a start-up company like PHYSEE. The gap leads to the design domains of Design 3.0 Organizational Transformation Design (Jones, 2014). It means there will be an involvement of a complex system that require different mindsets, value propositions, disciplinary composition, and skills.

1.2.2 Research scope

Physee offers not only a product but also a complete Product-Service-System (PSS). By offering the PSS, Physee needs to work through a construction project cycle (Klein, 2013). The problems within one project cycle in Physee become the research scope in this project. The current process for operating façades has a gap between supply-side discoveries and demand-side needs, which hinders the implementation of resource-efficient façades (Azcárate-Aguerre et al., 2018).

Physee can create communication strategy for the company, employee, supplier, partner, customer, and end-user. However, the scope is relative too broad for the master project. Hence, the scope is focused on the relation between Physee, customers, and partners. In this graduation project, the research is narrowed to investigate the stakeholder's communication with the most interaction with the SmartSkin: in Sales, Installation, and Pre-Sales (figure 3). Excluding the production phase.

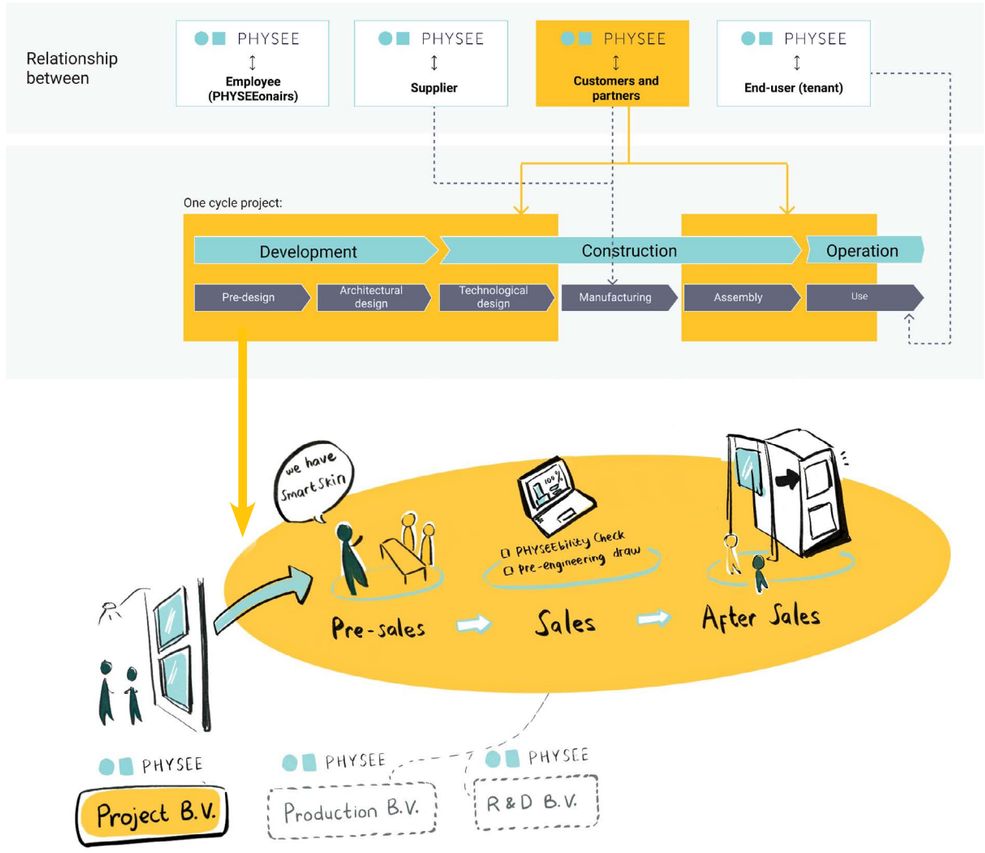


Figure 3. Research Scope: One Cycle Project

1.2.1 Problem areas

After deciding the project scope, there are two main key problems are being identified: 1.) Physee needs to inform and train many different stakeholders on different topics. Often there will be overlaps in the spreading of information between various stakeholders. Physee needs to find ways to present the right bulk of information to the right stakeholders in the right order not to overwhelm or confuse them or others. Besides, Physee's future is to expand outside the Netherlands, which implies their communication workflow. Therefore, they need to have a particular system to share knowledge and enable two-way communication.

2.) Physee needs to deliver different values to each stakeholder and want to align with the Physee value and (sustainable) business model. For example, architects claim thought leadership on sustainability and smart building; Real Estate Investors need to understand the impact on sustainability scores of SmartSkin for their asset portfolio.

1.3 Assignment (Design Scope)

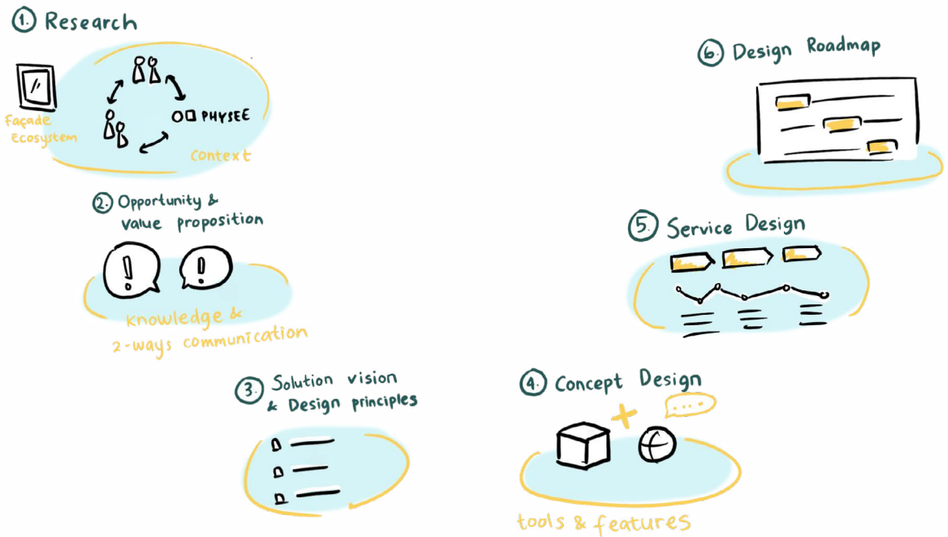


Figure 4. The diagram

The solution space will be composed by creating a service design to enable effective communication and collaboration (figure 4).

1.) Service Design (SD)

Service Design (SD) is an approach to help organizations see their services from a customer perspective. It rooted in design thinking, and brings a creative, human-centered process into the idea improvement through collaborative methods and iterative prototyping methods (Stickdorn, 2017).

The service design will provide how the end solution looks like. Therefore, the deliverables would be the service blueprint and the service design scenario of the solution. In the designing phase, service design requires designers to facilitate collaboration and bring in new stakeholders and experts along the way (van Boeijen, et al, 2020).

2.) Communication Strategy & Roadmap

The communication strategy is the way to inform the organisation and/or end-user about the proposed solution. It includes a strategic roadmap to understand the underlying value of the solution and the future vision of the solution. A roadmap is used to facilitate the design team to develop the solution.

1.4 Research Questions

The Research Question (RQ) is to communicate the company's strategy, value, and structure by using stakeholder engagement strategy. The Sub-Questions (SQ) are proposed based on several objectives 1. to understand the company's goal and value proposition; 2. to understand the context of the problem and research; 3. to gather the pain points from the company's perspective; 4. to understand the customer's needs; and 5. to solve the problem.

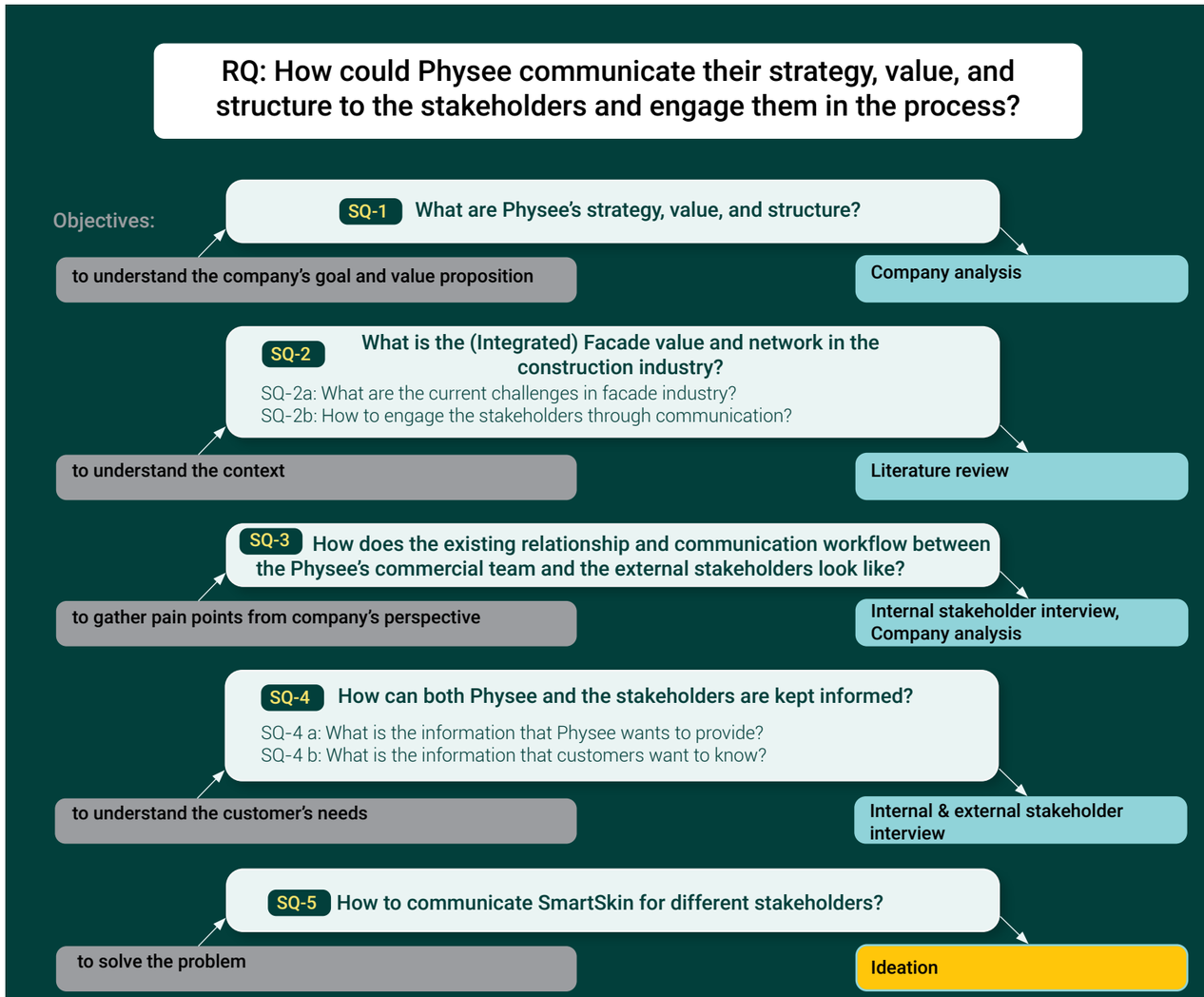


Figure 5. Research Questions

1.5 Approach & Methodology

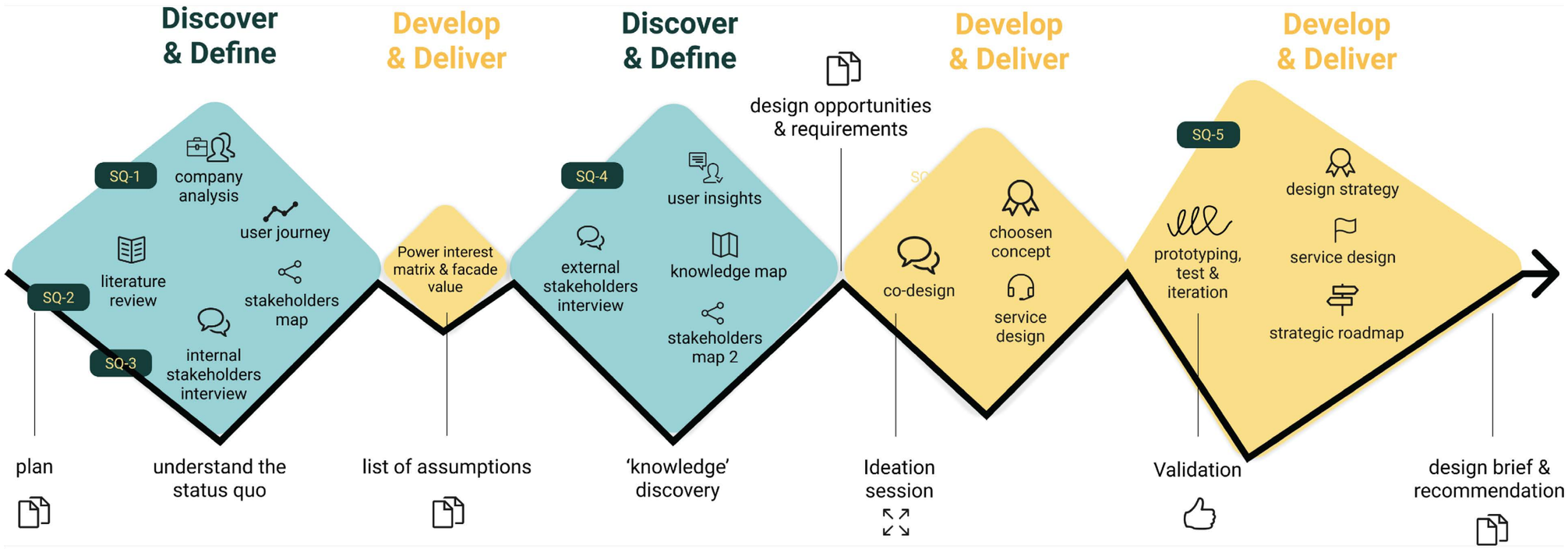


Figure 6. Design process based on Double Diamond model

The approach in this project is based on Service Design double diamond (British Design Council's design cycle). It mainly has 4 different stages (Discover, Define, Develop, and Deliver). Due to the nature of iteration, there were some diverging and converging processes within the project.

Discover: Gather data by focusing on the people's needs. Within the first diamond, there will be a literature review, company analysis, and internal stakeholder interview. While in the second diamond, there will be external stakeholders interviews.

Tools: Generative interview (diary booklet and card sorting), Stakeholders Map, Power-Interest matrix, product/customer journey, SWOT analysis.

Define: Gather insights from the discovery phase. The first diamond will provide the stakeholder map and the second diamond will provide the user insights. The process involves the Marketing & Lead Generation team to get more feedbacks.
Tools: Power Interest Matrix, Archetype, Affinity Mapping, Knowledge Map.

Develop: Seek inspiration to answer the defined problem. There is a small diamond between the first and second blue diamond which consists of a list of assumptions to test to the external stakeholders. There will be a co-creation session between the designer and Physee employees. Then, the designer will build the prototype (low & high fidelity).
Tools: Inspiration card, Crazy8, Solution matrix.

Deliver: In this phase, the concept & prototype will be tested to the users because validating is very important. The final outcome would be the product positioning in the company and market, service design, and strategic roadmap of the solution.
Tools: Brand DNA, Service design blueprint, scenario, roadmap.

Due to COVID-19 pandemic, the research used a dominant online tools such as Ms Team & Zoom for call; Miro, Figma, Ms Power Point for brainstorming and presenting; Google docs for report writing; and Atlas.ti for qualitative coding.

Chapter 2

Understanding the Context (Status Quo)

2.1 About The Company
2.2 Vision & Mission
2.3 The Offering: Building Integration

image source
1. The founders (google)
2. Windows with the sunblind at Physee HQ (by author, 2021)

In a communication context, an organisation's strategy, values, and structure affect key stakeholders, employees, suppliers, customers, shareholders, and the community (Scholes & Clutterbuck, 1998). Based on that, this chapter will cover the context, strategy, values, and structure of the organisation at Physee.

SQ-1 What are Physee's strategy, value, and structure?

The data presented in this chapter were derived from both primary and secondary research. Primary research included observation research and informal meeting with employees of Physee (CEO, HR, Commercial and R&D department). Secondary research included the analysis of project update meetings and available internal documents about the company, current strategy and product.

2.1 About The Company

Physee is a technology company that offers smart engineering solutions for the global energy transition. The company was founded in 2014 and was a spin-off from a startup incubator YES!Delft.

Physee consists of more than 50 team members with more than 10 different nationalities. There are 3 departments at the moment: Project B.V., Production B.V., and R&D, B.V.. As Physee grows up, the organisation keeps changing towards a better organisation and offerings.

PHYSEE
CHANGING THE PERSPECTIVE

Figure 7. Physee's logo & tagline (Physee, 2020)

2.1.1 The core values

Physee has four main core values of the company's foundation:
1. Passion for excellence.
This means they want to deliver high-quality work, understand the bigger picture, and know what they are doing.

2. Change the perspective.
This means that they want to deliver the best solution to solve the issue. It might take more initiative and need open-mindedness.

3. Trust and earn trust.
This means to keep the professionality runs by being collaborative and supportive.

4. Make your mark.
This means Physee wants to grow and learn from their mistakes continuously.

The first, second, and third value is something that they want to share to the world. At the same time, the last value is what PHYSEE intends to grow as a company. Physee values every added perspective, and the team diversity reflects it. Physee needs people who bring passion, new ways of thinking and curiosity to work. As a growing company with ambitious goals, things changes very quickly. When making an OKR (Objective & Key Result) or any evaluation, these four values always become the starting points.

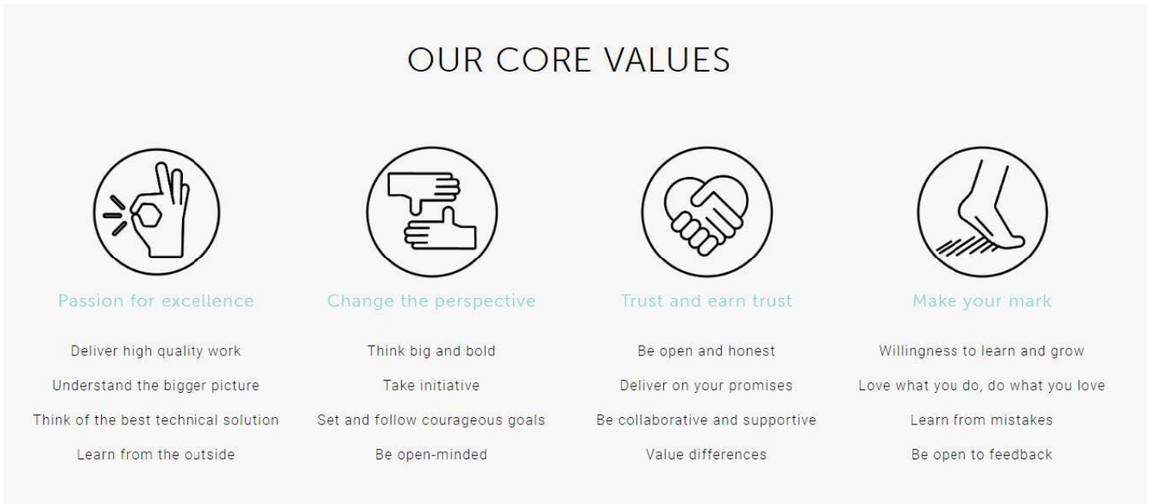


Figure 8. Physee's core value

2.1.2 Vision & Mission

“We are looking forward to the day that buildings are human centered Power-Plants”

-Ferdinand Grapperhaus,
CEO & co-founder of Physee

Physee vision is “We envision a future energy-neutral building where user’s comfort and productivity levels are increased. Therefore, we are balancing out the energy demand by producing and consuming electricity locally, providing tomorrow’s buildings with the SmartSkin they deserve”. The vision supported by the mission “ We are on a mission to enable building makers to transform the build environment into a smart sustainable and healthy ecosystem by providing them with 4.0 technologies”.

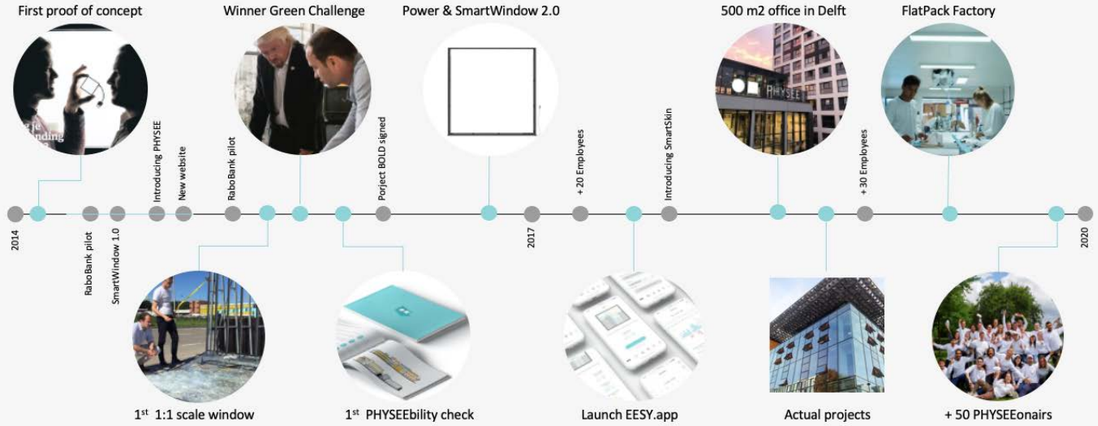


Figure 9. Physee’s timeline (Physee, 2020)

2.1.3 Company structure

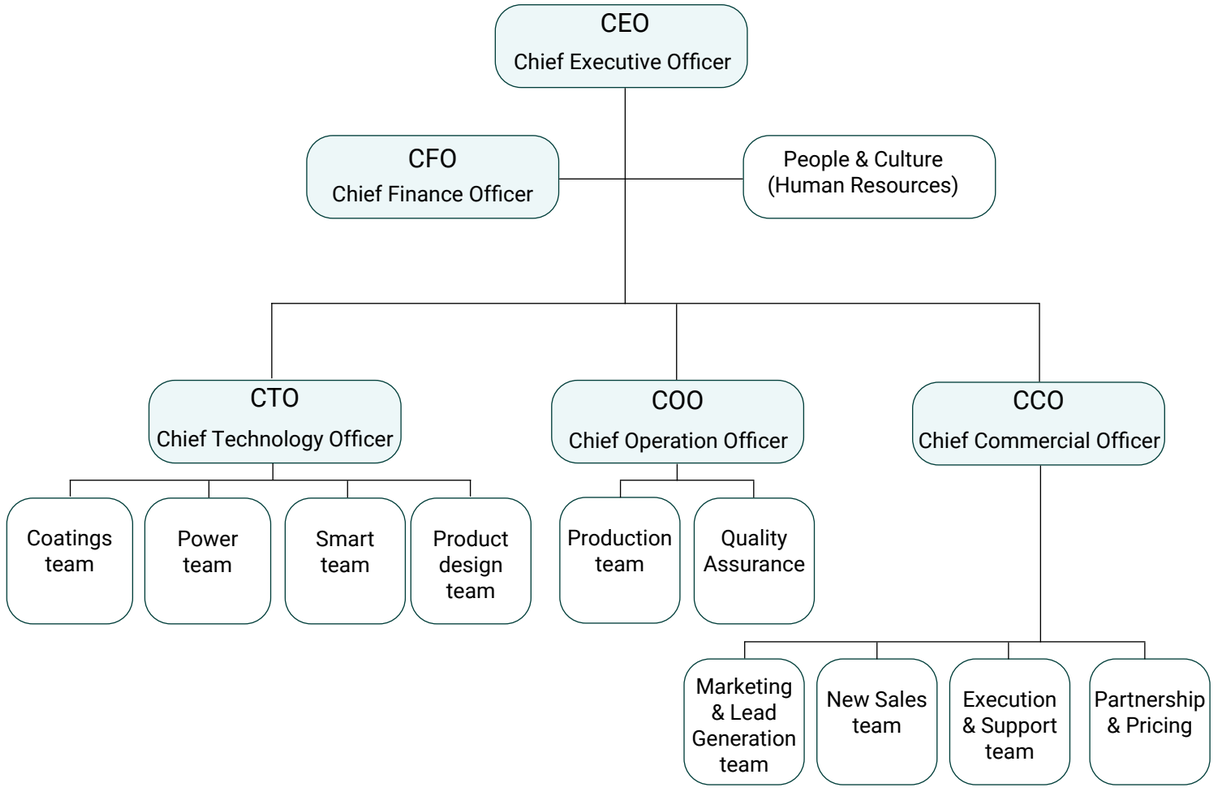


Figure 10. Physee’s organigram 2020-2021 (Physee, 2021, adapted by author)

The company has three main focuses:

1. Research and Development (R&D) which under CTO. The teams developed different technologies other than SmartSkin. For example: glass coating and Power+.
2. Production which under COO. The teams manage the production process and make sure it is delivered in a good quality.
3. Project which under CCO. The teams focus on the SmartSkin project implementation.

2.1.4 Team within one cycle project: Commercial department

The commercial department consists of 4 different teams. Three teams are directly involved in the project phases, which involve pre-sales, sales, and after-sales (figure 11). In comparison, the other team is the finance and legal. The main purpose of commercials is to take PHYSEE products and turn them into compelling stories with a pricing model that fits the market and creates traction. The main focuses of the commercial department are selling and service projects; set up a long-term partnership to help scale & create traction; create & update value proposition; align company message & identity.

1.) Partnership & Pricing (P&P)
Identifying strategic opportunities to partner on sales or development; closing and maintaining legal arrangements; and in charge of contracting & pricing. P&P is not involving in a specific one-cycle project loop but involving in almost every phase.

2) Marketing & Lead generation (M&LG)
Focusing on the brand identity and getting the traction of the future client. They are focusing on the Pre-Sales phase.

3.) New Business (NB)
Getting the client from traction to the execution.

4.) Execution & Support (E&S)
Getting SmartSkin in buildings on time and in full; making sure installed systems generate impact; standardizing procedures to outsource & become scalable; supporting product development with user, partner, and client insights.

The full description of the teams is written in Appendix C.

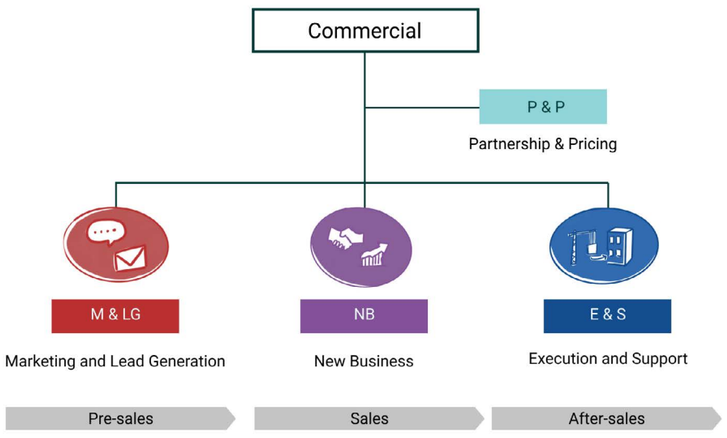


Figure 11. Commercial organizational diagram

2.2 The Offering: Building Integration

2.2.1 SmartSkin

Physee is currently moving towards a smart energy building. Not only produce the technology within the glasses but also going forward to smart building integration. The concept is called SmartSkin. SmartSkin is a solution that combines Product-Service-System (PSS) in the building which connected to the facade (figure 12). It is called SmartSkin because façades can be compared to the role of skin on the human body, which protects internal functions from the outdoor environment, stabilizes indoor climate and sends signals to the information centre (source: Physee general information).

Physee is currently developing a new concept of the SmartSkin that will be modular. It is called SmartSkin 2.0, the wireless solution. To understand how it changes, table 1 shows how the product, revenue stream, and stakeholder changes. It is not only those which change but also the overall communication in and outside Physee. Physee will keep developing their offering in the future. The case study in this project is how to communicate SmartSkin to the clients and partners.

Table 1. SmartSkin 1.0 and 2.0 differences

	SmartSkin 1.0 (more explanation on Appendix C)	**SmartSkin 2.0**
USP	Integrated, smart sunblind	wireless
Components	SmartWindows EESY grid SenseNodes SenseHubs	SmartWindows SenseNodes SenseHubs SenseLife SmartBlinds
Service	Pre-scan (check the efficiency by using a simple building model)	Pre-scan Physeebility check (check the efficiency by using more detailed building image)
Goal	energy production	energy production & energy saving (inside the building)
The stakeholder that is not/ less involved anymore		e-installer
Revenue stream	fixed price	subscription

Figure 12. SmartSkin Integrated System (source from Physee, image adapted by author)

2.2.2 SmartSkin business model

Currently, Physee offers two different business models to accelerate the Product-Service System of façade. One of them is to have a service contracting like 'SmartSkin activation'. It is a system to activate the façade supplying energy to the building system.

Physee is developing hardware enables software model. Based on this model, the implication is that Physee will provide façade services and some part of the building management system.

Table 2. SmartSkin business model

	Business Model 1 Direct Sales	**Business model 2 OEM Strategy**
Description	Physee sell it to the RED, architect, or the building investor/owner directly.	Physee collaborate with IGU Manufacturer to resell their offering.
Key partners	Architect/Real Estate Developer/Building owner/Facade contractor	IGU Manufacturer
Customer value proposition	a. activating façade with SmartSkin b. Energy reduction and comfort increase	a. offer the option package (SmartSkin ready and full package)

The implication of 2 different business models is affecting the type of information channels that Physee needs to use. The main difference is in the partners. The first business model involves multiple actors. Meanwhile, the second business model involves the salespeople from IGU manufacturer.

How to inform different needs of the stakeholders? On the one hand, with a direct sales approach, Physee needs to inform and maintain trust in using the technology. On the other hand, Physee also needs to collaborate a lot of time with the OEM to resell the offerings.

This research also will investigate the possibility of Knowledge Management in the OEM Strategy. It might be a different outcome to this strategic approach.

2.2.3 SmartSkin value proposition

Physee offers three main values to the client and partner. These values are intertwined within the SmartSkin 2.0.

1.) Sustainable
Physee provides the Pre-Scan tool for the clients to check the energy-saving amount when they implement SmartSkin in the building. SmartSkin 2.0 allows the building to reduce energy consumption by 30%. Physee also complies with sustainability certificates in Europe (e.g., BREEAM & WELL). In addition, Physee has a certified B Corporation.

2.) Smart
Physee uses sensors that are integrated into the building management system. Some features include the Smart Blinds and Sense modules.

3.) Comfort
Physee offers a unique user experience with SenseLife to track the end-user energy consumption and provide comfort.

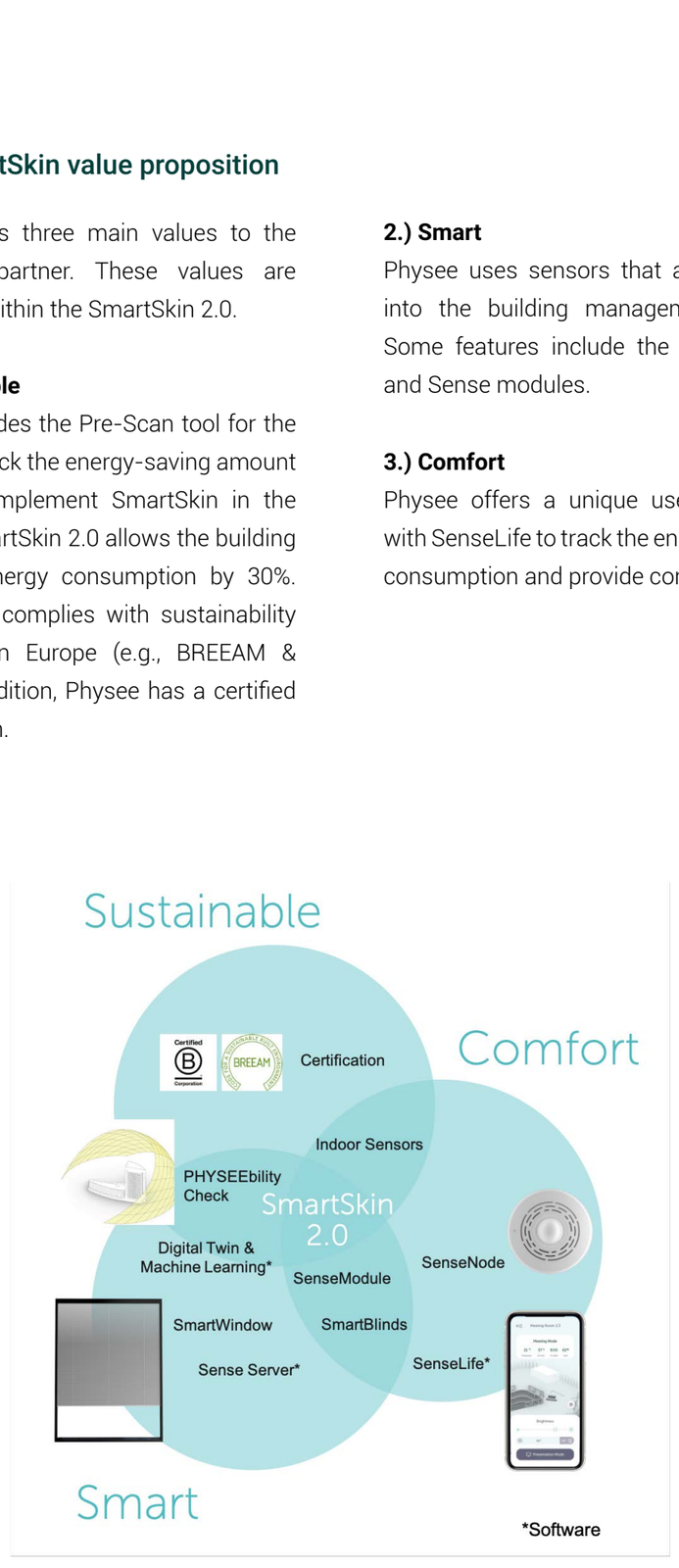


Figure 13. SmartSkin 2.0 and the offering (diagram made by author, adapted from internal document))

Chapter 2 - Key takeaways

- Physee is a scale-up company that started in 2015, was a spin-off from startup incubator YES Delft.
- Physee upgraded their product called SmartSkin. The SmartSkin version 2.0 adapts the concept of Product-Service-System, which offers more intangible value propositions, such as a wireless building integration systems.
- Physee offers this PSS to the clients and partners through 2 different business models: Direct sales and via OEM sales (IGU Manufacturer). Because of the difference between the business, the key partners also different. Consequently, It should be considered at the designing phase.
- The value propositions of SmartSkin are ‘sustainable’, ‘comfort’, and ‘smart’. However, not all the actors see this as their main focus.
- The commercial team is the front gate to face the client and partners to deliver the solutions in pre-sales, sales, and after-sales phase. Each of the teams faces different partners and clients.

Chapter 3

Literature Review

The literature review was conducted to understand the context of the façade value in the construction industry. Since this thesis project touches upon different topics, establishing the base knowledge on them is necessary. The procedure of the literature review is using the snowballing method. First, analysing the integrated facade network can help understand the essence of the importance of this technology in the construction landscape. Secondly, the literature underpins the stakeholder engagement and communication will be explained.

SQ-2 **What is the (Integrated) façade value and network in the construction industry?**

SQ-2a What are the current challenges in façade industry?
SQ-2b: How to engage the stakeholders through communication?

3.1 Integrated Façade

3.1.1 Integrated façades as a Product-Service System

Integrated facade is a mediator between the exterior environment and conditioned interior spaces of a building (Kim & Torres, 2015). Based on (Azcárate-Aguerre, Klein, & Heijer, 2016), integrated façades can have more functions of the building (multi-function), and some of them are connected to a system that is responsible for the building's indoor comfort. This system can replace centralized systems such as ventilation, humidity control, heating, cooling, energy production and storage, lighting, electric and ICT supply lines, etc., and are constantly expanding the range and effectiveness of their offerings. The integrated façade also functions as a consolidated system (figure 14) to support the building's operation by delivering measurable performance data (e.g. indoor quality, illumination, and energy balance). Because of this, the product became part of the Product-Service System (PSS) package.

PSS in the façade industry changes the management of the supply chain. The manufacturer or façade fabricator (like Physee) acquires a series of components from sub-suppliers and does the assembling into a completely functional product. Later the façade fabricator delivered a constant performance to the client through installation, maintenance, replacement, and removal of components (Azcárate-Aguerre et al., 2016).

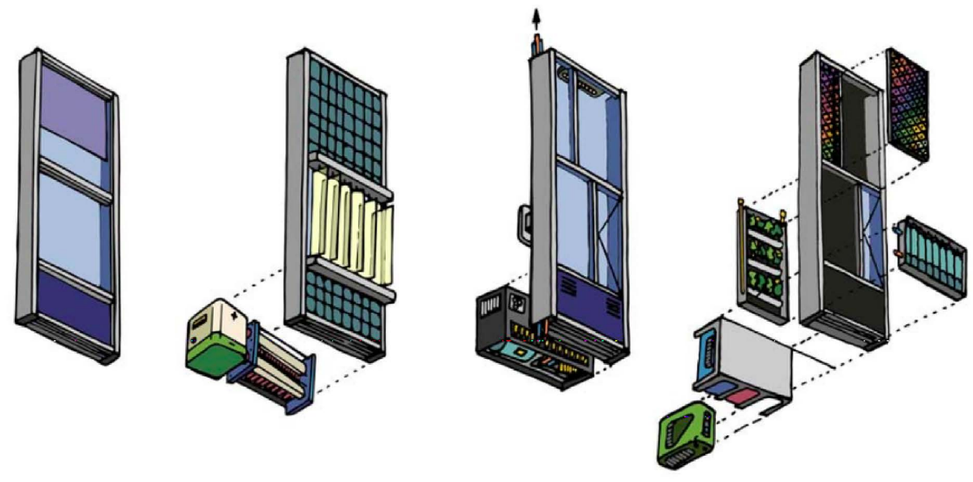


Figure 14. Service-oriented façade-integrated product combinations for multi-functional building envelopes (Azcarate-Aguerre, 2016)

What does Physee offer?

Physee offers a similar multi-functional façade that integrates the sensors in the building. For more information, see chapter 2.3

3.1.2 Façade Value

The integrated facade is a new thing in the construction industry. There are different goals for every stakeholder to make a decision. Consequently, the facade value (a conceptual framework) is used as a reference to support decision making between the stakeholders.

In the built environment, four types of performance criteria connect the demand and supply side on strategic and operational levels (Azcaarte-Aguerre, et al., 2018). Façade brief contains aspects that refer to four values: financial, energy, functional, and strategic value, which can be useful to support clients in the decision-making process (Heijer, 2013). These values are useful for giving an argument to the stakeholders about the benefit of façade.

1.) Financial façade value

The argument is related to the initial investment to the annual capital cost and operating cost, life cycle costs, measuring benefit per m2, and increasing the profitability by improving the space utilisation and reducing floor area.

2.) Functional façade value

Functional values are mostly related to the end-user and the building lifetime. The examples of arguments are improving the productivity or preventing the productivity loss of the user, supporting the changing of user needs, flexibility in the floor plan.

3.) Energy façade value

The energy value relates to the influence of the façade on the indoor environment and energy use. The strategy would be to reduce the client's footprint.

4.) Strategy façade value

Strategy value refers to the image of the organisations. Some types of organisations value the highest aesthetic quality, long-term reliability, and new technology application.

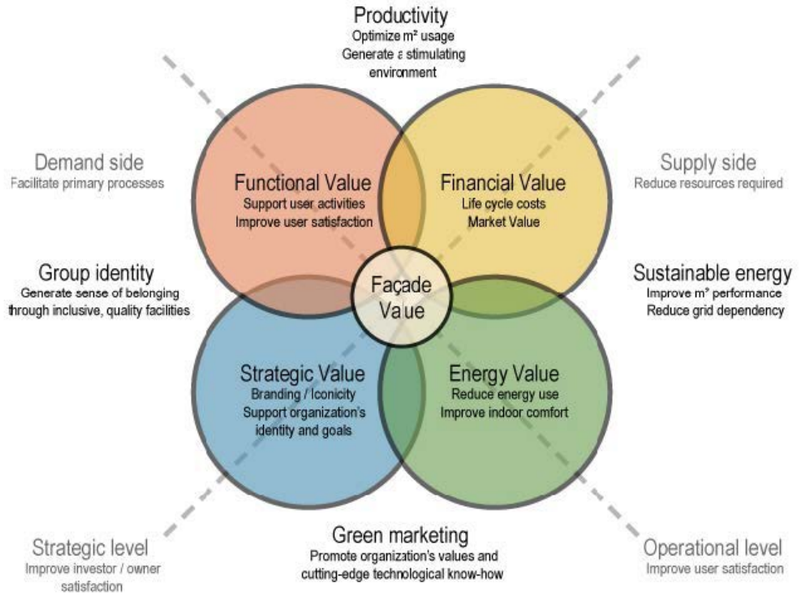


Figure 15. Four façade value (Azcaarte-Aguerre, et al. (2018) adapted from (Heijer, 2011)

What is not known yet? What can Physee do with these values?

An in-depth analysis of the value for each stakeholder (partner) needs to be defined in order to understand how to communicate with them (see chapter 4.2).

3.1.3 Integrated façades process and phases

In this subchapter, facade one cycle/ life cycle is explained. Theoretically, the façade industry process is linear, but there is a back-coupling between the phases in practice (Figure 16).

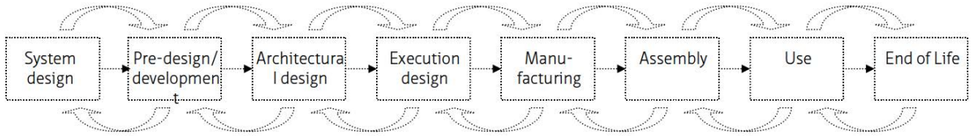


Figure 16. Design and construction phases of the curtain wall (Klein, 2013)

Table 3. Description of one cycle phases based on (Klein, 2013)

Phase	Description
System design	Systems are developed by system providers, anticipating market needs. Systems need to meet legal requirements as well as the requirements from architectural design.
Pre-design/ development	Define the basic requirements for the building. It begins with a market survey and feasibility study. The functional requirement is set based on the location, size of the building, the type of use as well as a legal requirement.
Architectural design	Drawings are made for building permits. The process requires continuous calibration with the development of the other crafts. It must be mutually agreed upon with the client and the costs have to be calculated.
Execution design	Water/wind tightness and thermal performance of the construction have to be guaranteed by tested systems. The architect and structural engineer create the plan after which the builder will directly execute the structure.
Production	In this phase, there will be a high logistical effort. The façade builder receives profiles and fittings from the system provider. Numerous subcomponents (sun shading and glass panes) will have to be designed, ordered, and integrated into the production process.
Assembly	At this time, all interior work can be executed independently of the weather, an important factor concerning the time schedule. Weather conditions are important in this phase.
Use	The façade is tested if it matches all desired functionality. Monitoring is an important issue in this phase. A failure in comfort performance is directly observed by the user. The energy performance will be reflected on the energy bill. Other than monitoring, maintenance and cleaning are also considered in this phase.
End of Life	In order to create energy-neutral buildings recycling or reusing components is becoming a crucial issue. A sustainable approach requires a concept for the end of life phase which needs to be developed in the phases from architectural design to assembly.

What is Physee's involvement in the process and phases?

Physee, at the moment, is involved in all phases, except end-of-life. They are working on it in the near future. Their main involvements are in the system design, pre-design, execution, manufacturing, and assembly. They also have missions to work less on the assembly and do a more automatic pre-design process.

To get know what is Physee involvement, see the journey map in chapter 4.1

3.1.4 Stakeholders in the façade construction

The façade supply network consists of various actors that are involved in the different phases (Figure 11). The roles based on (Klein, 2013) are :

1.) Owner/Investor/developer

The owner/investor/developer is not actively involved in innovation, but their attitude largely determines the chance for it. They think innovation always bears uncertainty thus they will have a strong opinion about it. They seek a high value or investment ratio, control about all aspects of the building/façade. They will try to minimise their organisational effort.

2.) Architect

The architects integrate the different stakeholders' input to build the façade, such as functionality, technical realisation, and artistic expression. The architect is a main figure in the process and has influence on most decisions, but at the same time his work conflicts with all other stakeholders. Architects are able to create an overview of the needs of the market and technical possibilities but do not have the financial capacity to realise innovation by themselves.

3.) Consultants

There are no explanations about what exactly consultants do. However, at Physee, this is called Building Physicist, which means they analyse and calculate if the building design is good enough to be built. Usually, they also calculate the energy saving of the building.

4.) Main/General Contractor

The central resource of the general contractor is his ability to organise and to take on risks for the client. Main contractors prefer to play a conservative role because beyond the traditional method, it means risk. They are only interested in innovation if a financial benefit is involved.

5.) Façade Builder

The main role of a façade builder is to translate the architectural design into realisable construction and has to guarantee the performance of the façade as a whole.They try to establish a relationship with the architect and the main contractor, but to large extent decisions are made by price. They need support from the system supplier.

6.) System Supplier

System supplier's main focus is towards the architect, who decides about the application of their products, but it is the façade builder who buys them. The products must be highly flexible in terms of architectural design and, at the same time, they need to be kept simple and understandable for the façade builder. The products are highly developed and require constant upgrade to keep up with legal requirements.

7.) Facility Manager

They are interested in low maintenance effort, clear responsibilities in terms of failure or damage. Because the façade system is becoming more integrated with the building management system, therefore their role also becomes more complex and important. Facility management will be involved in the early design stages because they also need to develop a long-term vision of the façade and end-of-life scenarios.

8.) User

Users need an appealing architecture and also high comfort, low energy consumption, and little maintenance effort.

9.) Society

Society has a passive role in the process of façade construction but the interests are relatively strong (See figure 17 for their interest)

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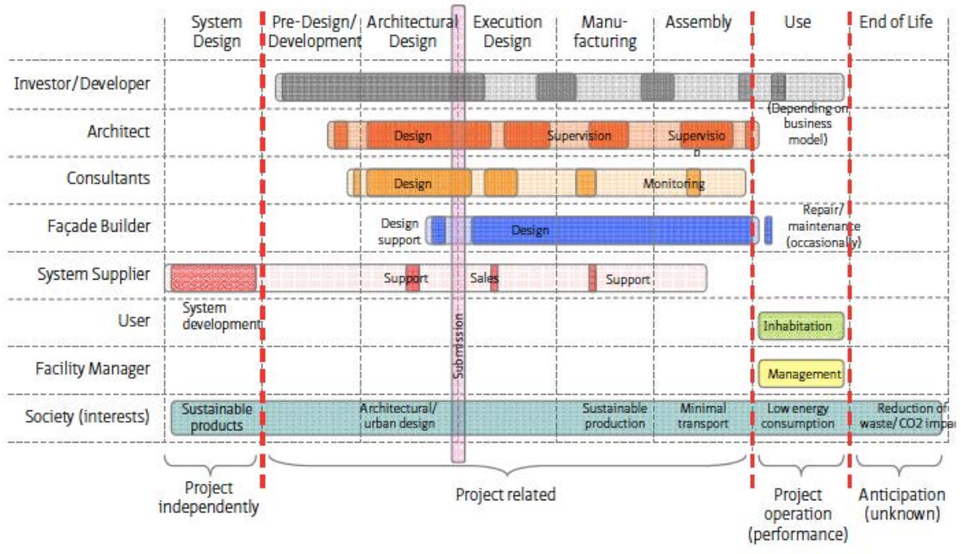


Figure 17. Involvement of stakeholders in the different phases of the façade design and construction process (Klein, 2013)

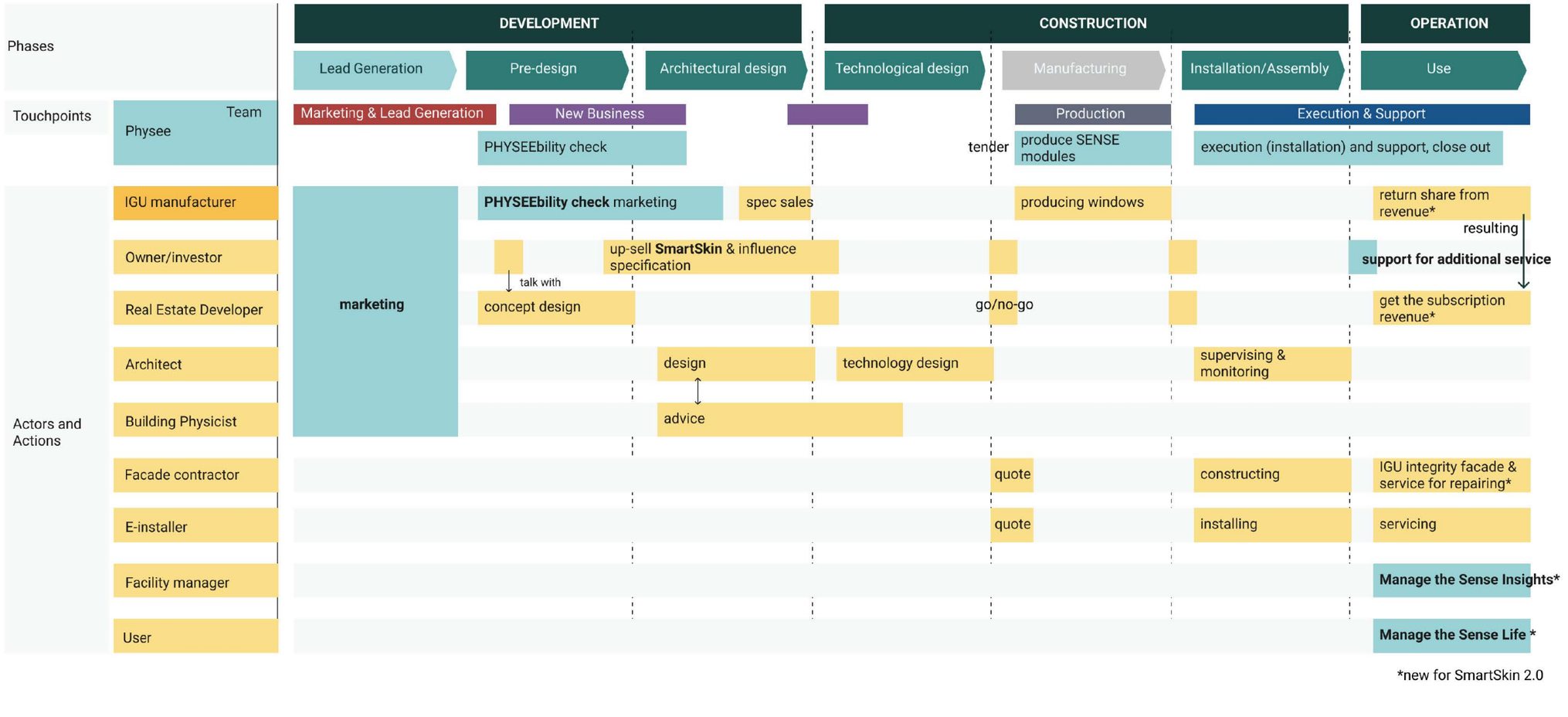
What is the Physee's role in the ecosystem (figure 12)?

Physee is mainly a system supplier, however, Physee at the moment also involves in building and maintaining the façade due to the complexity of the product. In the future, Physee would like to have less involvement in the building phase.

What other stakeholders are not listed in this chapter but also works with Physee?

E-installer.

Physee offers a smart solution that needs someone to connect the electric component outside the window. Therefore, they ask the e-installer to assemble the connection (like cables) in the building.



The **one cycle workflow** diagram shows the touchpoints of each stakeholder, including the internal team within Physee. Because their concept is a service package, other actors need to follow some new features or steps, for example, PHYSEEbility check. It is a service to scan the building drawing and check if the solution can better impact the building.

Figure 18. Involvement of stakeholders in the different phases of the façade design and construction process at Physee adapted from (Klein, 2013) model.

3.1.5. The challenges of adopting new innovation in the construction industry

When it comes to innovation, Phototalvic Generated Windows are considerably new in the market. Physee was established in 2014 and just started to scale-up and sometimes considered as a start-up company. Scale-up is a company that is raising investment to fund their growth. Physee moves into scale-up territory when they have been through their first rounds of funding and reached the Series A stage or similar (Logan, 2019).

Therefore, an evolutionary model is used to represent the innovation status at Physee. Diffusion refers to the gradual adoption of an innovation in a market segment or society. The diffusion is often depicted as an S-shaped curve indicating the cumulative percentage of a population that adopts a product over time (figure 19). Based on Evolutionary model theory, the wide-scale diffusion requires coordination in the market among competitors, potential consumers, producers of complementary products or services and suppliers. It will take an average of 10 years before the market introduction stage of breakthrough technology is completed (Ortt & Schoormans, 2004).

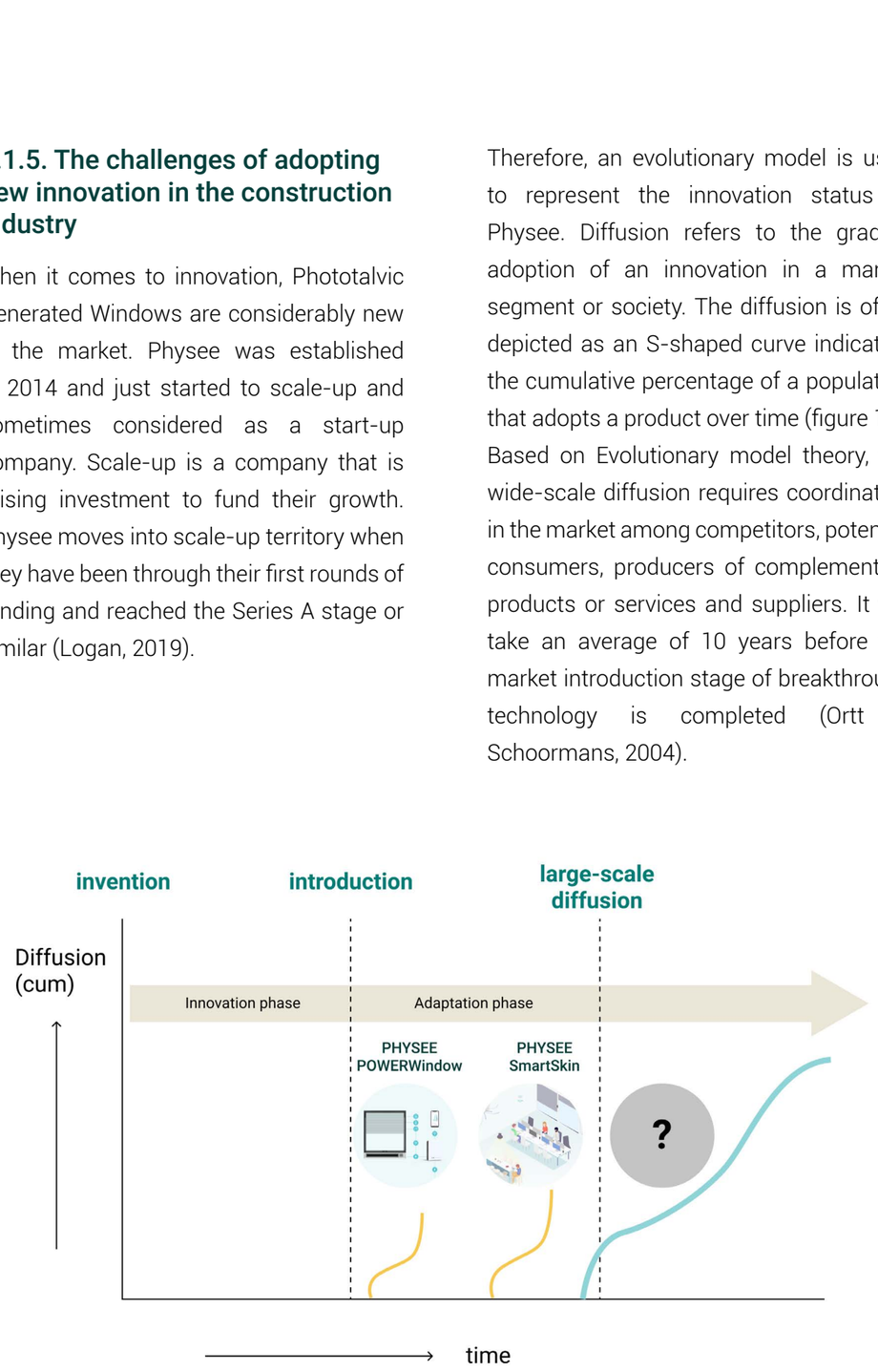


Figure 19. Technology diffusion in Physee using the Evolutionary model theory (Ortt & Schoormans, 2004)

Where Physee is now?

Based on the evolutionary model, Physee is in the adaptation phase. As a result, Physee has to change their business model several times (see chapter 2.3.2).

What are the implications for Physee and this project?

a. The product and market often change fundamentally over time. Therefore the solution type and functionality needs to be considered.

b. Timing of introduction is crucial. If the product is not on time (too fast or too slow), what are the challenges for stakeholders to adapt or to make use of the new technology of façade?

The future challenge of façade innovation (Klein, 2013) lies in creating more sustainable processes and comfort for the user such as:

1. Minimize embodied energy (e.g. choose low impact material, reduce the material quantities, offer recyclability);
2. Reduce operational energy (e.g. Improve level of insulation and adapt to climate change);
3. Predict façade performance (in terms of operational energy, embodied energy, and comfort);
4. Create a faster process (shorten the design, production, and assembly process, and reduce external risk);
5. Enable architectural possibilities (such as bridge knowledge gap between stakeholders, allow architectural design variety, and support architectural design intentions throughout the process);
6. Stimulate innovation (e.g. control innovation centrally, incorporate decentral innovation, upgrade existing construction).

These challenges influence the company to grow. The company needs to develop a product that reaches the most sustainable and comfortable solutions. This greater diversity of constructional façade types will widen the knowledge gap between architects and executing stakeholders. When designing façades in the future, instead of defining constructional solutions, the definition of façade functionalities will be the most important task (Klein, 2013).

The graph (figure 20) shows the stakeholders' connection in the façade ecosystem. There is a change in the phases and construction process. Physee, as a system supplier, will support most of the process which needs to communicate with the other stakeholders such as architects, consultants, and facility managers. A new way of educating architects or façade specialists is required to meet the needs of the future building market (Klein, 2013).

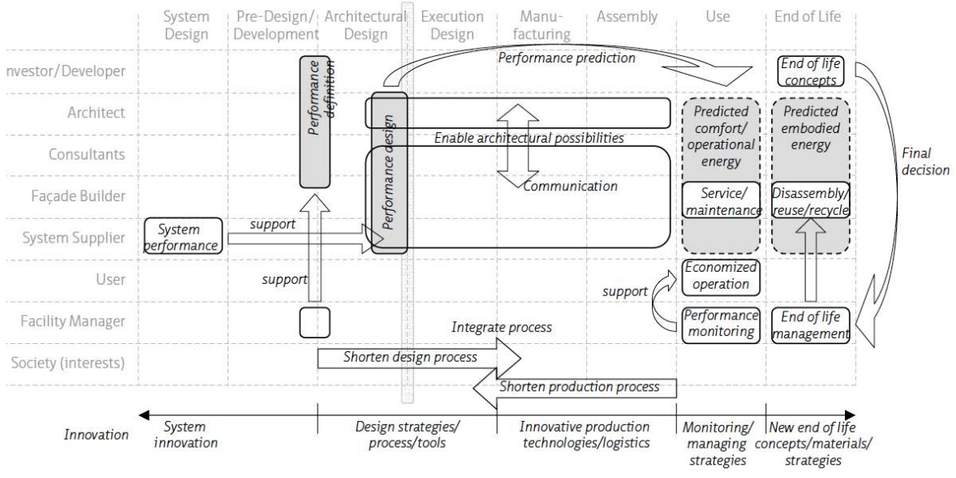


Figure 20. The impact of future challenges on the different construction phases and stakeholders (Klein, 2013)

By looking at the product offering, the Product-Service System approach to façade design, construction, operation, and renovation could provide incentives to supply- and demand-side stakeholders, especially when they want to implement the Circular Economy principles (Azcárate-Aguerre et al., 2018). However, in the construction industry, there are some issues about lacking efficiency and unwillingness to innovate compared to other industries (Force & Britain, 1998). In addition, the industry also has relatively slow technology adoption (Gandhi, Khanna, & Ramaswamy, 2016).

Furthermore, as mentioned in subchapter 3.1.2., the process of construction is linear. Consequently, it influences the flow of the supply chain depending on each phase. In the façade design and construction process, there is fragmented entanglement of the stakeholder's actions (Klein, 2013). The knowledge barriers of solar façade are lack of sufficient technical knowledge by architect, client/developer, and consultant (Prieto, et al., 2017).

To gain the innovative perspective, there are some drivers of change that can be followed, such as to improve the leadership commitment, user focus, process, and team integration, a quality-driven agenda, and commitment to people (Force & Britain, 1998).

Implication for a scale-up company like Physee

As a pioneer façade technology supplier, Physee might challenge the product retention. Suppliers and contractors tend to choose the familiar product because it has been proven consistently over time (Azcaarte-Aguerre, et al., 2018). Physee faces a challenge to deviate from traditional solutions. Hence, as mentioned above, Physee can focus to close the knowledge gap on the definition of façade functionalities. Another challenge is to keep update about their relationship each of the stakeholders.

3.2 Engaging the Stakeholders

The nature of the construction project has a lot of interactions (as seen in chapter 3.1.4). In innovation development, interactions are crucial (Çelik, 2018). Therefore, the organisation needs to engage the stakeholders by adapting the stakeholder engagement. Stakeholder engagement is the process by which companies communicate and get to know their stakeholders (Youmatter, 2019). The goal is to identify the stakeholder affected by and capable of influencing the design, explain the initiative to the stakeholders, assess their interests and area of resistance, and define the roles and responsibilities (Stanford, 2017).

There are five steps of the stakeholder engagement process based on Stanford (2017):
1. Clarifying objectives for engaging stakeholders,
2. Identifying the stakeholders,
3. Mapping (categorising) the stakeholders,
4. Determining what will engage them,
5. Planning precisely how to engage them.

At the same time, Kourdi (2015) highlighted the stakeholder map when seeking to involve an organisation's stakeholders. Stakeholder maps are a good way of understanding people that need to be on the same journey as the organisation. To manage an organisation's stakeholders, some considerations are:
1. The role of the customer or client,
2. Understanding internal relationships,
3. Developing external relationships,
4. Developing trusted client relationships.

Kourdi also mentioned the importance of communication to engage the stakeholders. The successful engagement of stakeholders involves actively giving and getting support and working together.

Stakeholder map

According to Kourdi (2015), to create a tangible outcome, we can use the stakeholder map as mentioned by the authors above. The stakeholder map is a document, part of the strategy brief, describing all stakeholders involved in the strategy design process and the formal and informal relationships between them. A stakeholder map is used to help understand the holistic view of what is happening in and outside the organisation, identify source power and interest, record the stakeholders' effect on and interactions with the system and each other, and help identify the conflict and whom to engage. To analyse the stakeholder map, first, we need to know who the principal players and influencers are, know their roles, how they participate in the business, and interact with others (Kourdi, 2015).

Social Network

Meanwhile, the fragmentation process in traditional contracting practice further hinders the integration of construction knowledge among contractors, diminishing the opportunity for them to influence design decisions (Nawi, Nasrun, & Baluch, 2014). Therefore, the interaction between these stakeholders needs to be investigated.

Çelik (2018) mentioned another term of interaction between the stakeholders, which called social interaction. The social interactions among a group of individuals are commonly identified as networks (figure 21). The process of 'causing' innovation refers to the unplanned occurrence of newness resulting from the interactions that form the network. On a deeper level, four different networks can be established: creative, managerial, political, and friendship. The network perspective can identify the current blockages in the innovation system.

While Janus (2016) mentioned that the analysis of social networks results in a map of knowledge flows, including informal knowledge-sharing relationships. The social network analysis can also provide essential insights for the use of knowledge by network members, to what extent they are interested in sharing and using the knowledge.

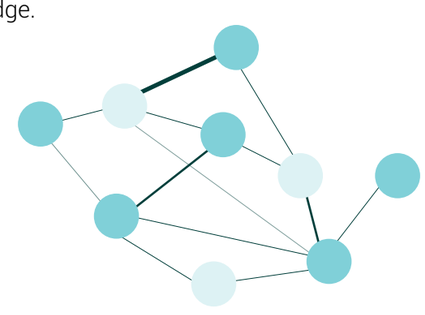


Figure 21. Social network illustration

The next step

First of all, Physee needs to make a stakeholder map and analyse the relationship and value between them. See chapter 4. However, during the analysis, first we need to understand the social network between Physee and the stakeholders they are working or will work with.

Why communication?

Communication can be defined as the exchange of information, thoughts, and emotions between individuals and groups (Boyaci, 1996). The purpose of communication in the organisation is to share information and create specific knowledge. In this research, engaging the stakeholders through communication is manifested through Knowledge Management (figure 22).

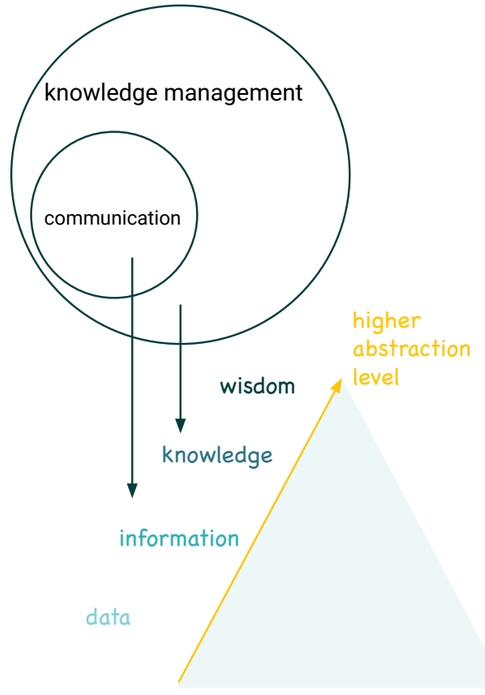


Figure 22. DIKW model (triangle) inspired by Ackoff (1989) combined with author's interpretation towards KM and communication

3.2.1 Knowledge Management (KM) to improve project communication and implementation

"Innovation happens when sharing knowledge happens" (Kandadi, 2018). Moreover, participation in a strategic alliance network increases the demand of knowledge transfer from partners (Walter, Lechner, & Kellermanns, 2007). The organisation needs to have a positive position in their external network of cooperating organizations and also manage the internal relationships between their business units so they can support each other. Eventually, might gain sustainable competitive advantages.

The Knowledge Shaing process in more general is called Knowledge Management

(KM). It is not about uploading the presentation into one folder, but it is the processes that are important (Kandadi, 2018). Knowledge Management is the most important concept that adds value to the organisation (Tingoy & Kurt, 2009). KM mostly dependent on interaction and communication between individuals and groups. KM can help to transform the information into systematised knowledge and eventually contribute to decision-making and planning (Matti, et al., 2020).

But first of all, we need to understand what is *knowledge*. Knowledge is the combinations of collected information, personal experiences, insights, expertise, and logical reasoning in an actionable context. Knowledge is more complex than data or information because it is subjective and highly contextual (Nazim & Mukherjee, 2016). With respect to Ackoff (1989), figure 22, the model of DIKW (Data-Information-Knowledge-Wisdom) is often being used in the knowledge management literature. Under the knowledge, there are information and data. Data are symbols that represent the properties of objects and events. Information is the collection of processed data. The accumulation of knowledge creates a higher level of abstraction, called wisdom.

From a design perspective, there are Hara and Norman's books that are discussing about knowledge. Hara (2007) mentioned that knowledge needs to be seen as the user's empowerment rather than the acquisition. As technology and media are developing, innumerable portions of segmented knowledge have stuck in human brains. As a result, we, as the information recipient, seldom get any more involved in the topic. Therefore, as Hara mentioned, "to get know something is not a goal, but a starting of our imagination" which leads to curiosity and more discussion. In the end, this mindset can open to more attraction and innovation.

While knowledge-based on Norman (2013) divided into 2, knowledge in the head and knowledge in the world. Most researchers mentioned tacit and explicit knowledge. Both types of learning have their challenge. It is challenging to handle the enormous volume of explicit information and difficult to capture and diffuse the implicit knowledge. It needs interpretation to understand the knowledge of the world and learnings to conceptualise the knowledge in the head. There are two other types of knowledge within knowledge in the world: knowledge to' (declarative) and 'how' (procedural). 'Knowledge 'how' is more difficult to teach, but it is best to be taught by demonstration.

Knowledge Management (KM) has become important since the mid-1990s. It is not something new. The goal of KM is to make the appropriate knowledge available from providers to receivers when and where needed. The knowledge providers may be internal or external to an organisation (Nazim & Mukherjee, 2016).

Knowledge Management (KM) has an important place in an organisation's value chain because it can improve the effectiveness of all primary activities by increased learning ability. KM can reduce project time and cost, improve quality, and provide a major source of competitive advantage for the construction organisation (Shelbourn et al., 2006). On the other hand, excessive knowledge transfer can lead to counterproductiveness for an organisation. Hence, the company needs to control the knowledge they share to prevent leakage and set clear rules regarding the type of knowledge they should not communicate (Ritala, et al., 2018).

An organisation needs to acknowledge the type of knowledge that needs to be transferred and recognise that certain characteristics of the knowledge source and the recipient can influence the success of the knowledge transfer (Goh, 2002).

In the management literature, Knowledge Management has been cited a lot to solve the problem. However, the focus is lack of human interaction, and the approach is very top-down rather than user-centered. The literature on Knowledge Management and Design has not been researched a lot.

Knowledge for the project

It is crucial to design a solution that focuses on user empowerment rather than the showcase. Before that, Physee also needs to understand what kinds of knowledge there are. Therefore, the user interview is conducted (see chapter 4).

3.2.2 Knowledge in construction industry

Construction project teams are temporary and consist of multidisciplinary teams. The parties move to another project after completion of a project, resign, or retire. Tacit knowledge becomes more crucial for construction organizations in order to be competitive and sustainable in the long term (Kivrak, 2008).

Good communication and trust culture among employees enhance tacit knowledge transfer (socialization) and are vital to organization innovation (Rhodes, et al., 2008).

Kivrak, et al., 2008 describes important factors in managing knowledge in the construction industry:

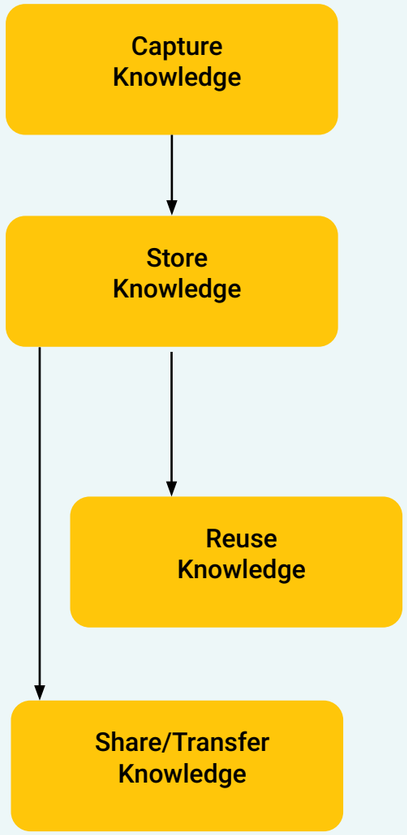


Figure 23. Knowledge processing, by author adapted from (Kivrak, et al., 2008)

1.) Capture knowledge
Tacit knowledge plays an important role in the success of the construction process. However, sometimes companies can not capture the knowledge that exists in the individuals' heads. The most important knowledge sources are determined by colleagues and the company's experience.

2.) Store knowledge
Store the knowledge gained from the previous projects to reuse it in the next project.

3.) Reuse & Share knowledge
Reusing the knowledge gained in previous projects is only in emergency conditions. The support and resources of project management to knowledge sharing has been considered very important.

Kivrak also mentioned that the successful implementation of the KM system would have some benefits such as reducing rework, sharing and retaining tacit knowledge, storing innovative ideas, continuous improvement, client satisfaction, organizational learning.

One way to encourage knowledge transfer is to focus on a selected value, for example, "increased customer satisfaction" (Goh, 2002). Therefore, the company can focus on capturing the customer's needs and preferences.

Chapter 3 - Key takeaways

- The literature review is divided into two parts: integrated facade to understand the context and stakeholder engagement to gain insight into communication.

- An integrated facade is a mediator between the exterior environment and the conditioned interior spaces of a building. It is something relatively new in the construction industry.
- The facade has 4 main value drivers for stakeholders: financial, functional, energy, and strategy. However, there is unclear research about stakeholder's value. Thus, this can be investigated on this graduation thesis.
- The phases of the facade life cycle are linear, but there is a back-coupling between the phases.
- Physee is the system supplier which works with multiple stakeholders.
- The challenge of adopting the innovation is because the Physee is in the introduction phase in the market. They are working to develop a product that is covering the challenges in the future. Another reason is that the construction industry lacks efficiency, unwillingness to innovate, and slow technology adoption.

- Engaging the stakeholder is needed to know more about the actors around (current and/or future stakeholders).
- A stakeholder map is a tool to engage the stakeholders.

- Engaging the stakeholders through communication is manifested through Knowledge Management (KM).
- Knowledge Management (KM) aims to make the appropriate knowledge available from providers to receivers when and where needed.
- Knowledge in the construction industry includes capture, store, reuse, & share knowledge.

"Innovation happens when sharing knowledge happens" .
- Kandadi, 2018

Chapter 4

Gathering Internal and External View From the Stakeholders

4.1 Internal Stakeholders: The Service Provider

4.2 External Stakeholders: Partners & Clients

image source
Physee documentation

As mentioned (Goh, 2002), there are two main stakeholders to improve the Knowledge Management (KM), the knowledge provider and the knowledge recipient. Because of that, the primary research will be conducted in two phases:
1.) Physee as the service provider. Later it calls as internal stakeholders (commercial department teams) and
2.) Partner & clients as the knowledge recipient. Later it is called external stakeholders.

SQ-3 How does the existing relationship and communication workflow between the Physee's commercial team and the external stakeholders look like?

SQ-4 How can both Physee and the stakeholders are kept informed?

SQ-4 a: What is the information that Physee wants to provide?
SQ-4 b: What is the information that customers want to know?

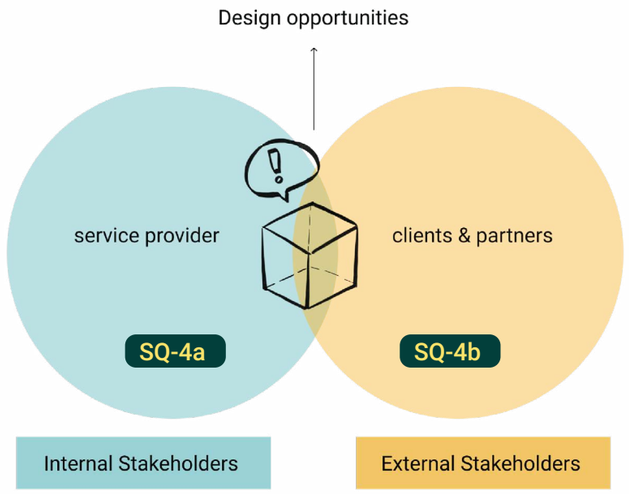


Figure 24. Methods plan

Data Collection

The data is gathered using qualitative research by conducting semi-structured interviews with a generative approach. Because the project involves many different stakeholders, the interview used semi-structured with casual interaction.

The data also collected from the scheduled interview and gathered from the informal interview with other departments and the project updates held every Friday and other project brainstorming sessions.

Sampling/participant selection

The research uses purposive sampling to represent each of the groups. Within Physee, the respondents are the people who work in the commercial team. While the external, each person representing the job was selected (see Appendix D & F for more details).

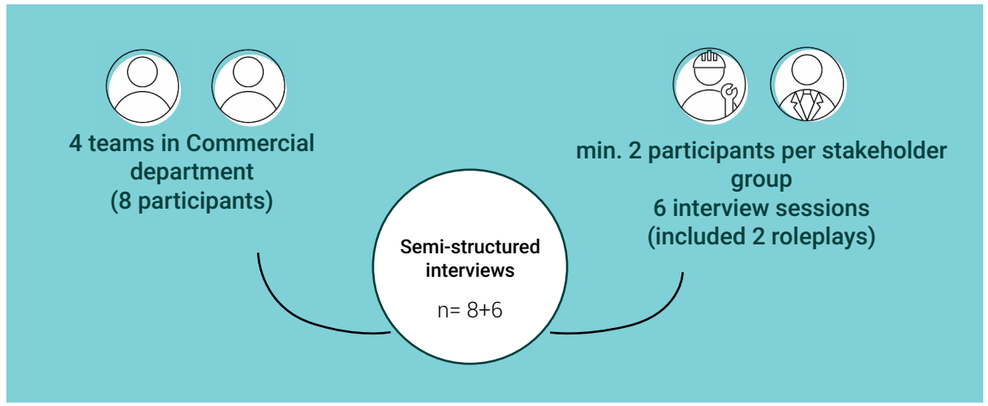


Figure 25. Sampling for qualitative interview

Data Analysis

Figure 26. Data analysis process

First, the recording is transcribed using the online automation transcription). The transcription then is analysed using *Atlas.ti.* The quotes are coded with some keywords. Second, the keywords are grouped and analysed.

4.1 Internal Stakeholders: The Service Provider

4.1.1 Objectives

The internal interview aims to understand the context; the people's relationship with other teams and the external stakeholders (client & partners); understand the transfer knowledge process and the knowledge content; gain insights about the goals, current pain points and needs; and understand the need for collaboration and how to collaborate more efficiently.

SQ-4a *What is the information that Physee wants to provide?*

4.1.2 Data Attributions

There are different data attributions to answer the sub-research question, including:

1. Stakeholder relationship between the pre-sales, sales, and after-sales.

We need to know who are the people that interact with Physee. During the analysis of the relationship, the approach/key value will be known.

2. Pain points & enablers in the journey map.

It is important to understand the pain points and enablers because we can improve the problem.

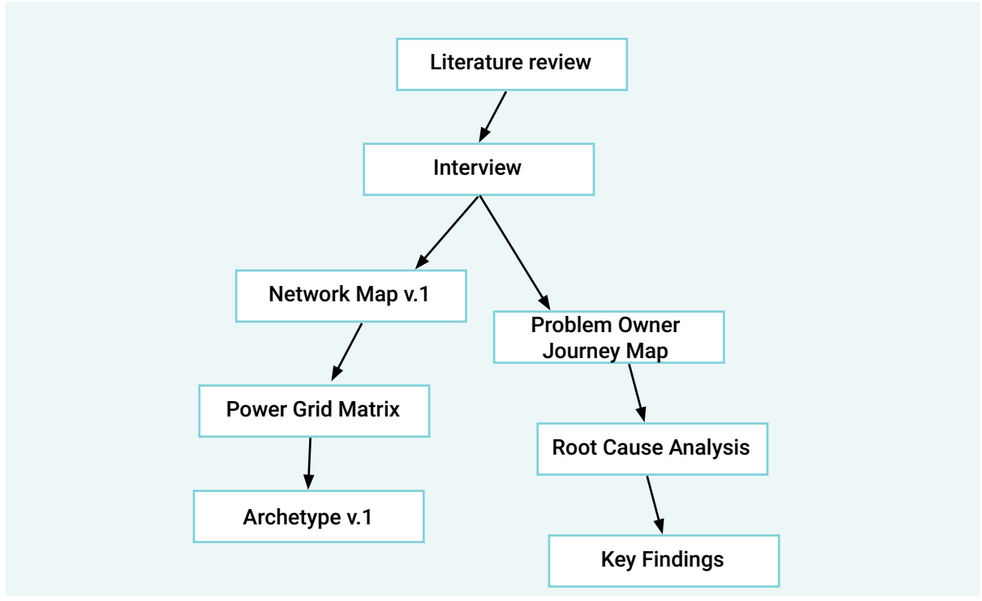


Figure 27. Method summary for internal stakeholder analysis

4.1.3 Results

Some insights were gathered from the interview session with 8 main stakeholders within Physee Commercial department and other informal meetings. The results are presented using the list of key findings and power grid matrix. As the tools, Problem Owner Journey Map and Stakeholder Map are helping the designer understand the context within the company. Some follow up to the journey map because it is not possible to create a complete map. There are so many people involved within the team. Each person has different emotions about the touchpoints. Therefore, the problem was analysed using the Root Cause Analysis to gain deeper insights.

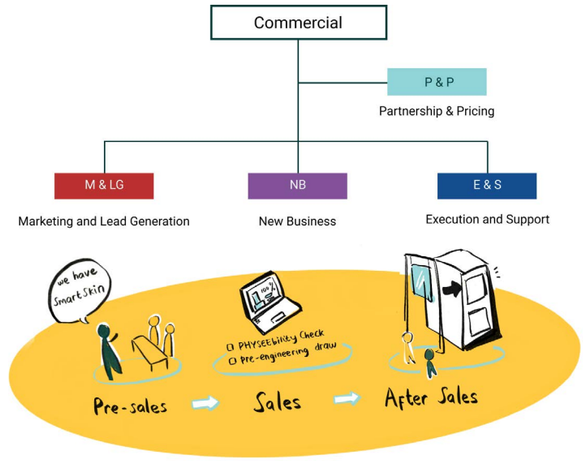


Figure 28. Physee Commercial Department

1.) Network Map per division

There are four different networkmaps. It is useful to understand the different touchpoints. In addition, the division is helpful to see how are the interaction and information flow for each team within PHYSEE.

The map shows two different circles: the internal stakeholders and external stakeholders. The further actor from the core means less interaction.

The maps show that the information exchange has two different patterns. Marketing & Lead Generation, which responsible for the pre-sales phase, have more one-way communication. In contrast, the other teams have more two-way communication. The two-way communication only shows the exchange document rather than allowing feedback or allowing the external stakeholder to also contribute to planning one cycle project loop.

The analysis shows that there are many communication, especially the New Business, in one team. However, the information exchange is considered a lot with minimal human resources within the team.

Marketing & Lead Generation (M&LG)

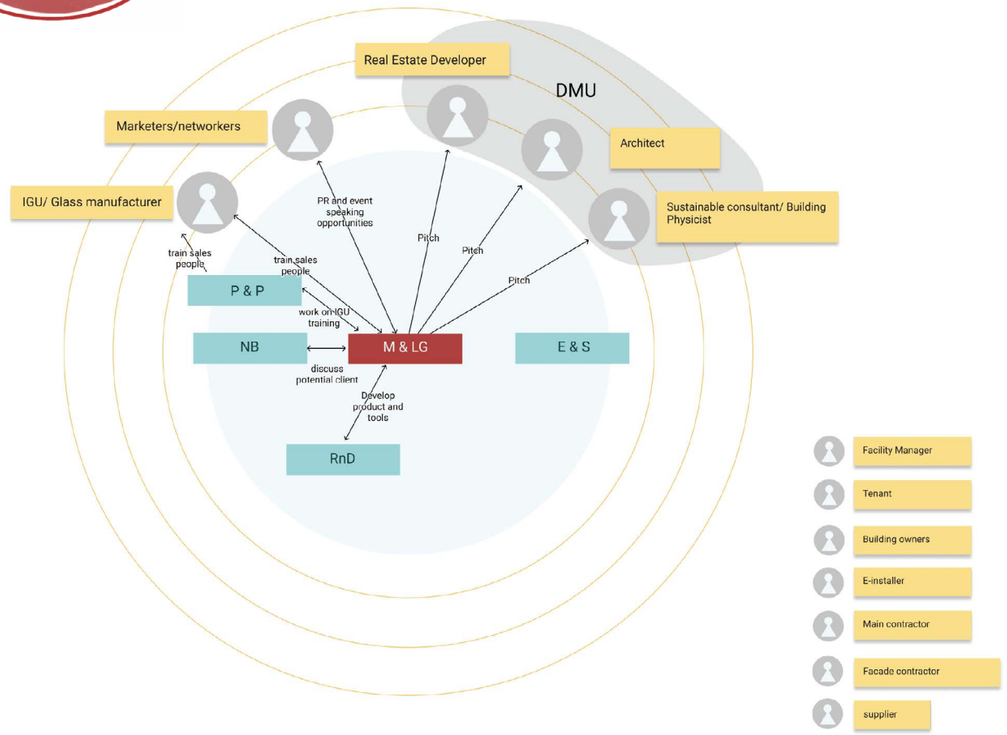


Figure 29. Marketing & Lead Generation stakeholder map

Needs:

Clear brand identity

Identify ideal target customer & their needs

Create SmartSkin attention

Pain:

Keep update the changing product

Can not show the data yet

“ But we can’t show any data yet. We don’t really have anything to prove yet”.

Tools:

Physee is planning to use Hubspot. Hubspot is the CRM tool for marketing and sales to oversee the customer data and to hand over the work easier.

New Business (NB)

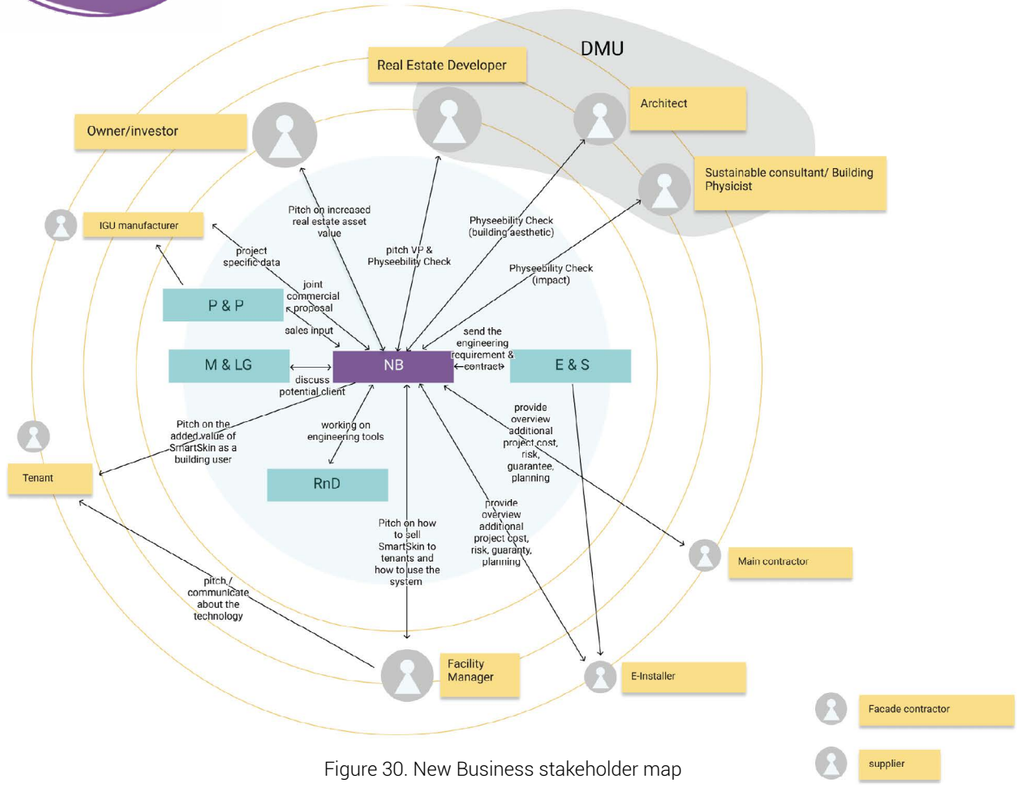


Figure 30. New Business stakeholder map

Needs:

Giving attractive business case

Clear technology & value/benefit explanation (e.g. comfort)

Pain:

Difficulty to present the intangible benefit (e.g why sensor, pre-scan data, comfort)

“I think the main challenge is that the product benefits are not 100% clear”

Execution & Support (E&S)

a. Execution

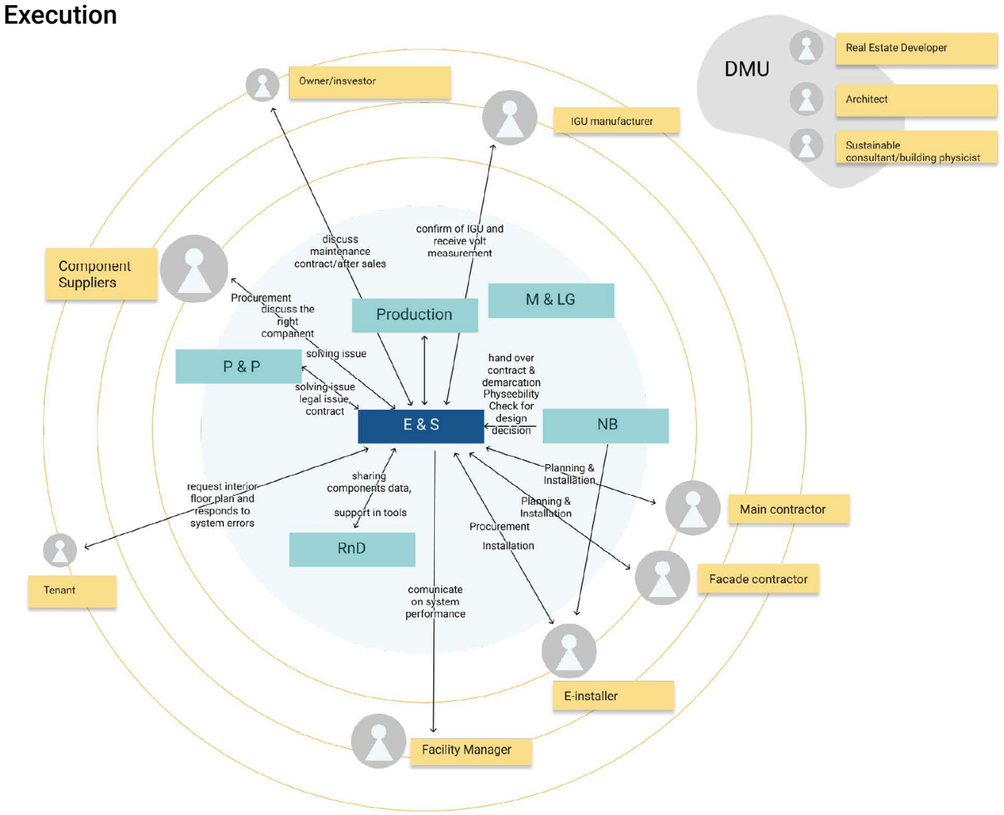


Figure 31. Execution stakeholder map

Execution & Support is handling 2 phases in project cycle, the installation and maintenance/use. Thus, the stakeholder relationship are different.

Tools:

ATLASSIAN

Jira

Project Management tools that used by Physee are Jira and Atlassian which useful to report a problem that is occuring within the project which will be assigned to the problem solver within the company by using the sprint method.

b. Support

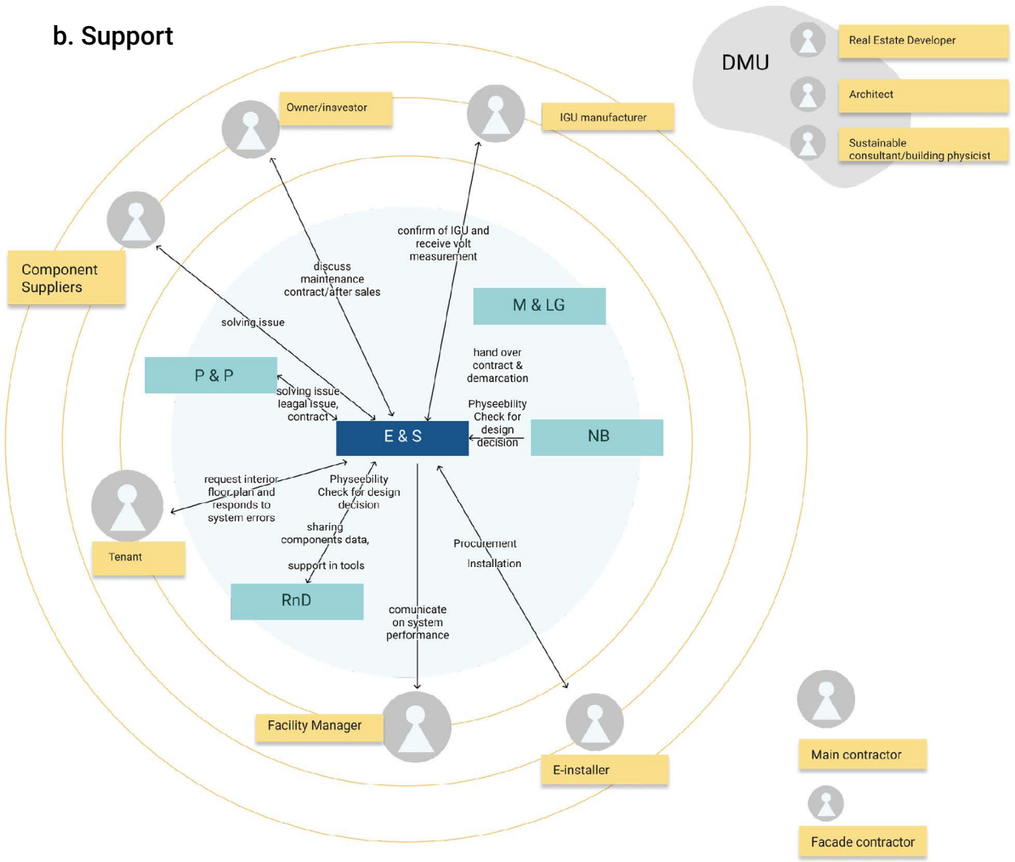


Figure 32. Support stakeholder map

Needs:

Everyone aligned with the result

Maintain trust & a good communication & relationship with façade contractor for the future projects

Efficient & focus

Pain:

Manual check

Underestimation

“when we’re scaling up, yes, then a lot of a lot of items or issue share should be clear for everyone, upfront”.

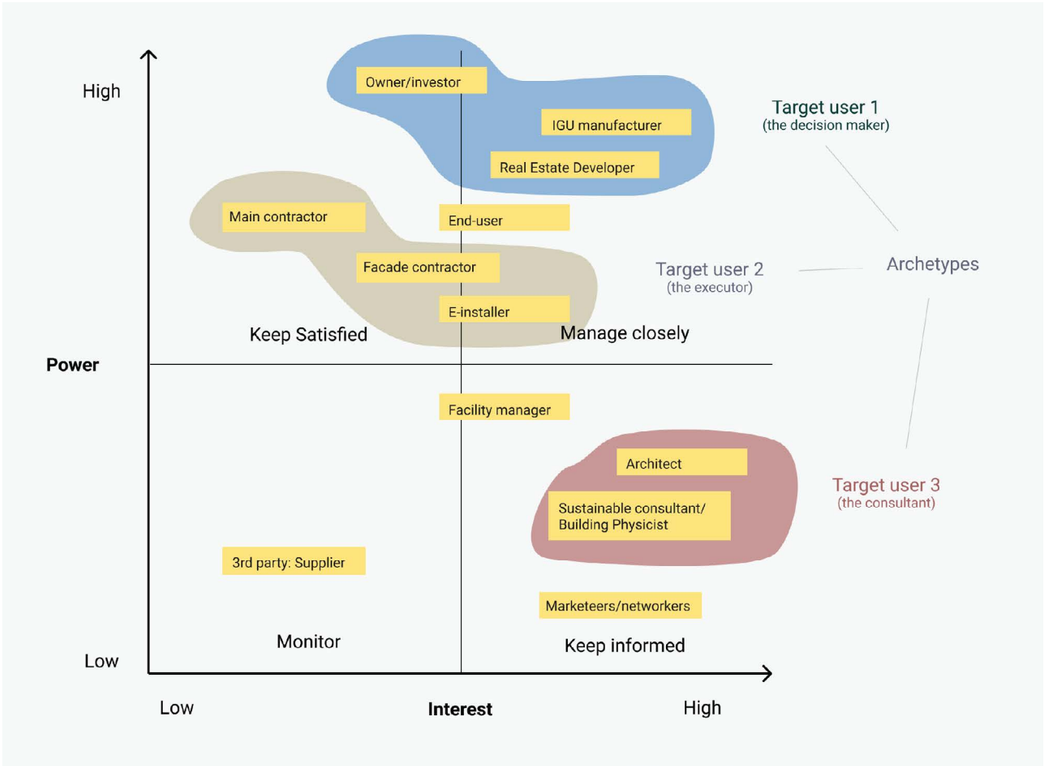


Figure 33. Power Grid Matrix of involved stakeholders

2.) Power Grid Analysis

The matrix (figure 33) explained that some stakeholders have more power in the project but less care about the uniqueness of the offering and vice versa. The power grid matrix is helpful to know who are the stakeholders that Physee needs to approach.

After finalising the power grid analysis with the internal stakeholders, there is some pattern that occurred. In the later phase, this can be categorised into three types of user.

3.) Archetypes

Archetypes are the information of user behavior that contain of details of a group's needs, motivations, and pain-points. Archetype provide insight into behavior patterns. It can help determine the approach and functionality of a user experience, as well as contribute to determining, validating, and prioritiizng product features (Ben-Menachem, n.d.).

The archetypes are:

a. **The decision maker**

Consists of building owner and/or investor, Real Estate Developer, and the IGU Manufacturer. They are mainly focus on the Pre-Sales process.

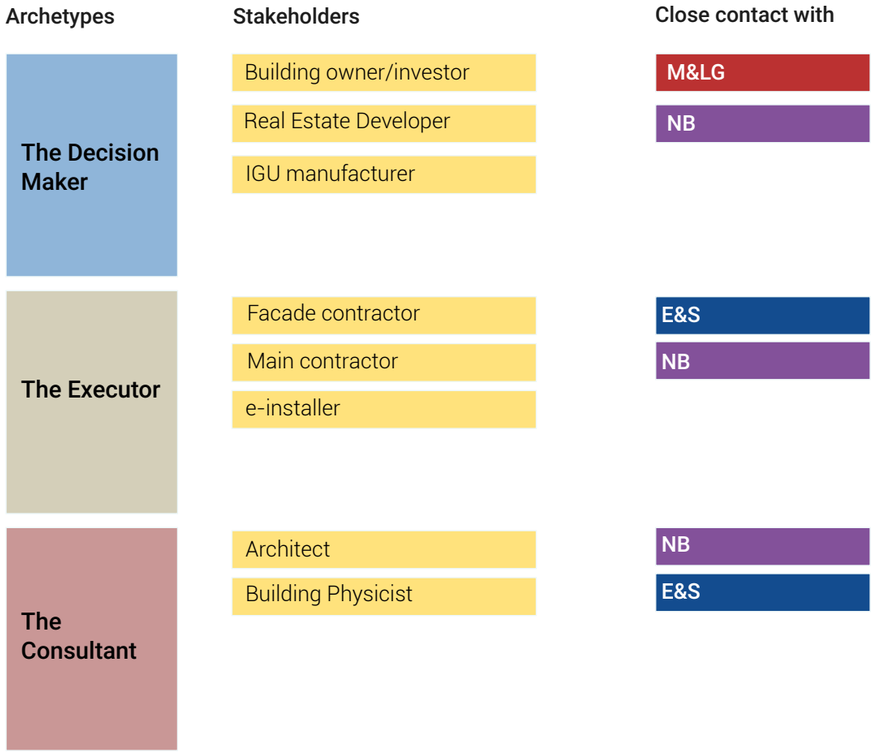


Figure 34. Commercial department involvement with each of the archetypes

b. The executor

Consists of the façade contractor, main contractor, and e-installer. They are mainly involved in the After-Sales process

c. The consultant

Consists of the building physicist and architect. They are mainly involved in the Sales process.

Apparently, the archetype can be divided with the Pre-Sales, Sales, and After-Sales process. It is relevant for now but in needs to be validate in the external stakeholders interview (chapter 4.2). Is this something make sense? If yes, what are their needs, motivations, and pain points?

Although there is a distinction between Pre-sales, Sales, and After Sales process, the involvement of the internal stakeholder sometimes is overlapping. For example, New Business team needs to focus on the sales process (see chapter 2), so their main stakeholders would be "the consultant". However, in reality, they also need to keep in touch with "the decision making" and "the executor". The problem is that the human resources are not that much. It also become part of the barrier in their work.

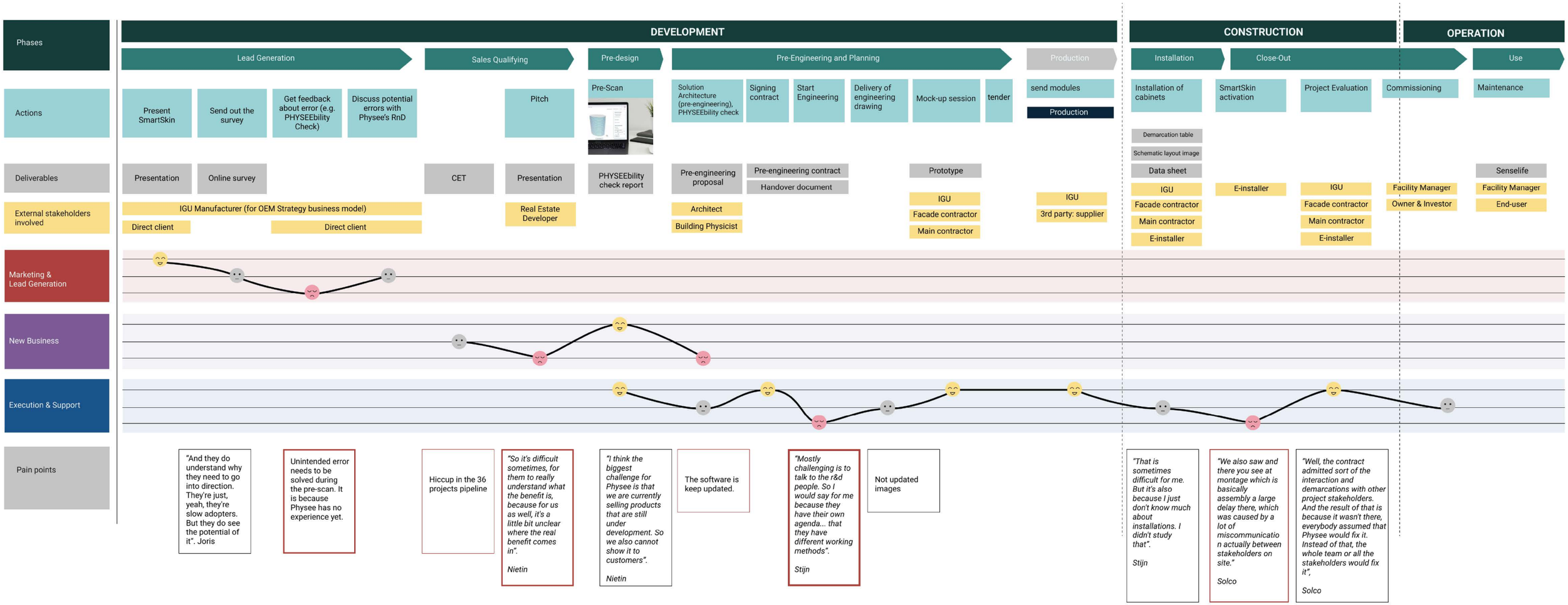


Figure 35. 'Problem Owner' Journey Map

4.) 'Problem Owner' Journey Map

The 'Problem Owner' Journey Map derived from Customer Journey Map. In this case, the research uses the problem owner point of view to understand the pain point or enablers within the organisation. The problem owner is the teams within the Commercial teams: Marketing & Lead Generation (M&LG), New Business (NB), and Execution & Support (E&S).

The framework of this journey map is from (Klein, 2013) façade construction phases. Then, adding Physee internal steps, such as Lead Generation, Sales Qualifying, and Close-Out.

The main pain points are about the unclear benefit, lack of experience, different working methods, unintended error, and miss expectation. Most importantly, the information is scattered, and the labour turnover is high.

5.) Root Cause Analysis (RCA)

To gather a deeper understanding of the pain points, the author conducted Root Cause Analysis (RCA). Five key findings are needed to be investigated in further research. The details of Root Cause Analysis is presented in Appendix E.

"Physee culture is open but sometimes information is scattered. It is in people's head but people can leave the company. We need a platform so people can share" .

- Waiman, Quality Assurance

6.) Key Findings

After conducting the Root Cause Analysis, there are several key findings. The findings consists of enabler and barriers.
There are 1 follow-up question (Q0) and 5 questions of the design challenges (Q1-5).

Enabler #1

It is important to present the data that stakeholders are seeking for.

"[The] main barrier is that we communicate from a technical perspective when selling our proposition. The technical part is something that the real estate developer finds hard to understand, because they work more from a financial and visual standpoint"
-Maarten, New Business

Because of the different stakeholders, Physee need to explain the right information that are needed by the stakeholders.

Q0 What is the information that stakeholders are looking for?

Q1 How could we provide a different data points to the stakeholders?

Barrier #1

Everything is changing rapidly, but Physee has no updated data yet (for themselves).

"I think there's a lot going on. I mean, we, we used to focus a lot on power generation. But now we say, we're not we focused only on data. But we can't show any data yet. We don't really have anything to prove yet."
-Maike, Marketing & Lead Generation

The technology evolves from time to time. The team need to catch up the RnD process but at the same time they need to inform the stakeholders about the changes in the offerings. However, they also have less human resources.

Q2 How could PHYSEE make their project clear although the product is work in progress offering?

Q3 How could the stakeholder keep informed about the latest update?

Barrier #2

The client underestimated the project because they don't know what will happen in the future.

"We also saw and there you see at montage which is basically assembly a large delay there, which was caused by a lot of miscommunication actually between stakeholders on site."
-Solco, Execution & Support

Because the process is new to all stakeholders, sometime it causes mismatch expectation. The team believes that professionally comes when Physee can meet the client's expectation.

Q4 How might PHYSEE prevent the the mismatch expectation in the project?

Barrier #3

Unforeseen problem is becoming Physee's responsibility.

"Well, the contract admitted sort of the interaction and demarcations with other project stakeholders. And the result of that is because it wasn't there, everybody assumed that Physee would fix it. Instead of that, the whole team or all the stakeholders would fix it."
-Solco, Execution & Support

Information is not well-documented. At the same time there is a limited human resources to fix the problem. One non-design solution is to improve the liability for projects.

Q5 How PHYSEE could maximize the clarity and collaborative workflow?

Barrier #4

Unclear data hinder decision making.

"I think the main challenge is that the product benefits are not 100% clear".
-Nietin, New Business

"They always find it difficult to really understand what the product is about. Okay, right. So to really get to the full understanding, I think that's, that's something that they really need to help them with".
-Joep. Pricing & Partnership

Physee not able to provide the real benefit because it is under development product.

Q6 How might we show the data as real as possible?

4.2 External Stakeholders: Partners & Clients

4.2.1 Objectives

The objectives of the external stakeholder's interview are to: know what kind of information that they need the most; gather pain points of different learning processes/methods; get their opinion about the SmartSkin 2.0 development; and understand the way of their collaboration process.

4.2.2 Data Attributions

The data attribution is gathered using the 'Golden Circle' model (Sinek, 2009) that consist of Why, How, and What.

a. Why: understand the reason to choose a certain façade

b. How: the participant getting the knowledge

c. What: type of knowledge that they value.

SQ-4b *What is the information that customers want to know?*

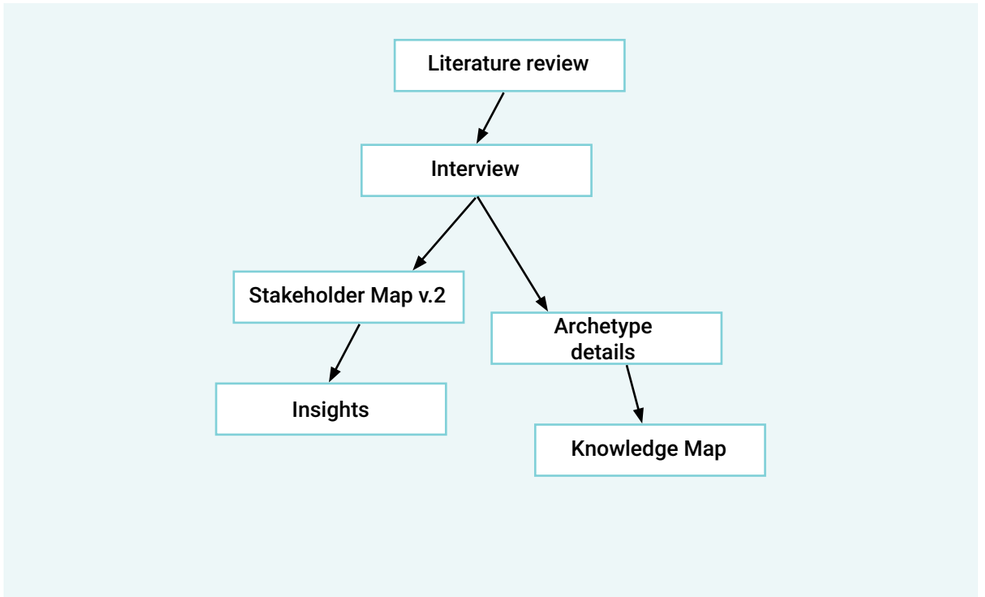


Figure 36. Method summary for external stakeholder analysis

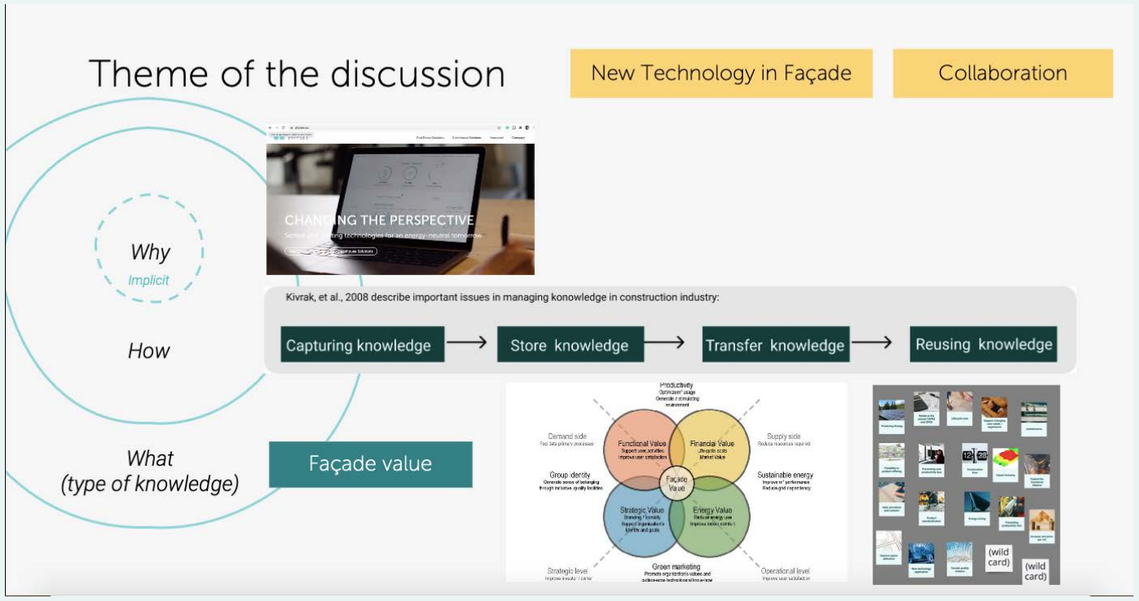


Figure 37. Interview plan

Value Card sorting by the respondent based on the importance.

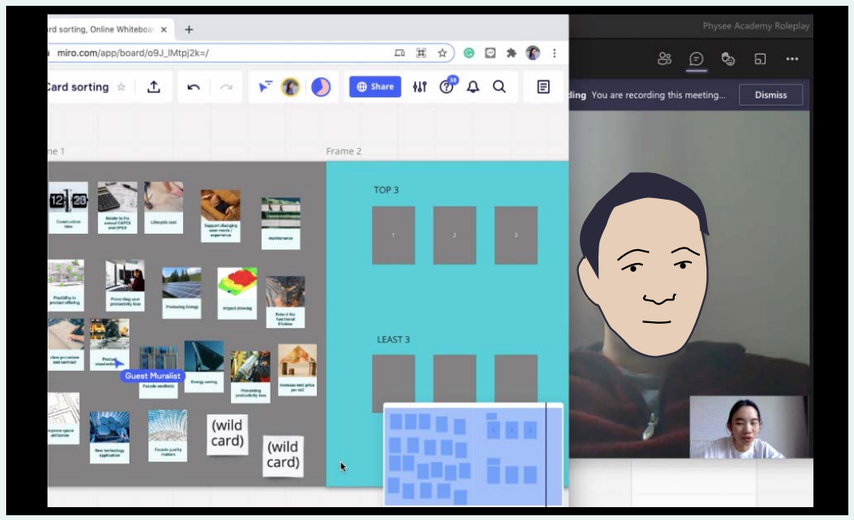


Figure 38. Interview session

The objectives of the discussion are to explore the respondent's opinion on new technology in the Facade industry and their thought about collaboration. The discussion was divided into three parts:

1.) Why

First of all, the respondents were being asked about their opinion when they first know Physee as an integrated facade supplier. They are being asked while exploring the website. The method is similar like a usability testing.

2.) How

Secondly, the respondents are being asked about their experience in capturing, storing, transfering, and reusing knowledge.

3.) What

Lastly, they are being asked about the value they appreciate the most. The card sorting helps to engage the participant to discuss their thought about the value of an integrated façade. There are four different values based on (Azcaarte-Aguerre, et al. (2018); however, after conducting the pilot test with a Construction Management TU Delft student, one value could be added. It is called operational value. It contains a practical value, for example, the clear procedure, time management, etc. This is a new findings from this research to complement the previous research.

4.2.3 Results

1.) Social Network Analysis

During the interview, there was also a discussion about the relationship between stakeholders to others. For example, Real Estate Developer is working closely with the Architect, listening to the investor. Different relationships were found (figure 39).

Because of this, Physee could understand which stakeholders need to be influenced first. As mentioned in the literature review, there is some distinction between the network: creative, managerial, political, and friendship. However, due to the limited amount of data, the network is difficult to be concluded in that way.

Another challenge is because PHYSEE keeps changing the offerings and value proposition, it also affects the workflow. After talking with some stakeholders, the author divided the type of network into 5 types (figure 39). From the Social Network Analysis, we can conclude that some stakeholders need to become a priority or keep informed.

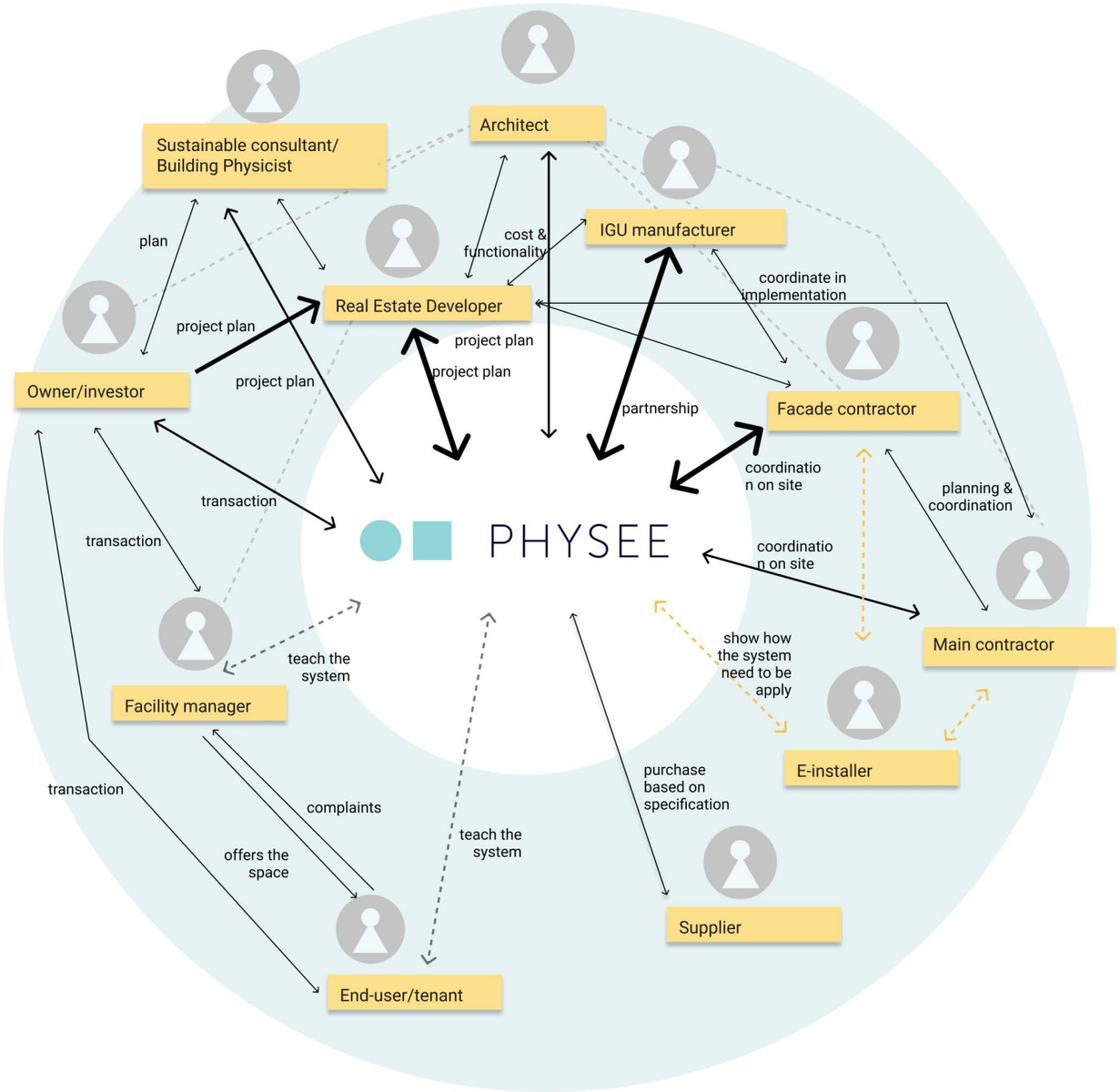


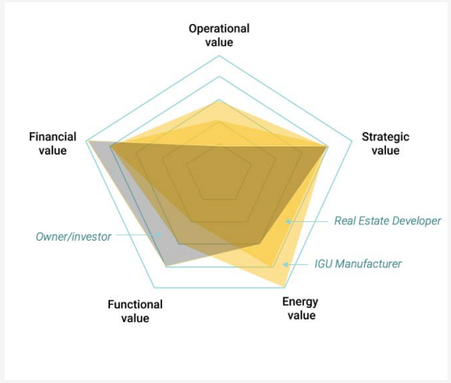
Figure 39. The general overview of the refined stakeholders map

Archetype 1
The Decision Maker

They are eager to know the long term benefit.

Decision Maker consists of :
Building owner/investor, IGU manufacturer, and Real Estate Developer (RED).

Jobs-to-be-done:
When they know Physee, they want to know how much it cost so they can sell it to the end-user. In addition, is it sustainable?



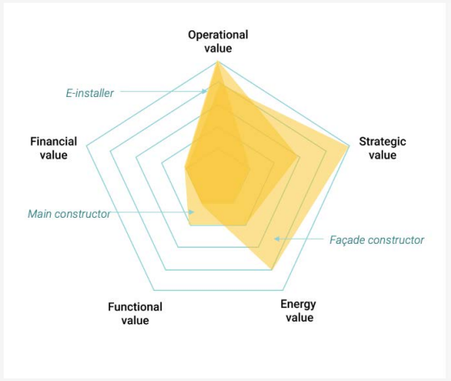
Value:
Financial value
e.g. ROI, financial gains, life cost
Strategic value
e.g. Façade quality, same vision, new technology
Energy value
e.g. Influence on sustainable score

Archetype 2
The Executor

Focusing on details and technical information.
The more detail the better.

The executor consists of:
Façade contractor, main contractor, and e-installer.

Jobs-to-be-done:
When they are facing a problem, they want to find a details of how to fix it so they can finish the work on-time.



Value:
Operational value
e.g. Clear procedure and contract, preventing production loss, construction time
Strategic value
e.g. Façade quality, standardization

Archetype 3
The Consultant

The more opinion or contribution they can give to the project, the more exiting for them.

Consultant consists of :
Architect & Building Physicist

Jobs-to-be-done:
When they want to find a supplier, they need to check if the supplier is match with their design so they can design based on their preferences.

Value:
Functional value
e.g. How it works, support changing user needs,
Financial value
e.g. ROI, financial gains, life cost
Energy value
e.g. Influence on sustainable score, impact

Figure 40. Three validated archetypes

2.) The validated archetypes

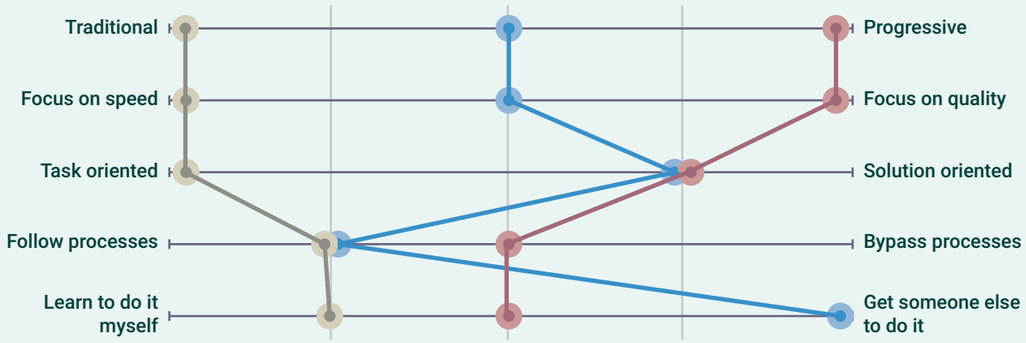
After talked with some stakeholders, the archetypes illustrations show similar value about the integrated façade. However, there are not entirely the same. For example, the architect focuses more on functional, while the building physicist values the energy more.

The spider web value diagrams' functions differentiate the archetype and how ideas/ solutions can fulfil the stakeholders' need.

The Executor

The Decision Maker

The Consultant



How Physee inform them (existing condition)	• phone • demarcation document • *bouwvergaderingen* • website	• presentation • email • events • Linkedin • press	• presentation • email • technical sheet • product demo • drawing
	• e-mail • data sheet • Physee check live session	• website • Google SEO • whitepaper • word of mouth	• Physee check live session

Figure 41. Archetypes differences

There are some limitations and critical points about the current deliverables at PHYSEE:

a. Can not cover to differents archetypes' needs

The archetypes have different goals and behaviour, as seen in figure x. Therefore, the current strategy, which is most likely one-way communication, is not enough to fulfil their needs. They have a different approach to handle certain information. For example, the executor is focusing on speed of the project. Therefore, they need information about efficiency.

b. There are not enough people to customise the information in the deliverable

As mentioned in the previous subchapter, the blocker of the company's effectiveness is the limitation of human resources. Hence, there should be another strategy to transfer the knowledge more efficient.

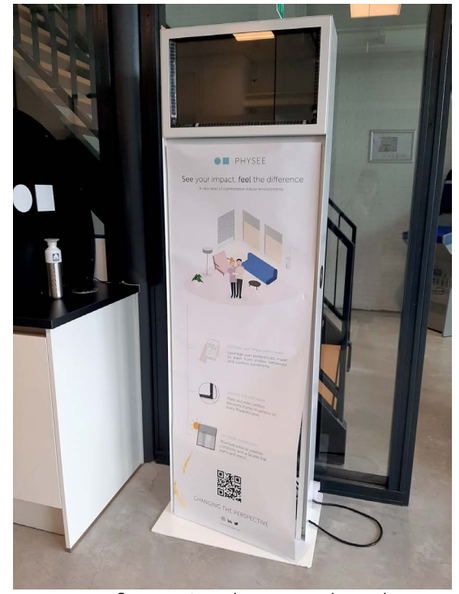


figure 42. Fglass sample and poster

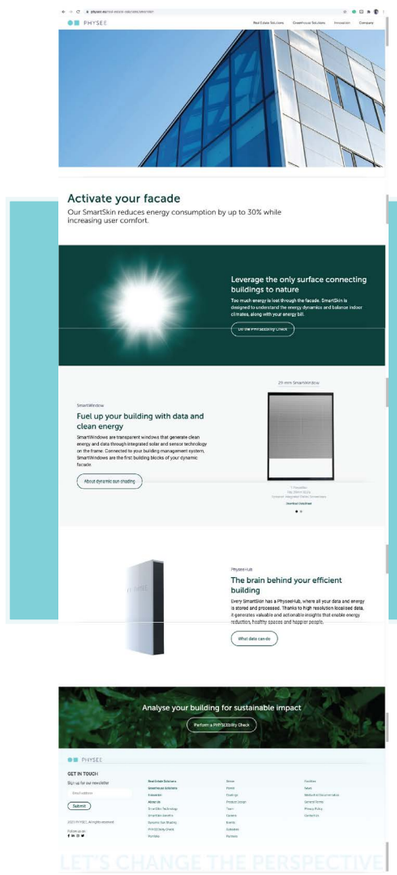


Figure 43. The current website

Q0 What is the information that stakeholders are looking for?

3.) The Knowledge Map

Knowledge Map is helpful to understand the detail of the information that archetype need. The information is different from each other. It is beneficial in the ideation phase to ensure that every need for information is included.

The next step is to answer the Q1.

Q1 How could we provide a different data points to the stakeholders?

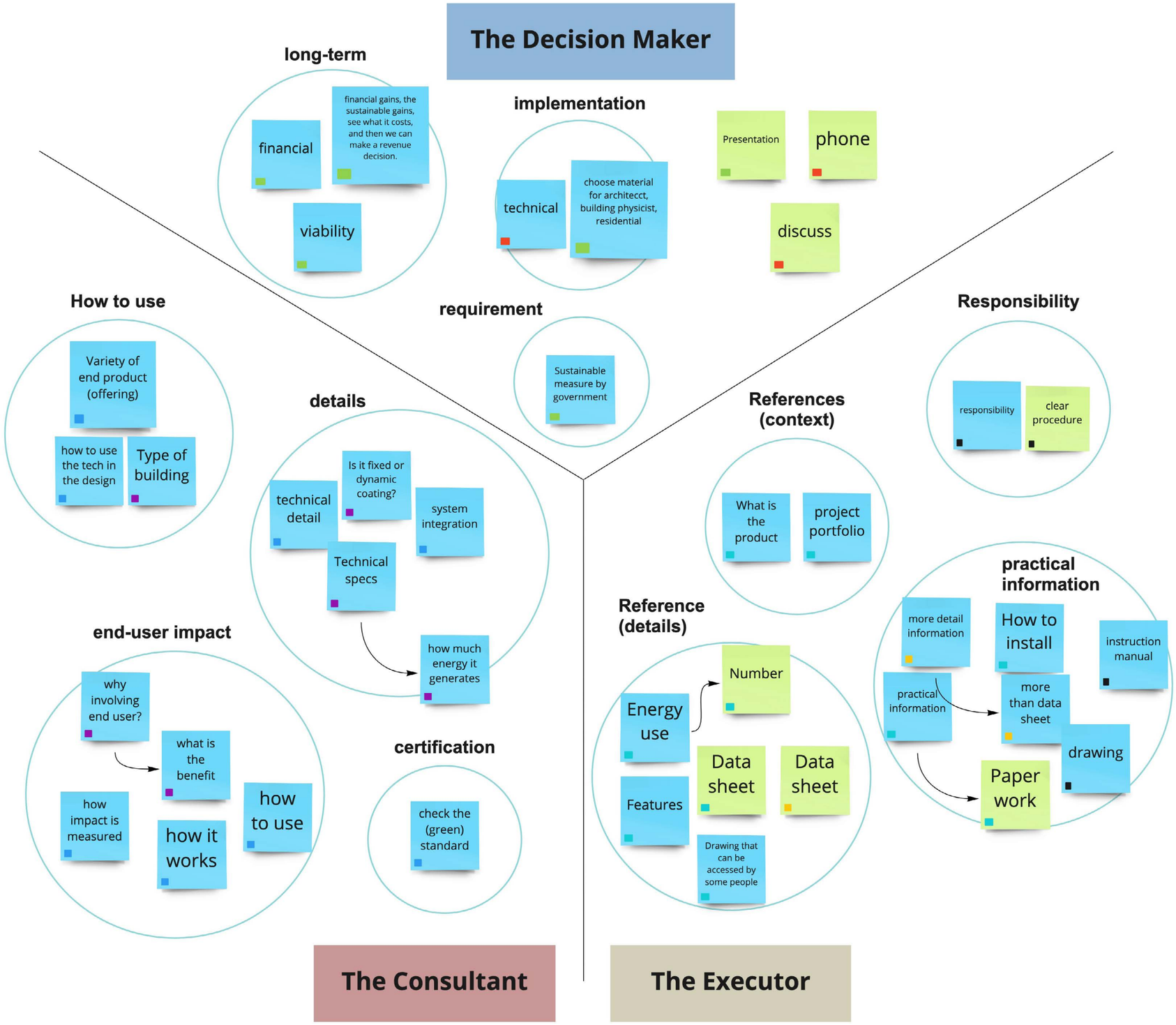


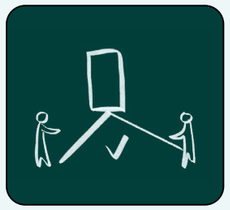
Figure 44. The Knowledge Map

4.2.4 Key Insights

There are 4 categories of insight and each of it has a (design) opportunity. A detailed explanation of how to gather the insights is described in Appendix G.

- The Decision Maker
- The Executor
- The Consultant

Category 1 - Relationship



Same vision creates more interest

! a **Design Opportunity:**
PHYSEE needs to show their value (sustainable, smart, comfort) in the soution.

Stakeholders will get more interested to collaborate when each of their visions are more aligned (e.g. sustainability & technology). It means the opportunity to work with is relatively high.

" think I will partner up with the companies who are also more into meeting these standards as well. I won't go to any company, who is not going to provide any impact on improving the building performance"
-Fezya, Architect

Choice is dependent to the other stakeholders

Opportunity:
PHYSEE can compose a network system of their future client to understand who they will work with.

Due to the linearity of the process, the stakeholders are inclined to ask approval from the other collaborators.

"I'm gonna ask my climate consultant to have a look at this website"
-NN, Main Contractor

"The end investor should take it anyway. Because we think this is our vision and we want to make this sustainable building."
-Tim, RED

Category 2 - Something New

Novelty bring interest

Opportunity:
PHYSEE can make use their difference/ uniqueness from the competition.
They need to be confident

Physee offers innovative solution to the partner and client. They are really keen to know more.

"SmartSkin and technology application number one's very interesting. For me, it's an eye opener."
- Jaap, IGU Manufacturer

Previous background determine the learning time

! b **Design Opportunity:**
PHYSEE can give suggestion of the learning leveling. (This opportunity is specifically only for IGU Manufacturer)

As the result, the stakeholder might need to understand what Physee's offering with a certain learning time.

"So I have to learn a lot before I go getting in touch with with customers and everything".
- Jaap, IGU Manufacturer

Unknown problem is Physee's responsibility

! c **Design Opportunity:**
PHYSEE needs to set the boundaries of their responsibility and provide a detailed documentation

The contractors are relying on Physee if there is any problem occur.

"It's difficult for us to know who's responsible for what do we go to the facade installer, or do we go to Physee?"
- NN, e-installer

Category 3 - Information Presentattion

Show is more important than tell

Usually, the stakeholders want to know the data in number or drawing, but they have difficulty finding out where it is.

"there aren't a lot of real products on the market. So it's, it's more, the information that you get is more like possibility studies or so in every situation, the information that you get is quite low"
-Kitty, Building Physicist

! d **Design Opportunity:**
PHYSEE could show the number or drawing like a real product.

Showing the Smart glass principles to inform the offering

Present the information based on the smart glass principles may help the client to imagine/structure the benefit of SmartSkin as an integrated facade.

"I would expect the combination of censoring something and then activating it".
-Kitty, Building Physicist

! a **Design Opportunity:**
PHYSEE needs to show their value (sustainable, smart, comfort) in the soution.

The design opportunity is similar to the insight of "Same vision, creates more interest"

Category 4 - Training session (from existing solution)

An interactive session is needed to be clear

Too many participants create less interaction which leads to the limited question.

"One on one session is more interactive. And that's the thing that is of course hard because it's very practical to get on site with 50 or 60 [people]... now, you listen and be 20% is not clear and get it done"
-Jaap, IGU Manufacturer

! f **Design Opportunity:**
PHYSEE needs a more interactive session that can be followed by many people

It is difficult to predict what customer may ask

The sales from IGU Manufacturer would not know what they might challenge during the selling. They depend on their experience.

"When you have constant conversations about these projects with with with customers or with people they say are calling with questions and some questions you can seek it up and come back"
-Jaap, IGU Manufacturer

! g **Design Opportunity:**
PHYSEE could help the stakeholder to documented problems and questions in a collaborative way.

Chapter 4 - Key takeaways

- Gathering two perspectives (service provider and clients & partners) helps Physee understand the gap between the needs and pains.

- The social network analysis shows different relationship between Physee and other actors.
- In the Physee ecosystem, three different archetypes are identified: 1. the decision-maker, 2. the consultant and 3. the executor.
- Several pain points are identified. Those points are presented in the journey map (chapter 4.1.3). To support the findings, the Root Cause Analysis was conducted.
- The biggest hiccup for Physee is about the information clarity.
- An additional finding about the 'facade value' based on Azcaarte-Aguerre, et al. (2018) was found. It is called 'Operational' value.
- The knowledge map shows that three archetypes have different needs. Therefore, the greatest opportunity for PHYSEE is to compose a solution needed by all of the archetypes.

Physee showcase truck at the factory (author, 2021)

Chapter 5

Design Challenge & Design Opportunities

5.1 Two Design Challenges

5.2 Imagining The Opportunities

image source
Physee documentation

By collecting two different views from internal and external stakeholders helps connect design challenges and design opportunities (figure 45). To evaluate the design challenge and opportunity, the author conducted SWOT (Strenght, Weakness, Opportunity, and Thread) analysis.

SWOT analysis is helpful to know more about the capabilities and weaknesses of the company while also considering the threads. Eventually, reduce the risk or chances of failure by understanding what PHYSEE is lacking. It is also beneficial to audit the design challenge that is relevant for the project. For example, Physee has Sustainability certification like BREEAM and BENG. So, how to maximize this existing information to the clients and customers by using their current capabilities?

Meanwhile, the opportunity part is left blank. The opportunity is focusing on the design opportunities.

Figure 45. SWOT Analysis

Ideation Guideline

The questions of the design challenges are answered by connecting the possible answer from the design opportunities. By using the question and opportunities, we can ideate the possible solution.

Design Challenges:

Q1 How could we provide a different data points to the stakeholders?

Q2 How could PHYSEE make their project clear although the product is work in progress offering?

Q3 How could the stakeholder keep informed about the latest update?

Q4 How might PHYSEE prevent the the mismatch expectation in the project?

Q5 How PHYSEE could maximize the clarity and collaborative workflow?

Q6 How might we show the data as real as possible?

Design Opportunities:

! a PHYSEE needs to show their value (sustainable, smart, and comfort) in the solution.

! b PHYSEE can make use their difference/ uniqueness from the competition.

! c PHYSEE can give suggestion of the learning leveling (only for IGU sales)

! d PHYSEE needs to set the boundaries of their responsibility and provide a detailed documentation.

! e PHYSEE could show the number or drawing like a real product.

! f PHYSEE needs a more interactive session that can be followed by many people.

! g PHYSEE could help the stakeholder to documented problems and questions in a collaborative way.

Figure 46. Design Challenges and Design Opportunities

5.1 Two Design Challenges

The design challenges are converged and grouped into 2 main design questions. Although it makes the question more general but it is helpful for the ideation session to generate various ideas. It helps people who also participate in co-creation session to distinguish the different challenge for this project.

Q2 How could PHYSEE make their project clear although the product is work in progress offering?

Q6 How might we show the data as real as possible?

Q3 How could the stakeholder keep informed about the latest update?

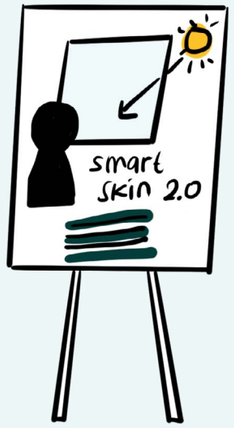
Q1 How could we provide a different data points to the stakeholders?

Q4 How might PHYSEE prevent the the mismatch expectation in the project?

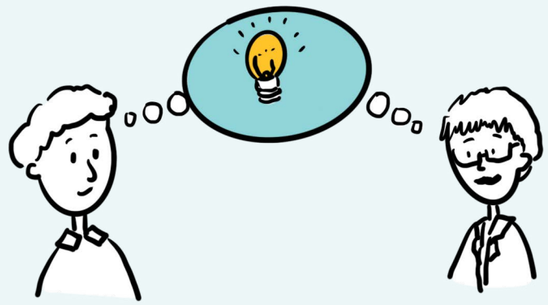
Q5 How PHYSEE could maximize the clarity and collaborative workflow?

How could we continuously update stakeholders about our product update?

The first design challenge is mainly discussing the **information presentation.** Some stakeholders find SmartSkin is very novel. They see risks to use the system, but at the same time, the newness can bring interest.



How might we provide a clear expectation and collaboration with the stakeholders?



The second design challenge is focusing on **stakeholder expectation**. Because of the novelty of the technology and system, sometimes there is some miss expectation. What the stakeholder think is not the same as what we are thinking. Sometimes they also like and eager to share their idea to Physee's technology to fit into their job.

5.2 Imagining The Opportunities

Engaging the stakeholders is pervasive in every phases. It is difficult for the author to explain what is this project about to the internal stakeholders. Thus, using the metaphor "Physee as a library+learning centre" to explain the goal of the ideation process might be helpful.

The library and learning centre have several aspects of accessing such knowledge. It is not only to facilitate the people receiving the ability but also sharing the knowledge, etc. The audience is very diverse, so do Physee clients and partners.

The primary purpose of the ideation process is to show 'HOW' people can experience and fulfil their need in Physee's ecosystem. Physee is the service provider, and the customer/client is the people who come. Physee offers some different subject, meaning they will have different shelves. There are also multiple ways for people to search and receive the book. It can be online or offline. To get the book, they also need to have additional check-out. So there is a lot of aspects that need to be considered.

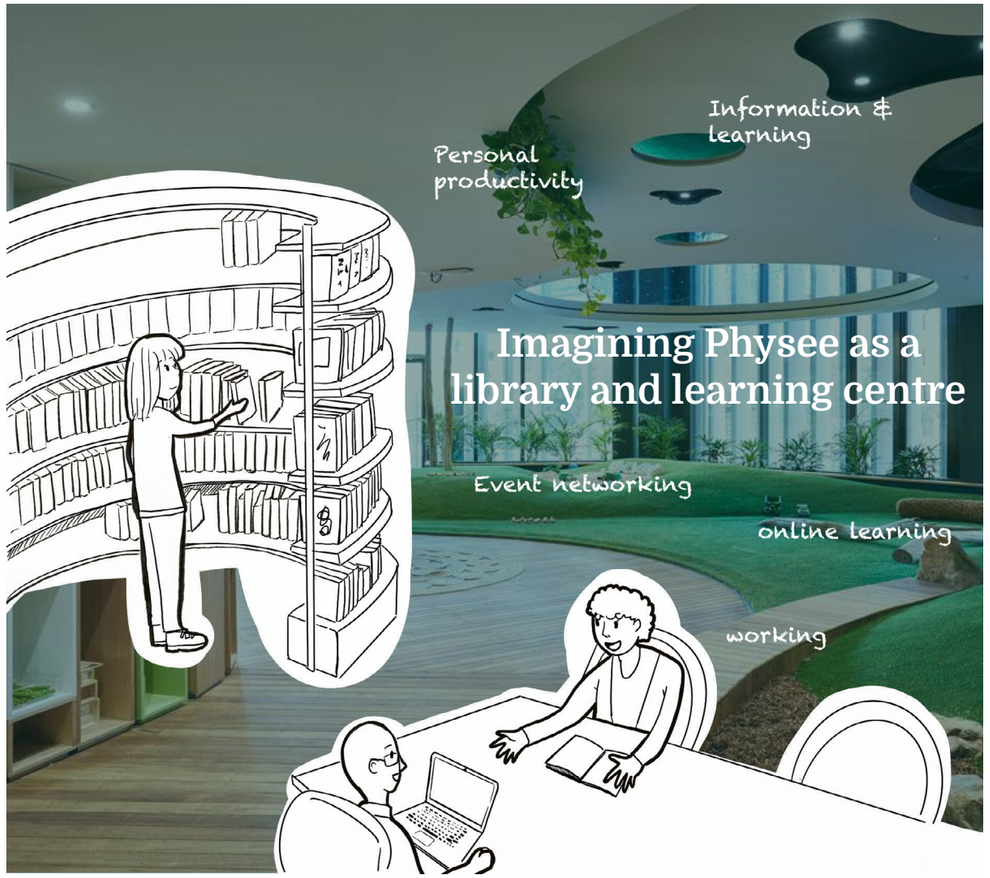


Figure 47. Getting inspiration for ideation

Design goal:

Physee will design a service to inform the updated knowledge to the stakeholders in a customized and collaborative way.

Chapter 5 - Key takeaways

- The design challenges from the internal interview can be answered by the design opportunities from the external interview.
- Design challenges are converted into two:
  1. How could we continuously update stakeholders about our product update?
  2. How might we provide a clear expectation and collaboration with the stakeholders?
- Physee "as a library and learning centre" is a metaphor that is used to explain about what is the design goal to the whole organisation.

Chapter 6

Design Ideas Exploration

The chapter 6 and 7 will explain the answer to the sub research question 5. This chapter will explain the diverge-converge ideas process in several ways. The primary method in discovering the ideas is by conducting the co-creation session. Then, the ideas were re-developed further until the ideas are clear. Finally, both internal and external stakeholders tested the selected ideas.

Finally, the project's strategy is discussed in chapter 7 and followed by the service design of how the solution will be.

SQ-5 How to communicate SmartSkin PSS for different stakeholders?

6.1 Collecting Ideas with Co-Creation

Co-creation has a tight meaning to create a collaborative environment. Sanders and Stappers (2008) define co-creation as an act of creativity shared by designers and people not trained in design to work together in the design development process.

In this thesis project, co-creation is defined as a collaborative way of working in the 'develop' phase to generate as many solutions as possible (physical and/or non-physical). The main purpose of co-creation with the Commercial department is to get more ideas from the problem owner perspective, reduce failure risk, get more iteration time, and have long-term support from the problem owner.

Set-up

The co-creation session involves the Marketing & Lead Generation in the preparation, co-creation, and synthesis session (Appendix H).

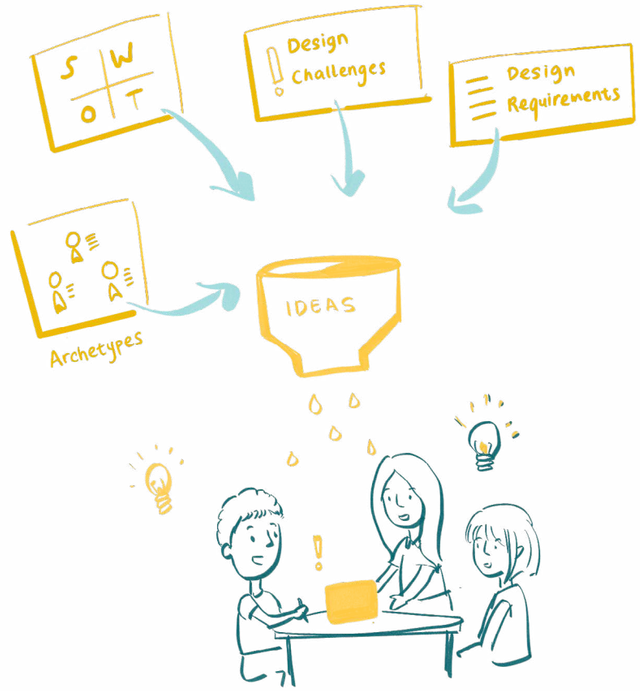
Guide (3):
- Author as the main facilitator
- 2 co-facilitators from Marketing and Lead Generation (lead each group and brainstorm together)

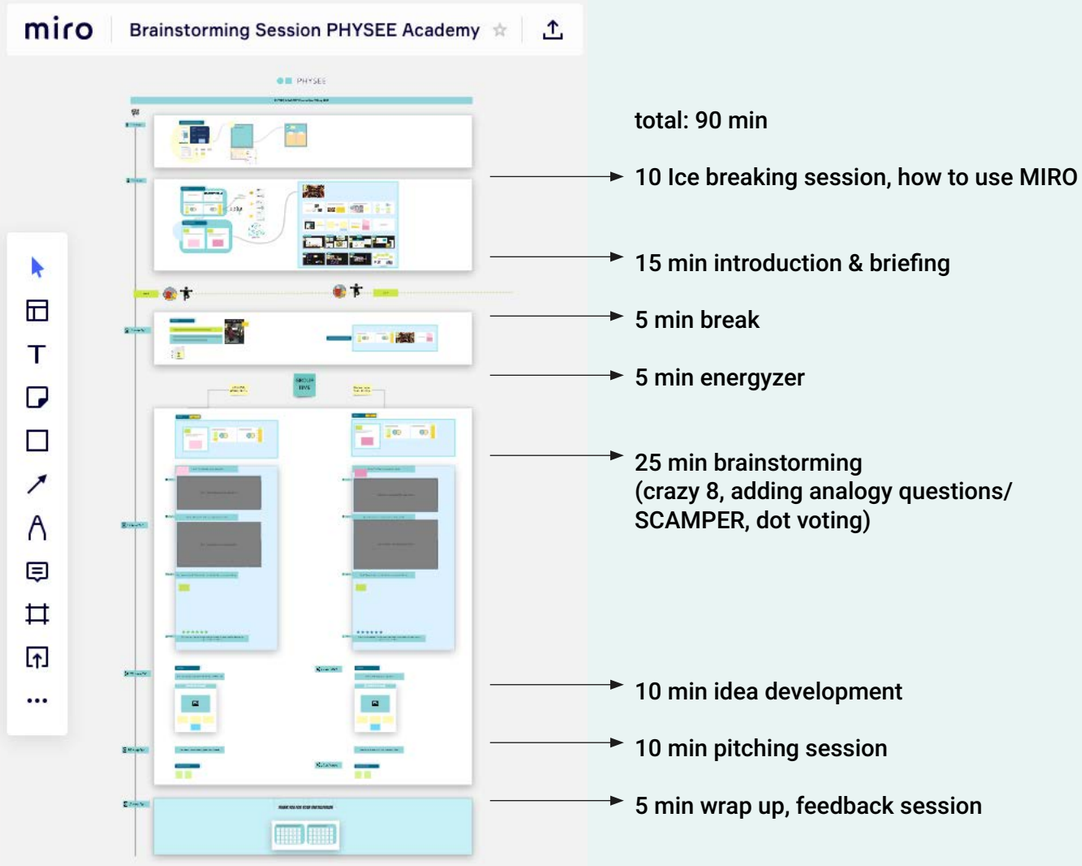
Participants (7):
- 1 Chief Commercial Officer,
- 3 New Business team (SmartSkin Engineer, Jr Solution Architect, Account Manager),
- 2 Execution & Support team (head of E&S, project manager),
- 1 Quality Assurance intern.

The co-creation was conducted using an online whiteboard (MIRO) and communicated via online video call (Ms Teams). The process lasted for 1,5 hours, with a 5-minute break in between. The first session is to brief the problem, design challenges, and inspirations to the participants. The second session was the brainstorming session and ended with ideas pitching. Then, there were two groups in the brainstorming session. Finally, each group tried to solve one design challenge. As a result, fourteen idea groups are generated from the co-creation process, and 2 voted ideas were presented (see Appendix I).

How could we continuously update stakeholders about our product update?

How might we provide a clear expectation and collaboration with the stakeholders?





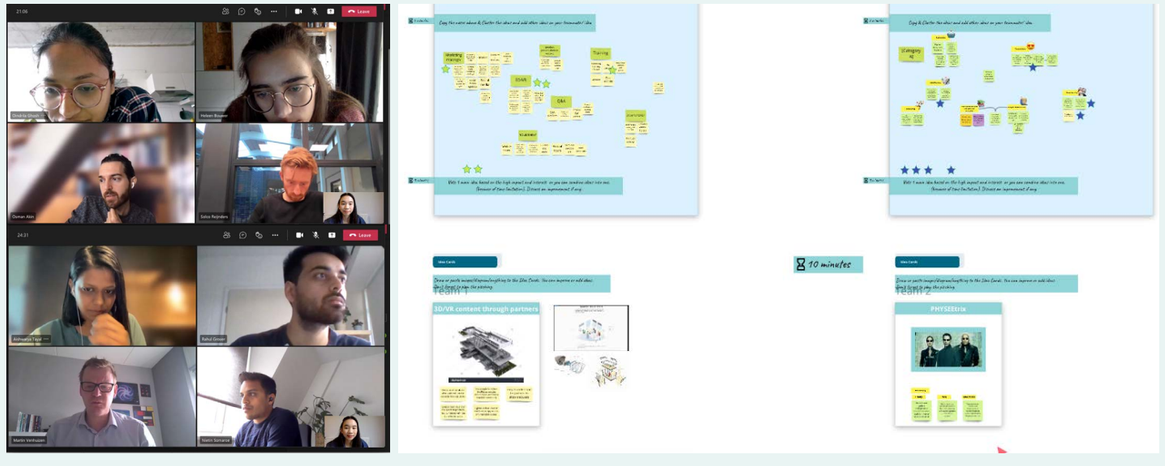


Figure 48. Break-out room on Teams and the ideas making on MIRO.

6.2 Ideas Development & Validation

After conducting the co-creation workshop, the ideas were analysed and grouped based on similarity and objectives. The ideas were also rated based on interest, impact, difficulty, and SPD graduation thesis relevance (figure 49). Some ideas that less relevant are like 'social media update' or 'Elon musk as a partner' (see Appendix J). Next, some assumption is made and become a validation question. The process to test the concepts is by looking back to what the stakeholders really need (chapter 4 and 5).

1.) Develop the features based on some considerations such as the archetypes, knowledge map, and insight map.

2.) Finding inspiration by auditing the existing solution is important to develop the further concept.

There are four different ideas that involve external stakeholders and two ideas that only involving the internal Physee management.

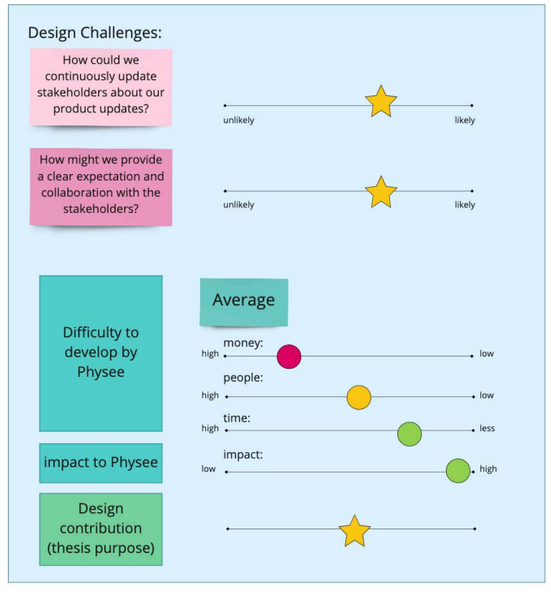


Figure 49. Example of ideas analysis

6.2.1 Ideas as the pain reliever (the assumption)

The concepts are mapped into the customer journey to check the relevance in relieving the pain points. The concepts are explained in Appendix J.

After auditing the ideas, some of it needed to be tested internally and externally.

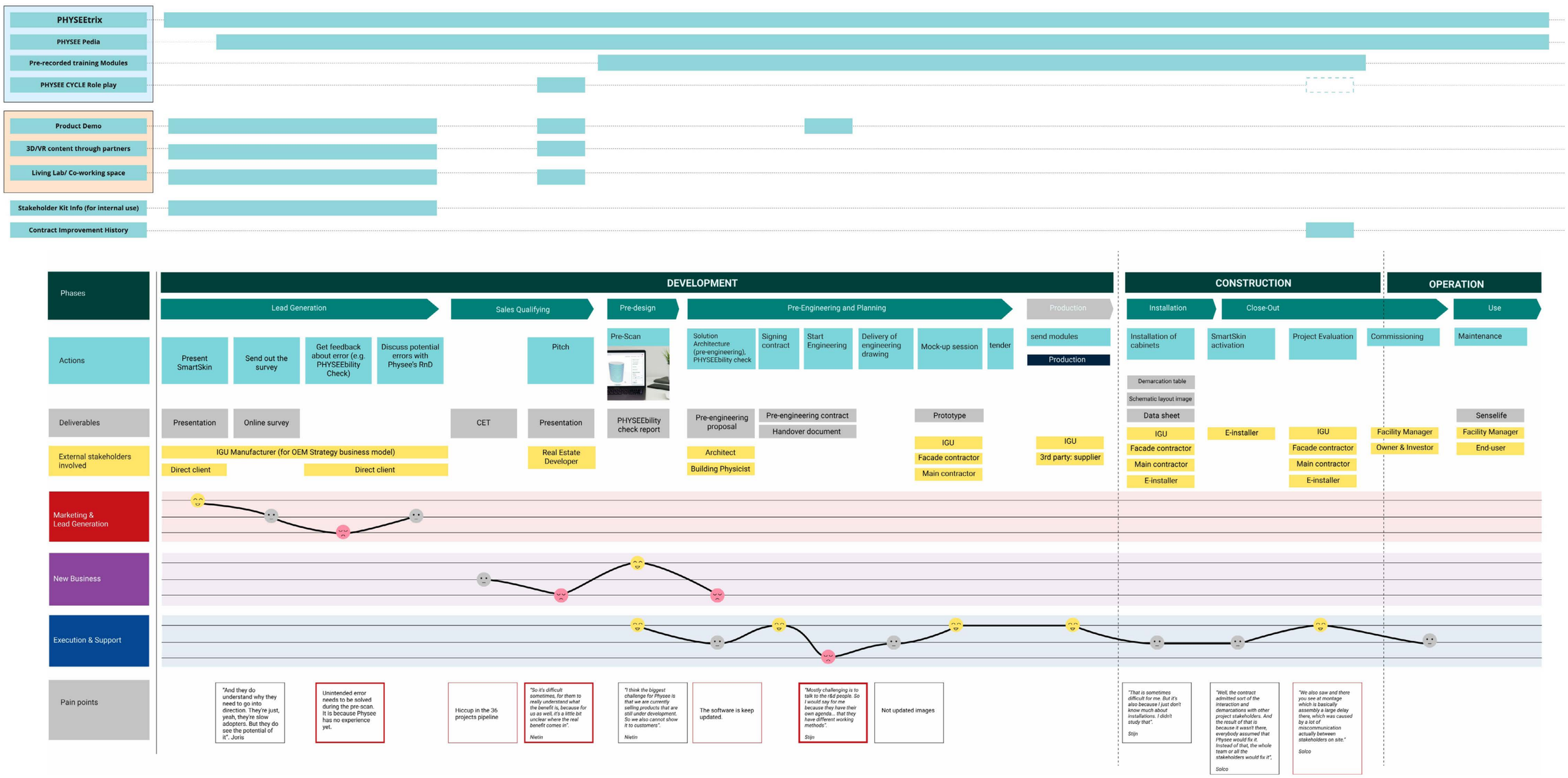


Figure 50. Pain relievers

6.2.2 Developing the ideas and getting feedback

SQ-5 How to communicate SmartSkin PSS for different stakeholders?

Setting up the idea validation

The validation aims to find the most desirable, feasible, and viable solution (figure 50); and useful as the foundation for designing a roadmap. The success of the service design relies on the team alignment and how the organisation can contribute to making it happen (Reason, Løvlie, & Flu, 2015). Therefore, internal stakeholders validation is essential to prove the feasibility and viability. Meanwhile, external stakeholders validation is essential to validate the desirable point.

details of who and how the validation has been conducted is explained in Appendix K. In the Appeendix K, some digital prototypes are presented.

Within the validation phase, the 'lean' startup approach is used. It focuses on the iteration process: build, test, learn -> build, test, learn -> (...). Subsequently, save a lot of time and allow the designer to rapidly uncover the solutions' viability, feasibility, and desirability.

Eventually, there will be an assessment of the strategy to the answer of the SQ-5. The

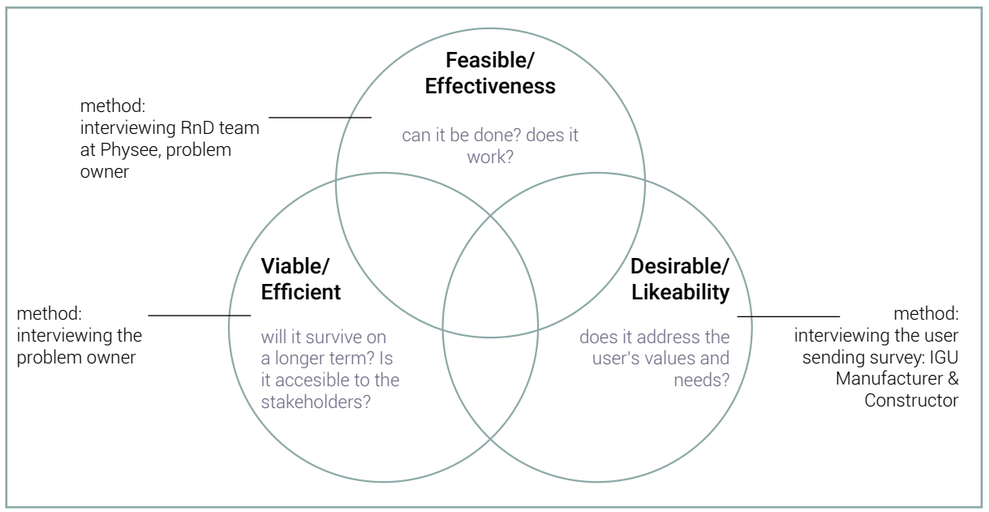
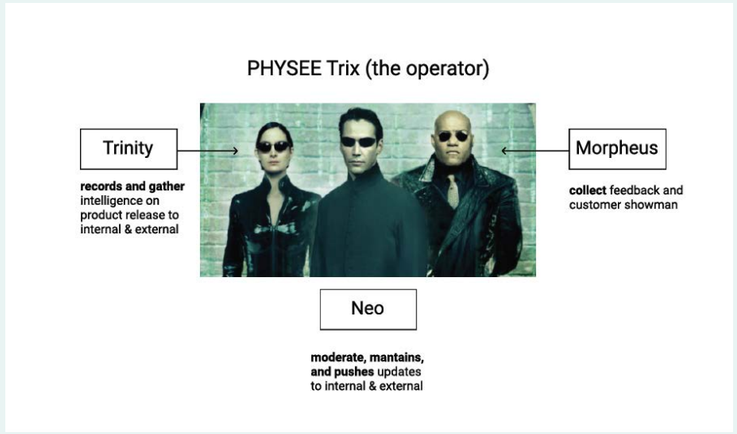


Figure 51. Validation criterias

Only for internal testing

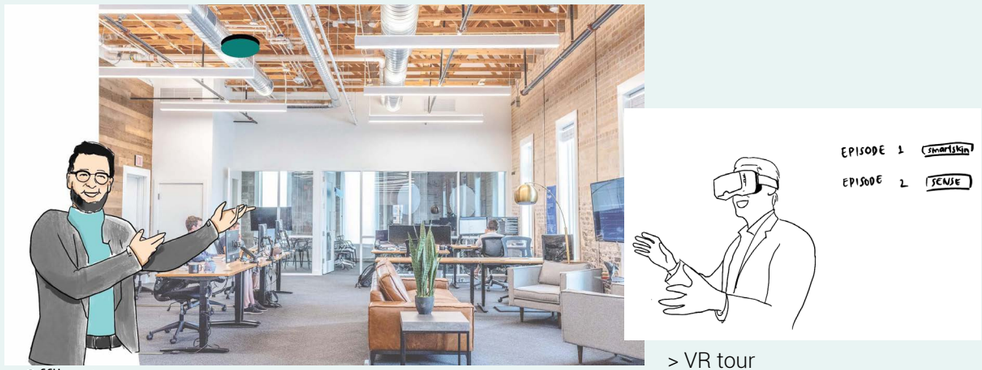


Idea 0 - PHYSEE Trix

How: a housekeeping team in Physee consists of 3 roles.

Goal: to gather information, get feedback, maintain & push updates.

Selected ideas for external testing



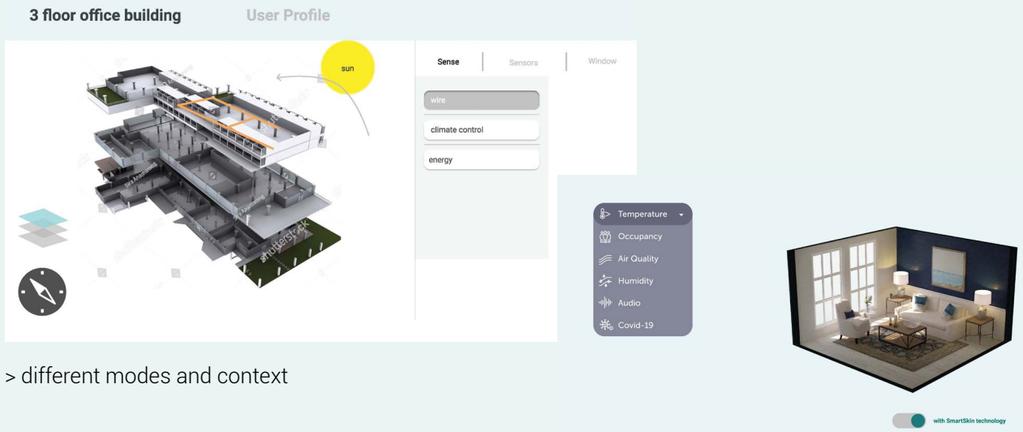
> Offline tour

> VR tour

Idea 1 -PHYSEE Lab

How: An offline tour session. Collaborate with a co-working space or cafe. Another alternative is to create a VR experience.

Goal: to show the real case to the potential customers/partners.



> different modes and context

> Room scenario

Idea 2 - 3D Content

How: A demonstration using a 3D image. The user can oversee the general implementation plan in a sample building.

Goal: To show how the system works.

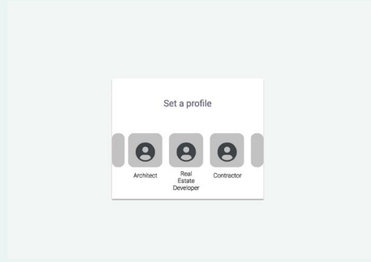
> 1:1 prototype

> maquette model (image source: www.foppe3d.nl)

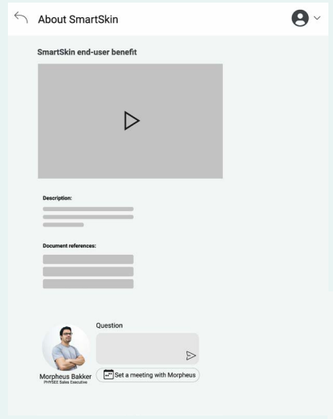
Idea 3 - Product Demo

How: A demonstration using SmartSkin system and how it can influence the product. People can try to explore PHYSEE software and apps during the exhibition and try different scenario (e.g. summer time, winter time)

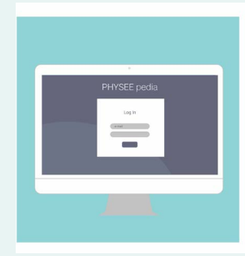
Goal: To show how the system works in different time and scenario.

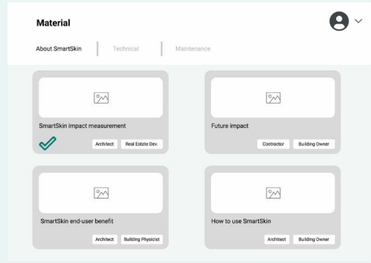


> customisation

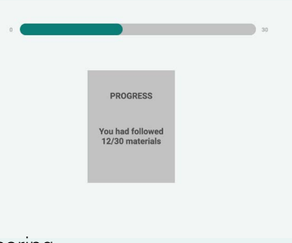


> video, description, reference, contact person





> course like platform

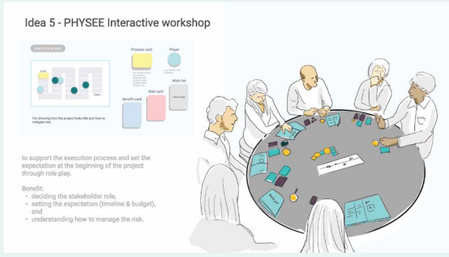


> Scoring

Idea 4 - PHYSEEpedia

How: An online platform to learn more about PHYSEE. The set up is like an online course.

Goal: To guide the stakeholders in step-by-step learning



> booklet

> gamification

Idea 5 - Interactive Workshop

How: A workshop like a serious game. Goal: Reducing the misalignment in the project. Each stakeholder will go through one cycle project workflow.

Goal: to understand the benefit, risk, and wishlist from each stakeholders.

Figure 52. Ideas for testing

Validation data gathering (internal)

The validation conducted with:

- Marketing and Lead Generation team.
- Execution and Support head.
- 5 engineers (hardware and software).

Validation data gathering (external)

There are two different methods to gather the feedback because of the limited time and number of participant. The methods are described as follow:

1.) Interview with 2 archetypes:

a. The Decision Maker (Real Estate Developer);

b. The Consultant (Architect and Building Physicist).

2.) Survey with 2 archetypes:

a. The Decision Maker (special for IGU Manufacturer to test the OEM Business model strategy/second business model). 40 surveys were sent with 7 responses.

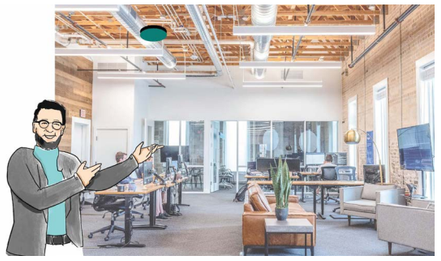
b. The Executor (combination of Facade contractor, main contractor, and e-installer). 15 surveys were sent with 4 responses.

Due to the limited number of responses, the surveys was treated in qualitative analysis. There are also an open ended question in the survey which could make the validation input stronger (see Appendix X).

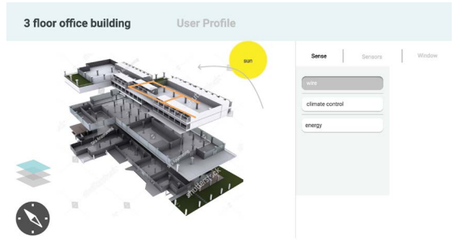
Validation feedback

The feeback is gathered from internal (idea 0-5) and external stakeholders (idea 1-5) validation (green=like; red= dislike, blue=new idea/recommendation).

- Become a specific role at the company.
- Follow up is important because it is more professional & serious.
- Can be integrated with the existing role (e.g. quality assurance team, and sales team)



- one of the respondents (RED) is working on a co-working space and very positive about the idea.
- Special spot/space about PHYSEE.
- Longer time visit.
- VR is too complicated.
- shorter visit (like 30 min)
- Multifuntion place: can become a place to have a meeting with client.

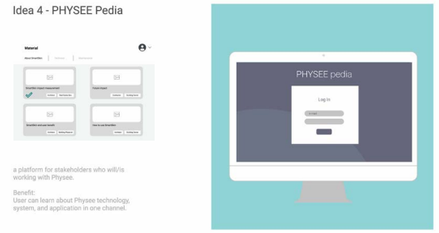


- Comparison with and without SmartSkin
- Scenario
- Comprehensive: the image is too detail and creates confusion. People needs to have a certain knowledge to understand the scenario.
- Simple & 1 floor image.
- Digital Twin: It is not necessary to use because it is high effort.

Idea 3 - Product Demo

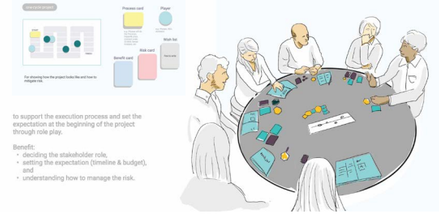
- Looks good as an awareness.
- Seems limiting the opportunity of customisation.

Idea 4 - PHYSEE Pedia



- Create a personalise website and information
- Confidential information like the 'money talk' or building information.
- Scoring system like a course.
- Not fruitful to follow a course to understand the technology, seems too complicated.
- Adding new touch points by choosing a profile (architect/RED/investor/etc.) will only take time.

Idea 5 - PHYSEE Interactive workshop



- Make a clearer expectation.
- Caution: one person who dominate the discussion, others are silent.
- Short time workshop.

Chapter 6 - Key takeaways

With the variation of the ideas, it is difficult for the participant to choose which one is the best. Each of the ideas has its own goal. Therefore, auditing the ideas is necessary. In conclusion, the ideas as the pain reliever (chapter 6.2.1) for the different problems are approved. Although some ideas have less impact on the company and the external stakeholders, Physee could integrate those ideas into one project. There is still potential for every idea at this stage, but idea 1 (Physee lab) and idea 3 (product demo) has the least potential.

Chapter 7

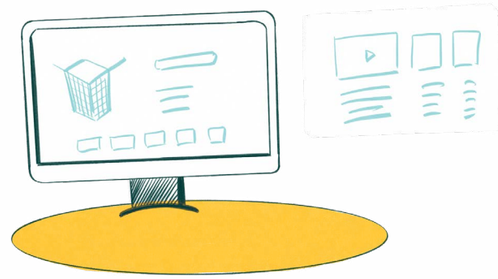
The Final Concept: Strategy and Design

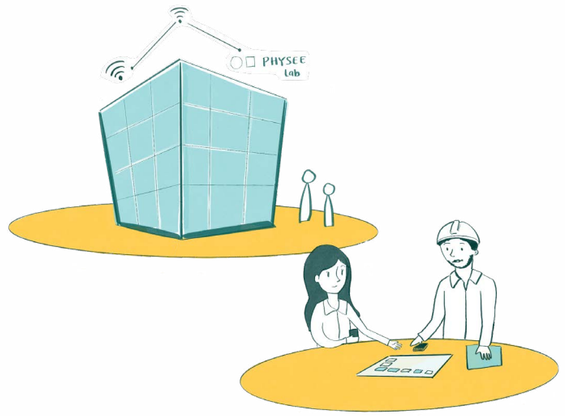
7.1 Service Design Positioning

7.2 Design Strategy

7.5 Service Design Proposal

PHYSEE INSIGHTS





This chapter aims to define the criteria of the final concept. The final concept consists of:

- Positioning the service within and outside the company;
- Designing the engagement strategy;
- Showing the design concept outcome; and
- Translating the strategy into a plan.

7.1 Service Design Positioning

The first proposal (mentioned in chapter 1.1.3) was to develop the 'PHYSEE Academy' to share the information with clients/partners. However, after conducting the validation test, the academy seems relevant only for the IGU Manufacturer sales (Business Model 2) and 'the executor'. Meanwhile, the other stakeholders don't want to spend so much investing time in the learning process.

The service positioning is adapted from the brand DNA triangle theory (van der Vorst, 2019). It contains of believe, positioning, and personality (figure 53). A new positioning is proposed based on the broader target user, the partners and clients. These users differ based on three archetypes (the decision-maker, the consultant, and the executor). The goal is to offer seamless and easy collaboration by engaging them through trustworthy, universal, confident, and mature information access.

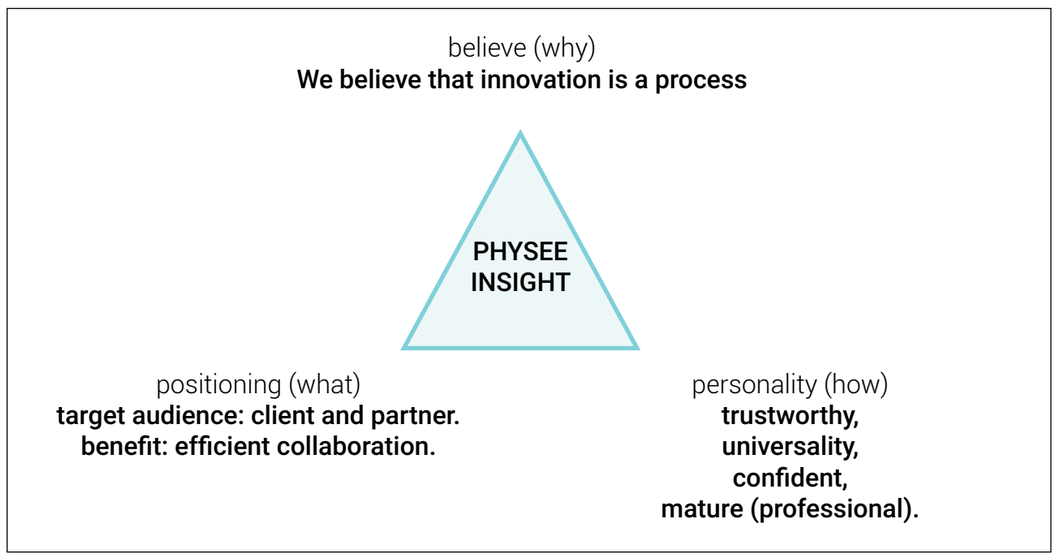


Figure 53. Service DNA (adapted from Brand DNA framework)

This service is useful for Physee to engage the stakeholders.

PHYSEE INSIGHT offers service that is open & up-to-date, easy to access, and gives people the encouragement to contribute to the solution.

PHYSEE INSIGHTS

Figure 54. Logo

The re-branding of the service is explained throught the naming and logo.

1.) PHYSEE INSIGHT naming

INSIGHT means knowledge or understanding. It is parallel with the purpose of the solution to create an understanding and eventually engaging the stakeholders. The solution aims to enable Physee to gather insight from inside and outside.

2.) Logo inspiration

The logo represents a 'way'. It tries to invite people from outside to inside PHYSEE. The belief is "innovation is a process" reflected in the path illustrated in the logo, just like a path that never ends.

7.2 Design Strategy

The overarching strategy is divided into three main focuses. The strategy is connecting Physee and the world. The strategy is also derived from the *Knowledge Processing* framework (Kivrak, et al., 2008), including capturing; storing; transferring; and reusing knowledge, as the basis.

The proposed strategy enables PHYSEE to speed-up the process of engaging stakeholders, scaling-up the information update in easier way, and providing user-centric information.

1. Enabling the knowledge source

To communicate the knowledge to the stakeholders, Physee needs to create sufficient resources and empower the existing resources that they already had.

One of the important recommendations is to fix the internal information flow within Physee. Physee needs a solid foundation to place the bulk of the information they have. One of the ideas that can help Physee is to create a group that focuses on sharing, processing and maintaining information like PHYSEE Trix.

2. Making the adaptive & modular knowledge

The adaptive and modular knowledge is needed to adaptable or is reuse to inform the stakeholders. It also helps Physee and other stakeholders informed about the overview of the company/project and kept updated.

3. Engaging different audiences

The final strategy is to engage different audiences. The purpose is to align the information to different stakeholders: Finaly, leverage the collaboration between outside and inside PHYSEE.

in the beginning of the strategy, Physee could improve their focus to share the implicit knowledge. After they managed to making more adaptive and modular knowledge, they can focus on improving the explicit knowledge.

PHYSEE INSIGHT connects Physee and external stakeholder in knowledge sharing. The goal is to engage both parties to collaborate.The design principles are derived from the three objectives.

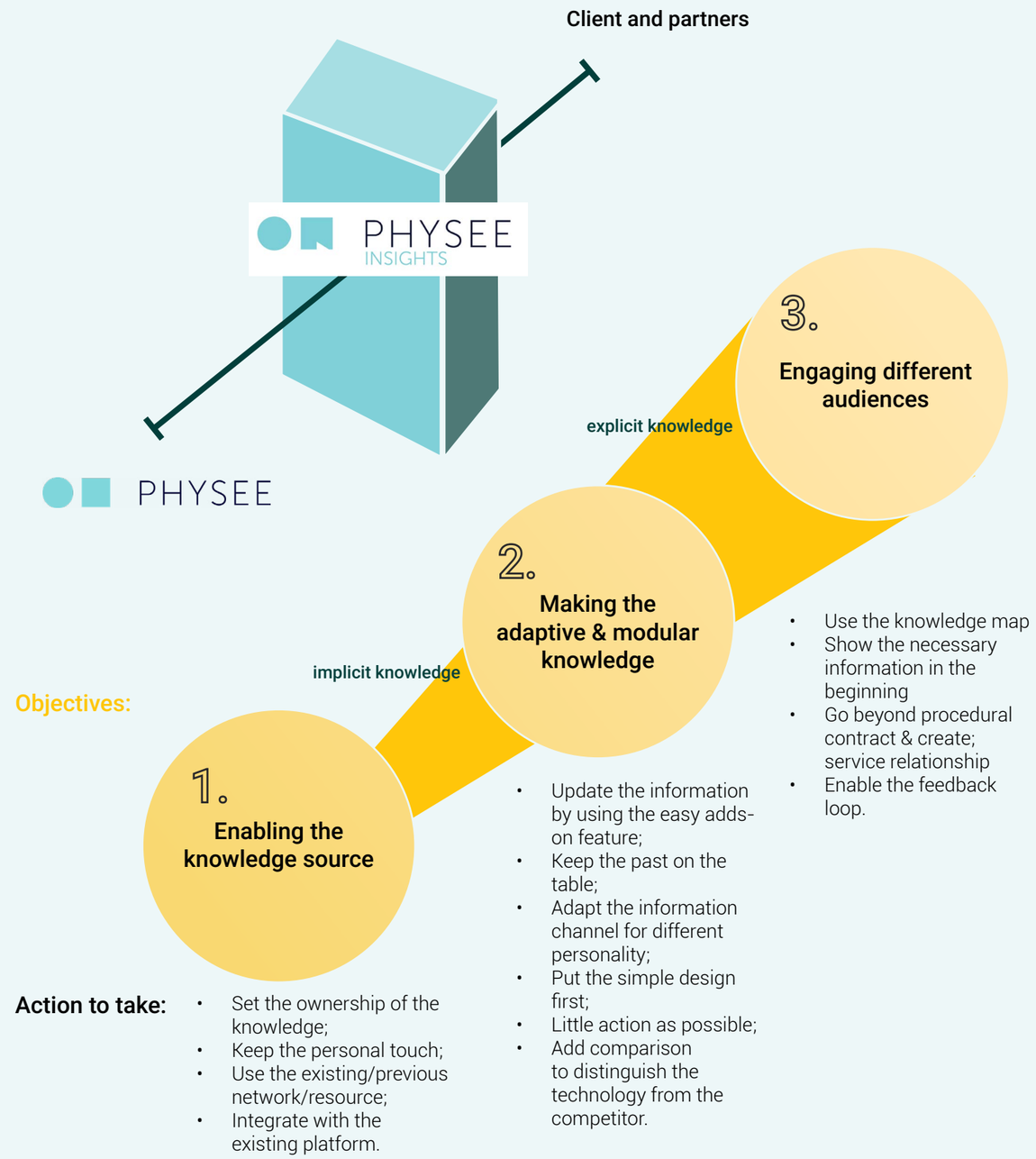


Figure 55. PHYSEE Insight Strategy

Concepts overview

There are 6 main concepts for PHYSEE Insight.

Idea 0 - PHYSEE Trix

A team at PHYSEE that manage the PHYSEE Insight, like an agent.

Idea 1 - PHYSEE Lab

A hub where clients/ partners can see, feel the PHYSEE's solution.

Idea 2 - 3D content

A scenario visualisation to show how PHYSEE technology works.

Idea 3 - Product Demo

A 1:1 prototype to show how the product and system works.

Idea 4 - PHYSEE Pedia

A list of important information which is shared through online.

Idea 5 - Interactive workshop

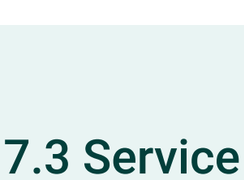
A workshop to plan the project and gather feedback with clients/partners.

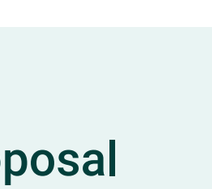
7.3 Service Design Proposal

7.3.1 Goals of the service concept

The proposed service concept can reduce the number of communication and increase the rate of interest. Physee will have a less number of contact like phone calling, email, and presentation. In addition, it will attract more interest because the existing method like a website is not enough keep the stakeholders understand what PHYSEE is. Without knowing what they are value in integrated facade and their goals in the project, they will probably can not trust the service provider. Within the research, a respondent from 'the consultant' archetype mentioned that they did not receive what they expect from the website. They just left Physee. They expect to find their needs in the new solution.

The new service, not only complement the existing approach (phone, email, presentation) but also provide the customised touch points (see the next subchapter).





	The Executor	The Decision Maker	The Consultant
BEFORE **How Physee inform them (existing condition)**	• phone • demarcation document • *bouwvergaderingen* • website • e-mail • data sheet • Physee check live session	• presentation • email • events • Linkedin • press • website • Google SEO • whitepaper • word of mouth	• presentation • email • technical sheet • product demo • drawing • Physee check live session
AFTER **Adding the touch points**	• PHYSEEpedia • 3D content • Interactive session	• PHYSEEpedia • 3D content • Interactive session • Product demo • Living Lab	• PHYSEEpedia • 3D content • Interactive session • Product demo • Living Lab

Figure 56. Communication channel before and after

7.3.2 The service blueprint

The service blueprint is build upon the user needs and value. They have different goals within the project, so the approach is also different. The blueprint is divided into 2 part: Development and Construction. In the 'development' process, AIDA (Awareness, Interest, Decision, and Action) digital marketing sales funnel method is being used to show how the new blueprint.

The Decision Maker

The decision maker is divided into 2 different business models (see chapter 2.2.2) which means, the IGU manufacturer can also become the people who sell the SmartSkin. After the validation, there is a different approach only for IGU Manufacturer 'sales team'. They are not enthusiastic about attending the interactive workshop. However, the rest ideas are helpful.

The Consultant

They are mainly very visual, looking for the opportunity to collaborate. That is why the 'interactive session' idea is part of the decision process.

The Executor

They are mainly focused on the operation part, so they need PHYSEE pedia as their guide. Also, showing 3D content and involve them in an interactive session. They are enthusiastic about it (see Appendix K).

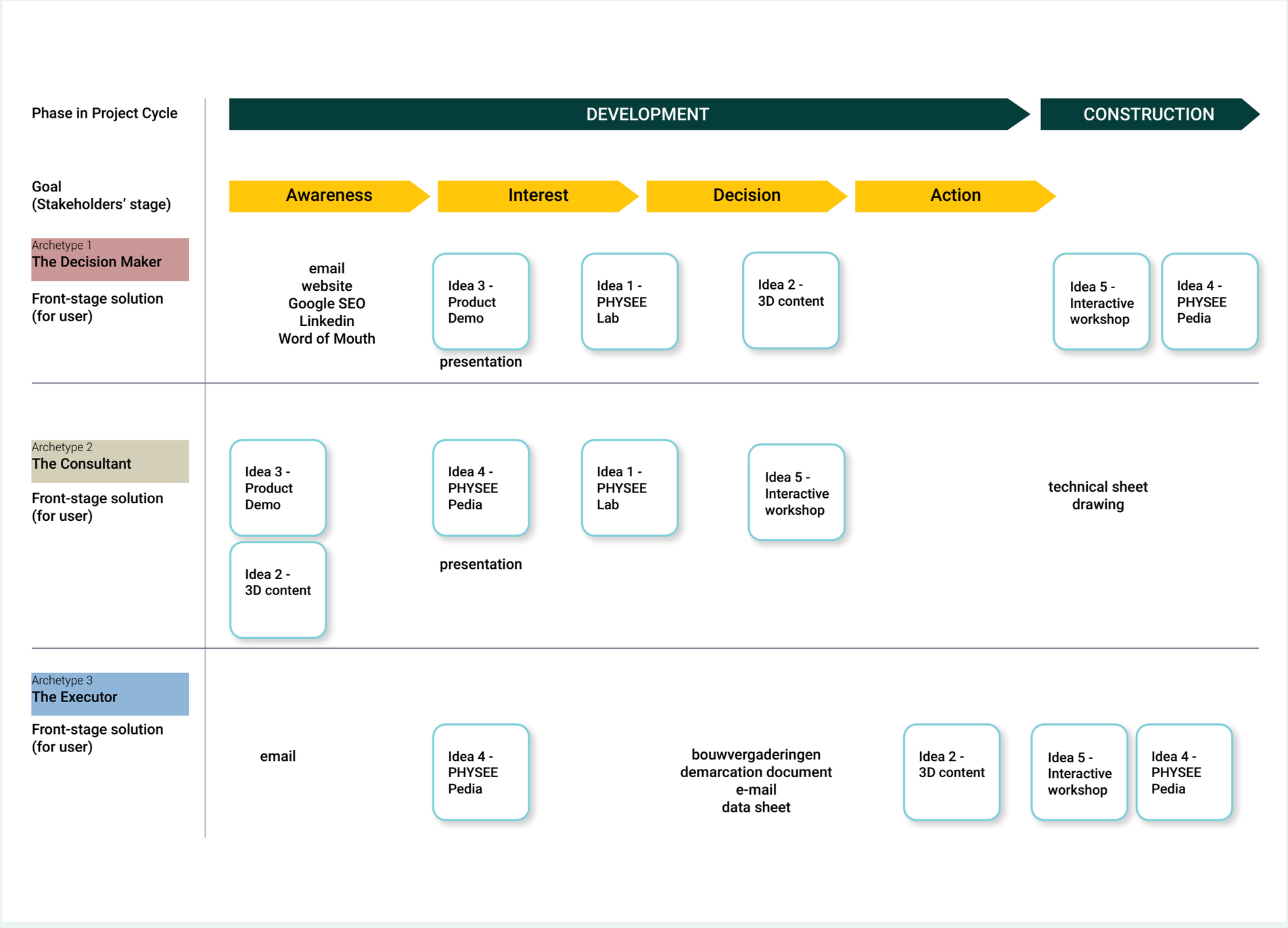


Figure 57. Concepts in a service

7.3.3 Organisational impact

PHYSEE INSIGHT will be a new project at PHYSEE. It will involve all internal departments. PHYSEE INSIGHT will become the right hand for the Commercial department to engage, collaborate, send learning materials, and gather feedback from the client & partners.

In addition to business model 2, the primary stakeholder is only the IGU sales. They are the right-hand man to sell this to the clients & partners and act like Physee.

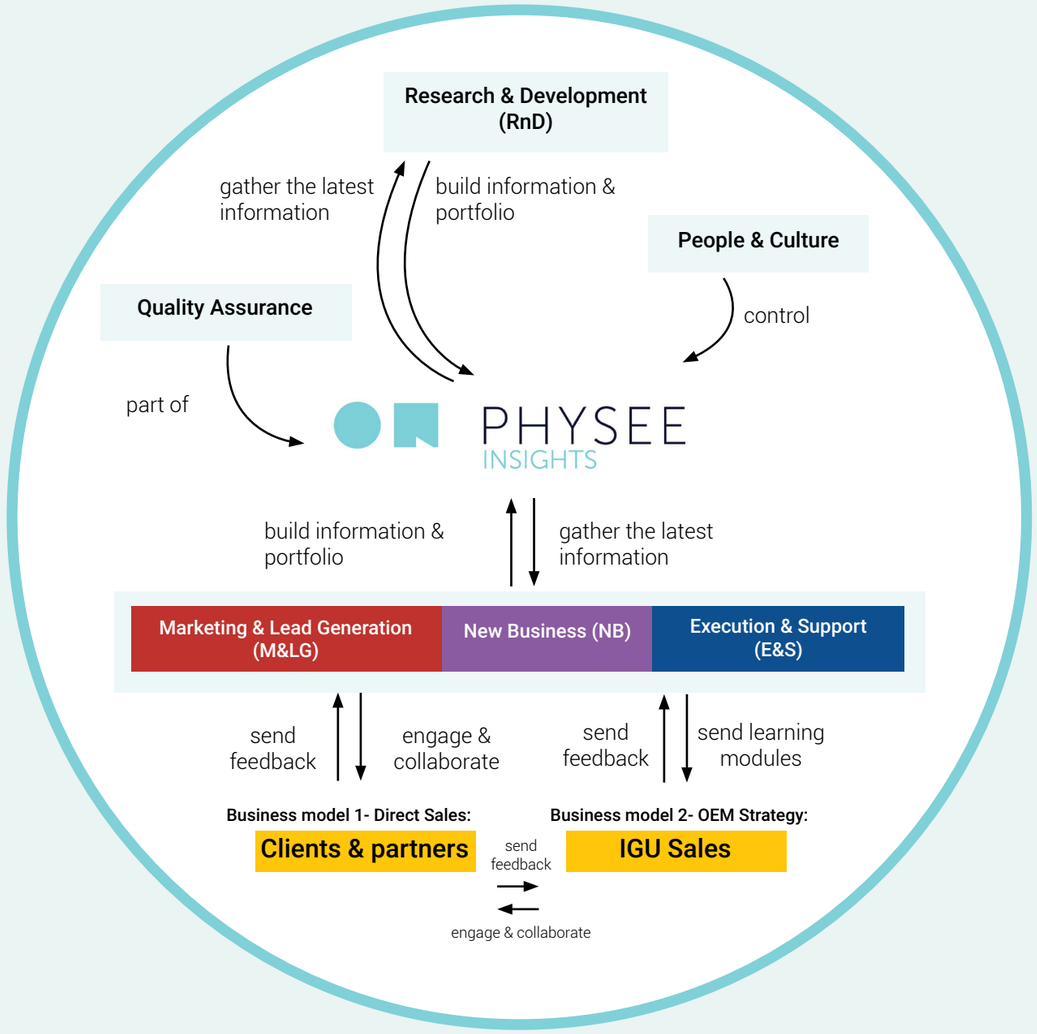


Figure 58. Organisation structure with Physee Insight

7.3.4 Concepts integration ecosystem

PHYSEE Insight will engage the stakeholders by sharing explicit and implicit knowledge with PHYSEE Trix as the people in charge. The concepts are the combination of tangible and intangible solutions.

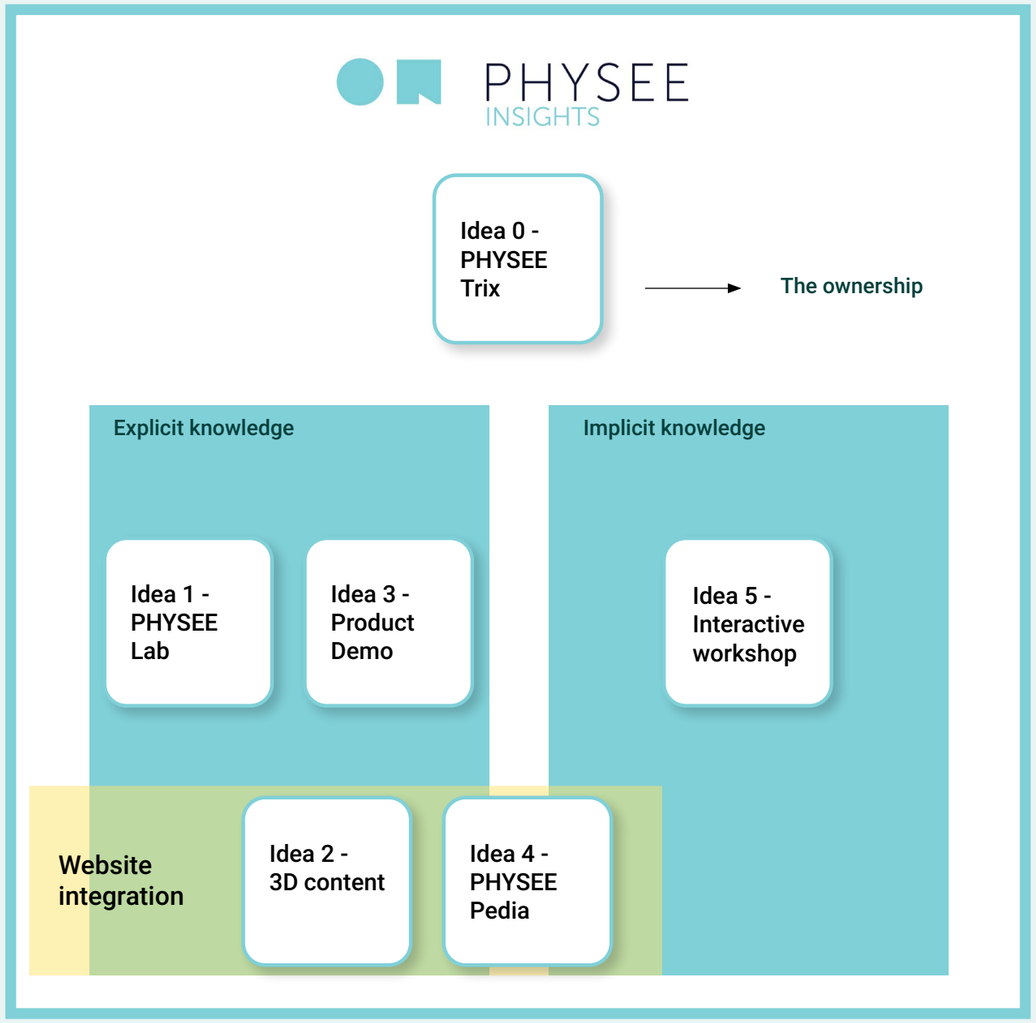


Figure 59. Concept Integration

7.3.5 Concept analysis

Where should Physee focus on?

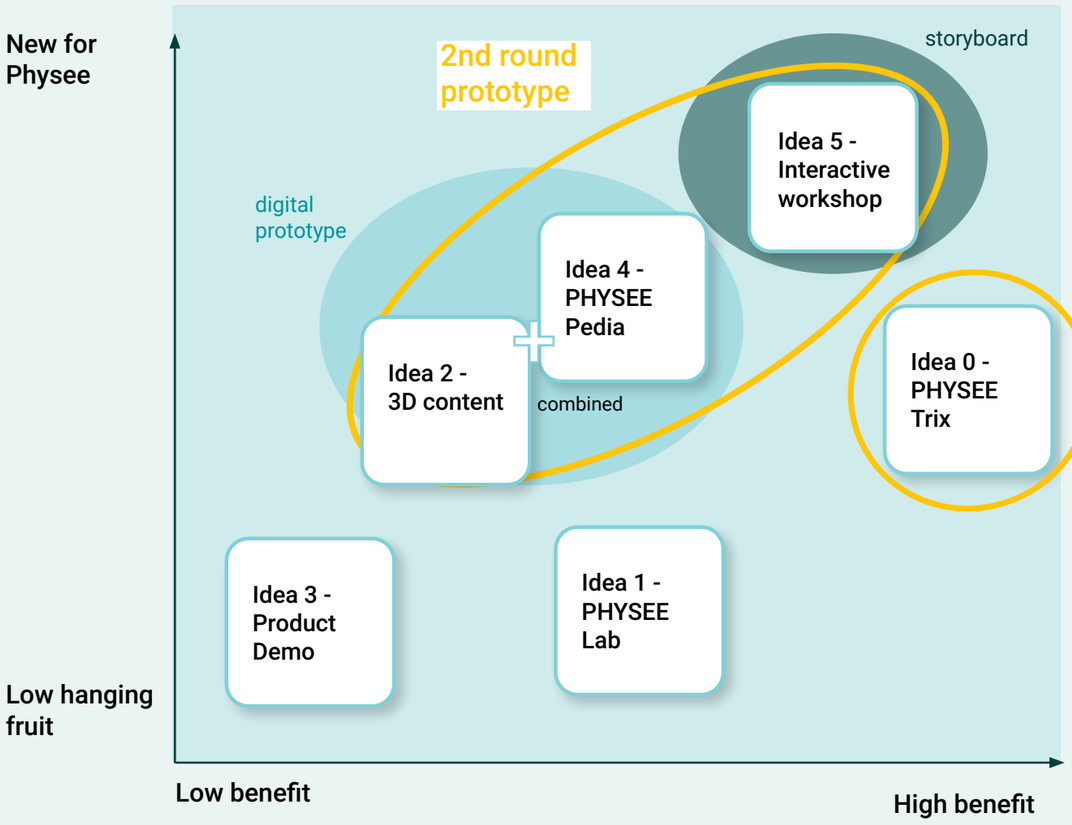


Figure 60. Concepts analysis diagram

The concepts were re-evaluated and mapped based on the newness and benefit of the company and the stakeholders. As a result, ideas 2 and 4 can be combined in the website platform. While idea 5 is a proposal for an interactive session by Physee. While Idea 0 is not too much about designing. However, it is something needs to be considered at PHYSEE.

Physee needs to focus on these ideas because the ideas are offering a new perspective, novelty, and have a higher benefit.

7.3.6 Design Principles

Design principles are "fundamental pieces of advice to make easy-to-use, pleasureable design" (Interaction Design Foundation, n.d.). Design principles are useful for understanding why, what, and how the solution needs to build upon.

In the next page, the final concept (3D content+ PHYSEE Pedia and the interactive workshop) can adapt the design principles.

After understanding the design principles, then those principles can be translated into the design. For example, in this master thesis, there are two different concepts. One concept is translated into a digital prototype. Another concept is translated into a storyboard (figure 57).

1.

Enabling the Knowledge Source

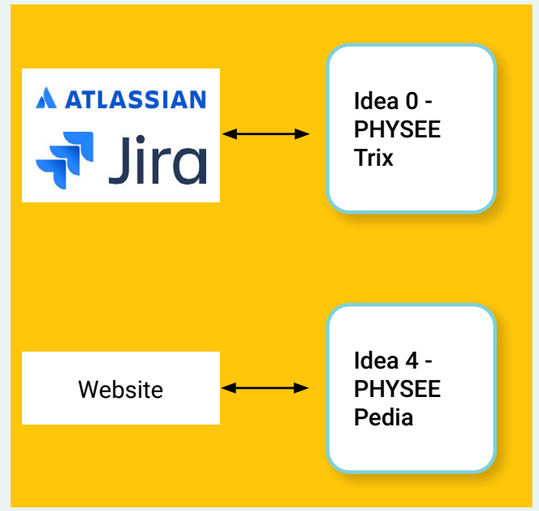
a. Set the ownership of the knowledge

The ownership of the knowledge is crucial to keep the information flow. PHYSEE Trix will help the organisation to manage the information flow and documentation. Physee could assign one person from one department to update the internal information on a platform (e.g. SharePoint).

PHYSEE Trix consists of three main roles: the controller, feedback gatherer, and updater.

b. Integrate with the existing solution

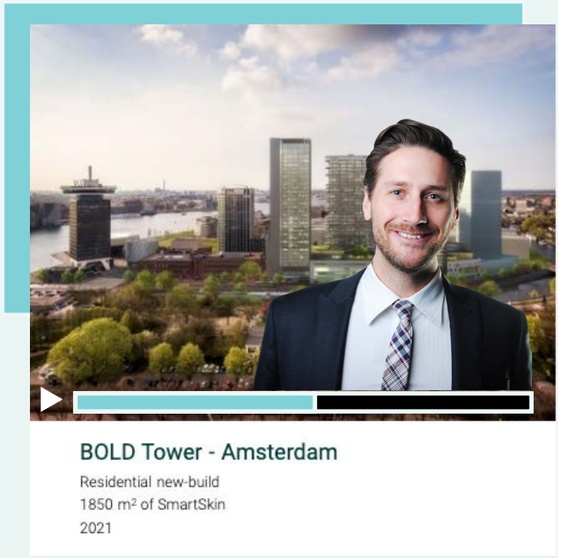
There are already some existing solutions inside Physee. However, those tools can have a better performance if combined with the proposed solution. As an example, JIRA/Atlassian is managed by PHYSEETrix. So then, the existing website can also use the PHYSEE Pedia structure or principles.



c. Use the existing/previous network/ resources and make it real

A portfolio is an essential information to almost all stakeholders. They want to see the example of the previous project because it proves that the company can scale the product in the market.

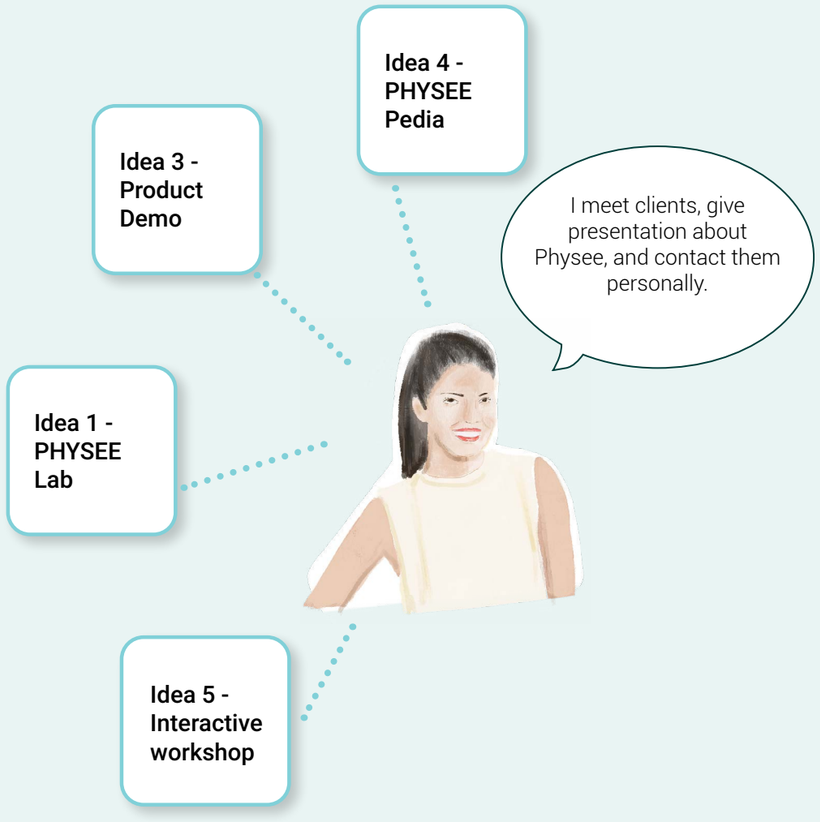
In design, for example, Physee can ask the previous client to share their story working with Physee. A more straightforward approach can also be used by adding images on PHYSEE Pedia.



man image: source google.com

d. Keep the personal touch

The current approach, like personal communication, is meaningful for the stakeholders. PHYSEE wants to make more automation information, but leaving the personal touch will only create less attraction to the stakeholders. This advice can complement the PHYSEEpedia to reduce the number of live meetings.

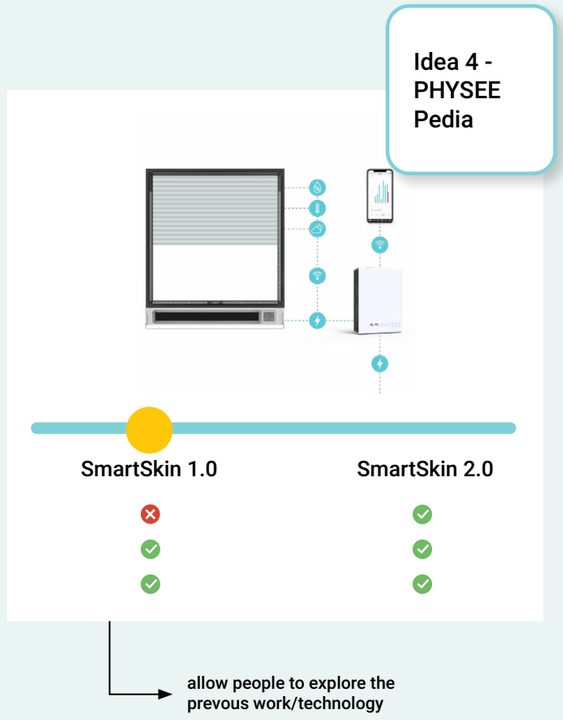


2. Making the adaptive & modular knowledge

a. Keep the past & show the future on the table and let people know the improvements

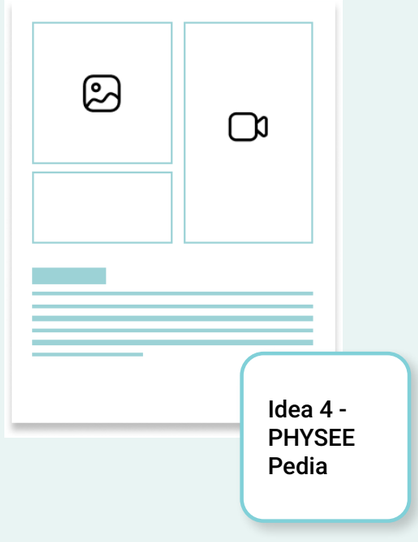
Showcase the previous implementation SmartSkin 1.0 to prove that it is real and keep the previous technology posted.

Stakeholders like an investor would know how impactful is the previous project. They see the whole project at Physee is very interesting. Because of that, Physee can also showcase future improvement as well.



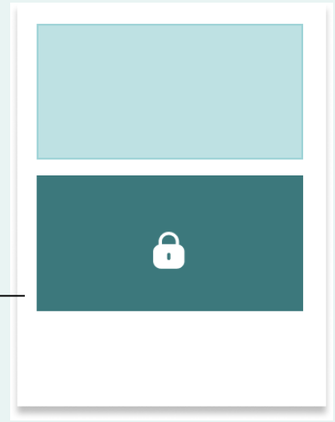
b. Show different type of information presentation

The platform should adapt the information for different personalities. For example, building physicist tends to have more time in learning the details than RED. Or someone who is more visual in the real experience.
How? Physee can provide both images, video, and text.



c. Hide the confidential information

Some information can not be revealed due to some confidentiality. So hide some info by using the password for example.



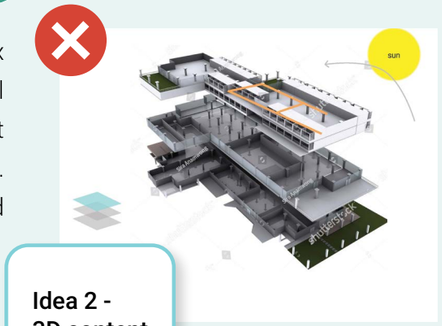
Lock some content or provide password to access the information

Idea 4 - PHYSEE Pedia

d. Put the simple design first

Do not scare the reader with too complex information/images. Otherwise, they will be overwhelmed. Instead, share the first information/image as simple as possible. Then, it can be followed by more detailed information/images.

3d image model: source google.com



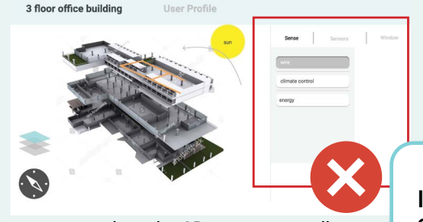
Idea 2 - 3D content

3d image model: source PHYSEE

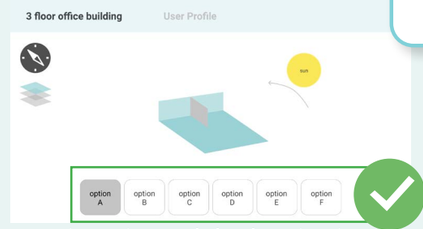
e. create a little action as possible for stakeholders

Sometimes the stakeholders have limited knowledge. So how to help them understand Physee better?

First, the design shall give less action as possible. For example, Physee providing animation in the 3D content to navigate the SmartSkin instead of asking the user to navigate and interpret the data by themselves.



explore the 3D room manually



give options and play the animation

Idea 2 - 3D content

f. Add comparison to distinguish the technology from the existing offering in the market/competitor

Physee offers a new system and building integration in the market. Hence, it is difficult to understand the SmartSkin's benefit. However, the stakeholders will understand how SmartSkin benefits by showing the difference between standard building and building with SmartSkin.

"The comparison should show the differences, SmartSkin vs. no smart facade, this should give the customer a good impression"
- NSG Sales

Idea 2 - 3D content

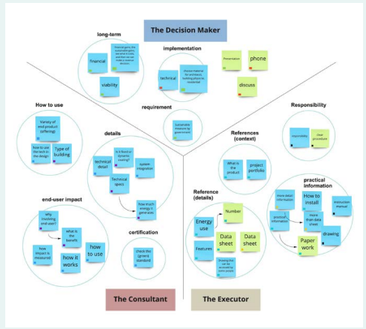
toggle button

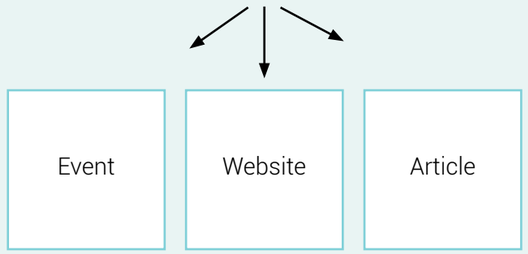
3.

Engaging different audiences

a.Use the knowledge map to create one channel for all

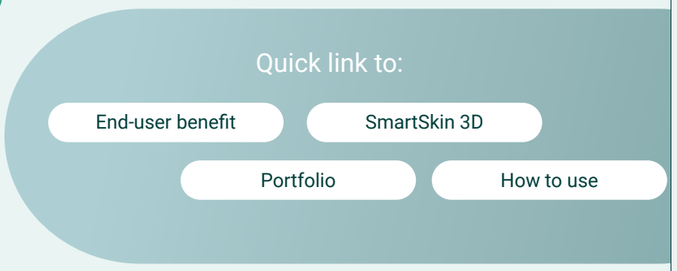
To design the right content for different stakeholders, Physee can use the knowledge map to assess if their communication channels are targeted to the right stakeholders. Not only create more efficient content writing, but the map can also give the right content for all stakeholders.





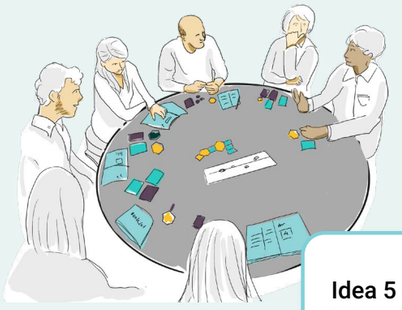
b. Show the necessary information in the beginning

There are different needs of each stakeholder. Giving them some options, in the beginning, can help them get what they want in a faster way.



c. Go beyond procedural contract & create service relationship.

Start a more open discussion and prevent the mismatch by using some tools like a card. Eventually, the conversation can give a chance for the stakeholders to think about the possible plan.

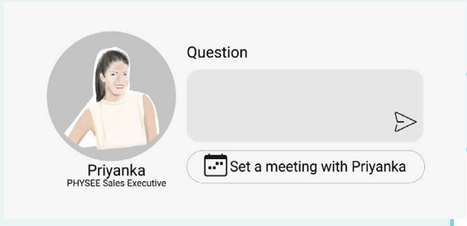


Idea 5 - Interactive workshop

d. Enable the feedback loop

Feedback is often lost in the process. Through PHYSEE Trix, feedback can be gathered in more documented.

Evaluate each feedback and generate reports to improve future information pushes/releases.



Contact person

Idea 4 - PHYSEE Pedia

Facilitate the workshop

Idea 5 - Interactive workshop

Figure 61-74 Design guideline illustration

7.3.7 Prototype & Storyboard

The prototype and storyboard are used to show how the design principles are implemented in the concepts. The prototype is representing the ideas of 3D content and PHYSEE Pedia. Meanwhile, the storyboard represents the Interactive Workshop idea.

The prototype looks like a wireframing rather than UI (User Interface) design because the goal is to show the functionality of each concept on the website.

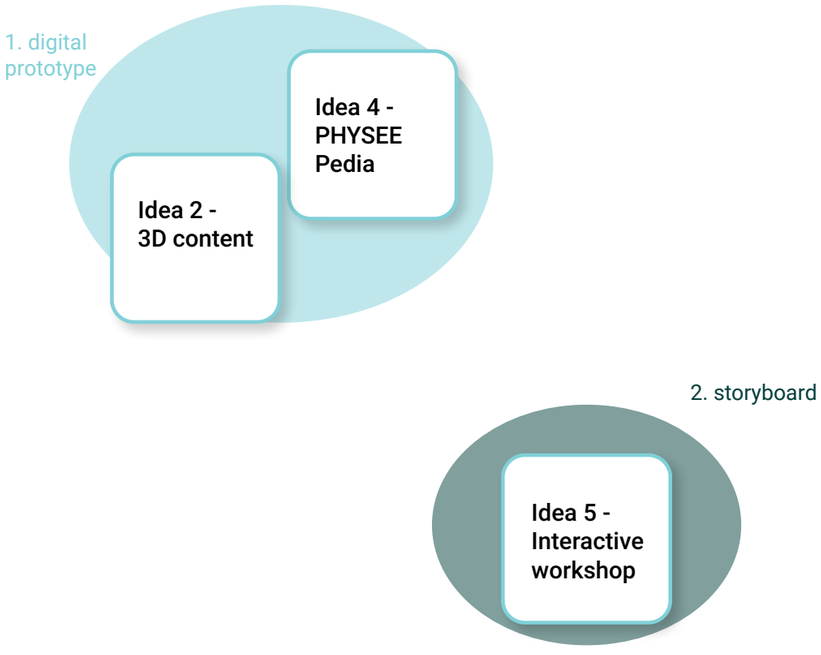
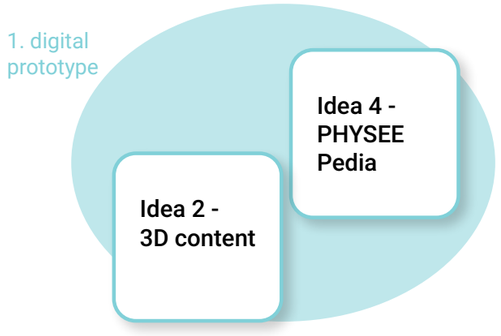


Figure 75 - Prototype and storyboard planning



Information architecture

What it looks like if PHYSEEpedia & 3d content are integrated with PHYSEE's website?

The proposed information architecture below is not the complete version. The main goal of figure 76 is to show how the idea of 3D content and PHYSEE pedia are integrated with the website.

main audiences:

- **The Decision Maker**
- **The Executor**
- **The Consultant**

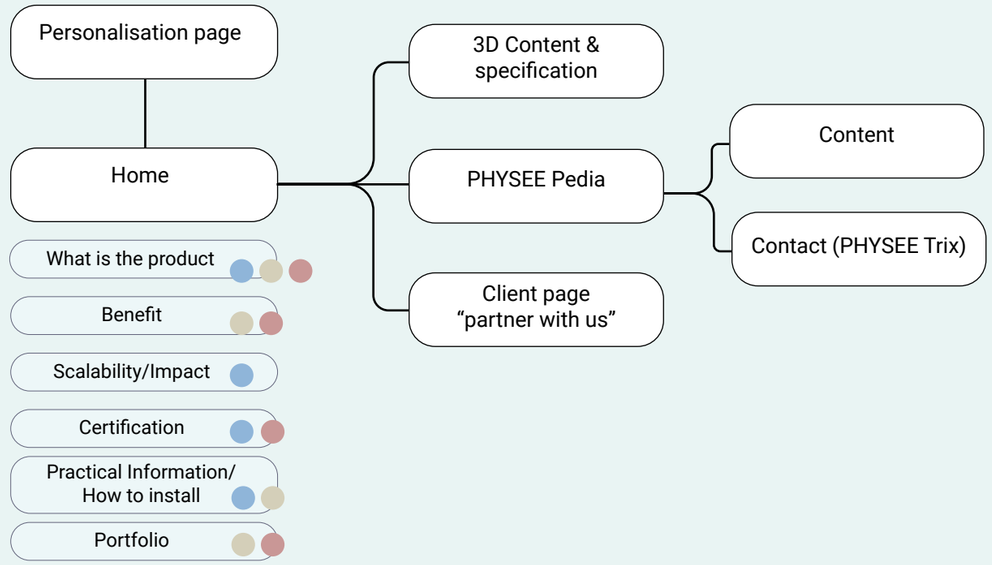


Figure 76. Information architecture of new proposed website

The digital prototype is created by using Figma (online wireframing) to show the flow of the concept. There are 3 main features that is important in the concept.

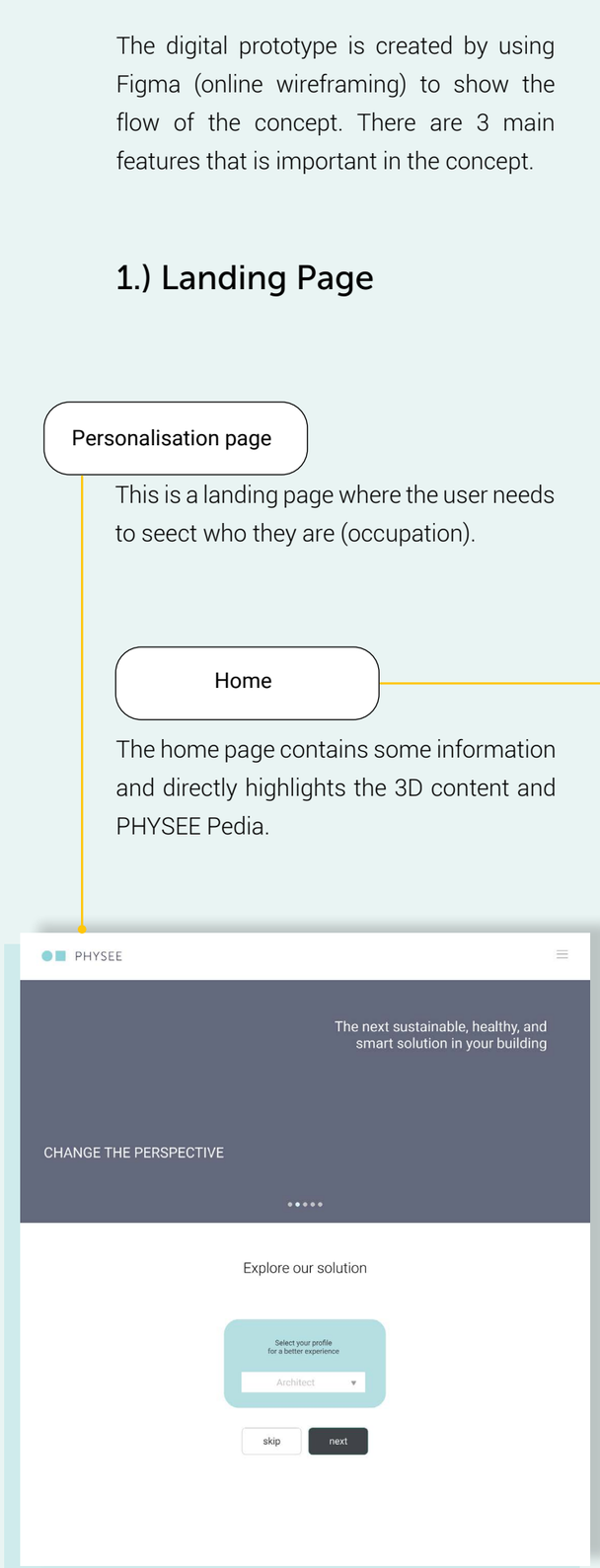
1.) Landing Page

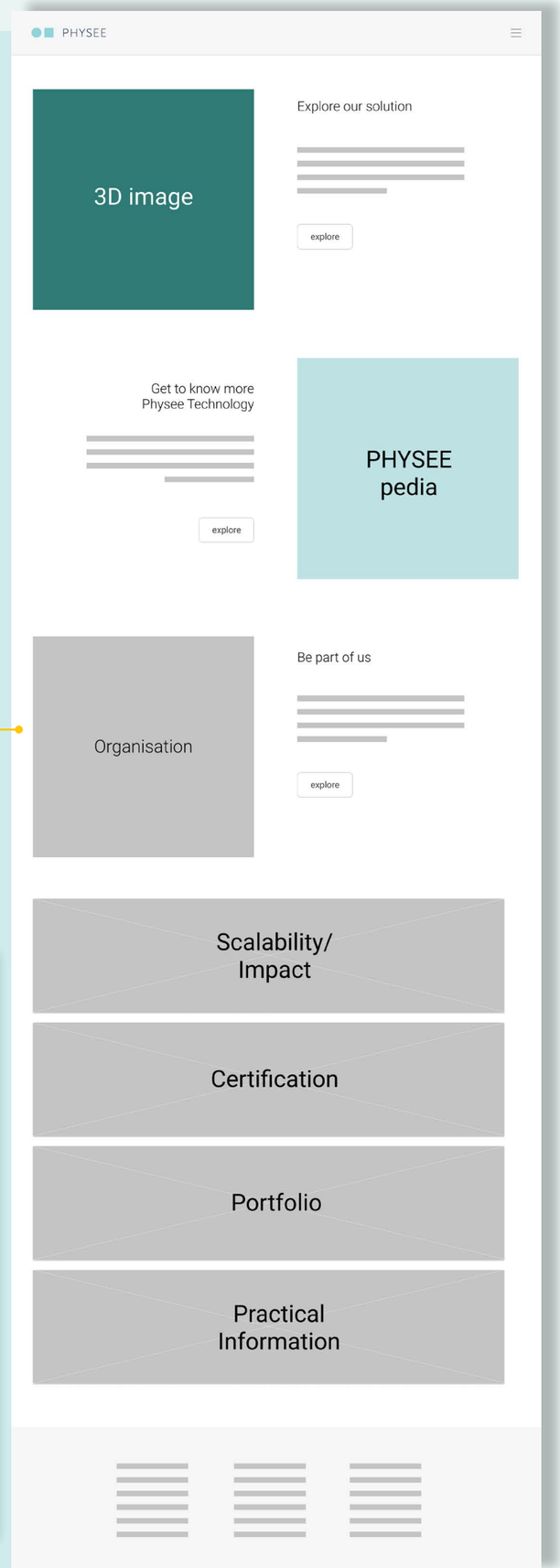
Personalisation page

This is a landing page where the user needs to seect who they are (occupation).

Home

The home page contains some information and directly highlights the 3D content and PHYSEE Pedia.





2.) 3D Content & Specification

Product portfolio

to show the past, present, and future offerings to the client & partners.

3D image

to show how the system works using animation.

Scenario

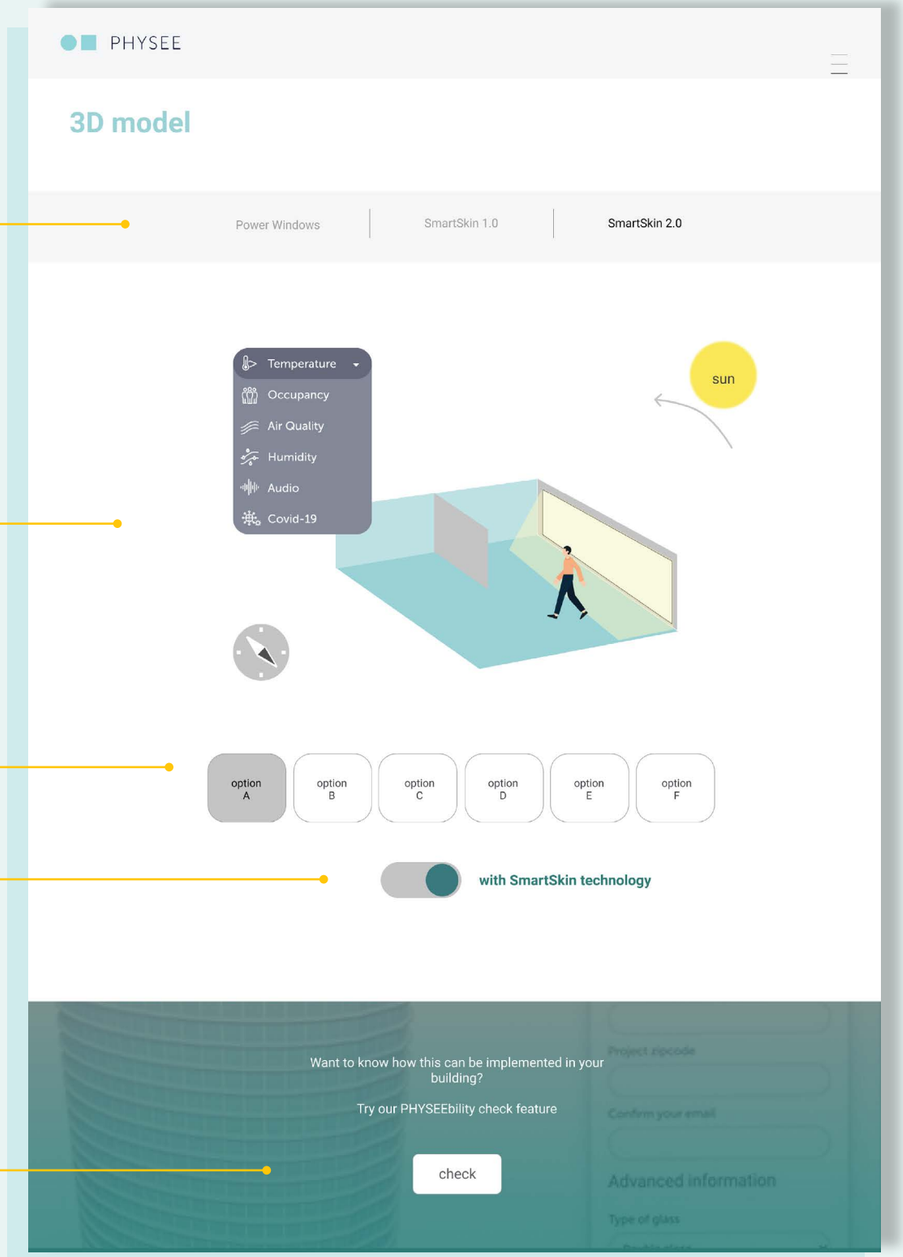
user can try different scenarios.

Comparison

to show the differences with SmartSkin technology implemented in the building.

Action

to attract them using the services.



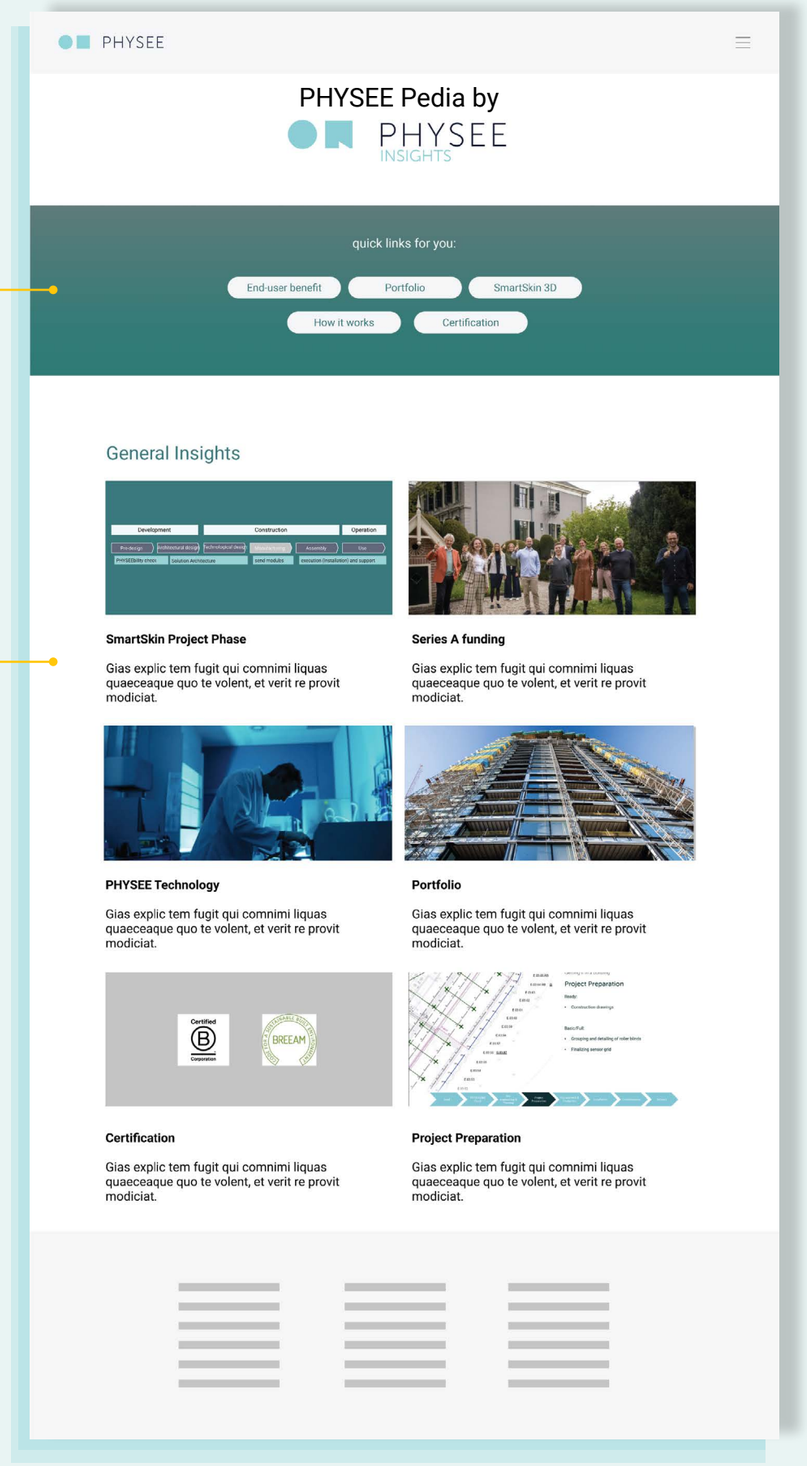
3.) PHYSEE Pedia

Custom menu per archetype

a quick action to access the specific content. This information is grouped based on the archetypes.

Content overview

to show the general information about PHYSEE and SmartSkin.



Showcase

to show the content with videos or images.

References

to share documents needed to know more about the technology.

PHYSEE Trix

a question option.

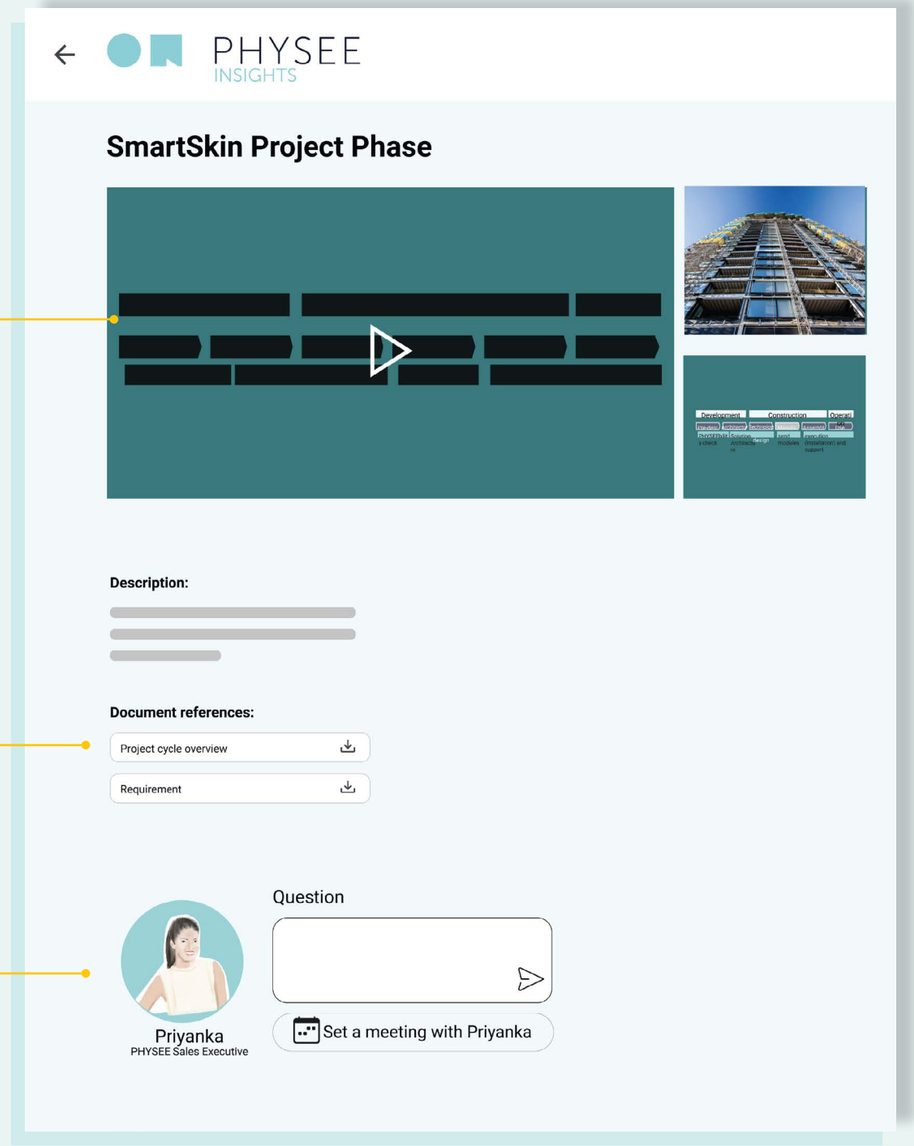


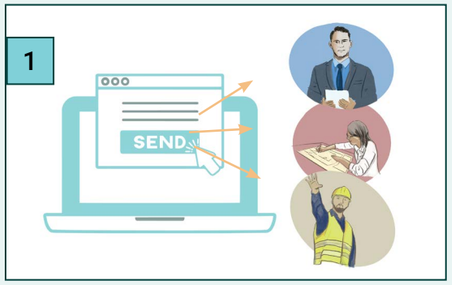
Figure 77-82 Website prototype

2. storyboard

Idea 5 - Interactive workshop

The storyboard below explains how the future/existing PHYSEE's stakeholders can discuss in more interactive and comprehensive.

Storyboard

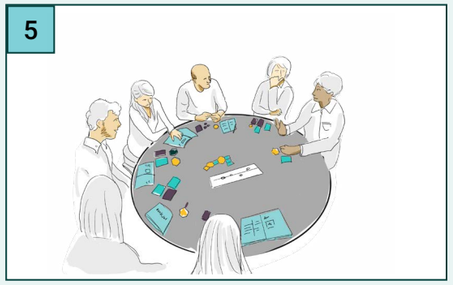


Priyanka from PHYSEE send invitations to the stakeholders that will involve at PHYSEE SmartSkin project.

Priyanka from PHYSEE will come to facilitate the workshop.

Each participant chooses their role. And get the risk and benefit cards on their hand

Priyanka will give a step card and lead the discussion.



The discussion start when someone put the risk and/or benefit card

They also received a blank card so they can add more information that is not listed on their own deck.

The book is given during the workshop so participants can write down some notes.

Priyanka conclude the session and send the Minutes of Meeting to the participants.

Figure 83 Storyboard

7.3 Delivering The Strategy

7.3.1 Design Roadmapping

The roadmap presents a possible way or direction towards the future vision. This roadmap aims to give an overview of how the possible concepts will be implemented in a specific timeframe (called horizon). A roadmap also communicates the "why" behind what we are building. It is a plan of the strategy.

The roadmap is designed based on the concept consideration (chapter 7.2.5). The most beneficial ideas for PHYSEE is needed to be prioritized. This roadmap is also build based on the time pacing strategy framework (Simonse, 2017). It is consists of three horizons. The technique comprehends three parallel scenarios based on three different life cycles of strategic business innovation (figure 85).

Firstly, the value enhancement of PHYSEE Insight will focus on the NPD (New Product Development) at PHYSEE. The focus is to deliver a new version of SmartSkin to the market by promoting SmartSkin through product demo.

Secondly, user-centered value creation on PHYSEE Insight is dedicated to the different archetypes. It allows users to understand that SmartSkin is valuable for them and they need it. That is why PHYSEE can renew and publish their website by adding 3D content and PHYSEEpedia idea.

Thirdly, the value in value proposition creation encompasses a broader impact (Simonse, 2017). Physee can expand more impact by focusing on the services to the client and partner like realising Physee lab and interactive workshop.

Based on these criteria, the design roadmap in figure x is proposed.

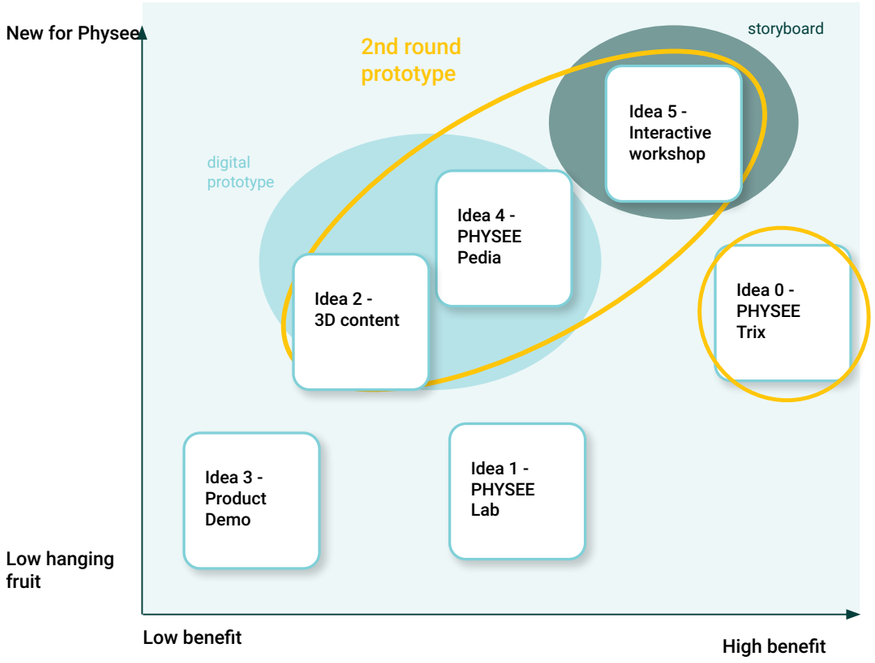


Figure 84. Concepts analysis diagram

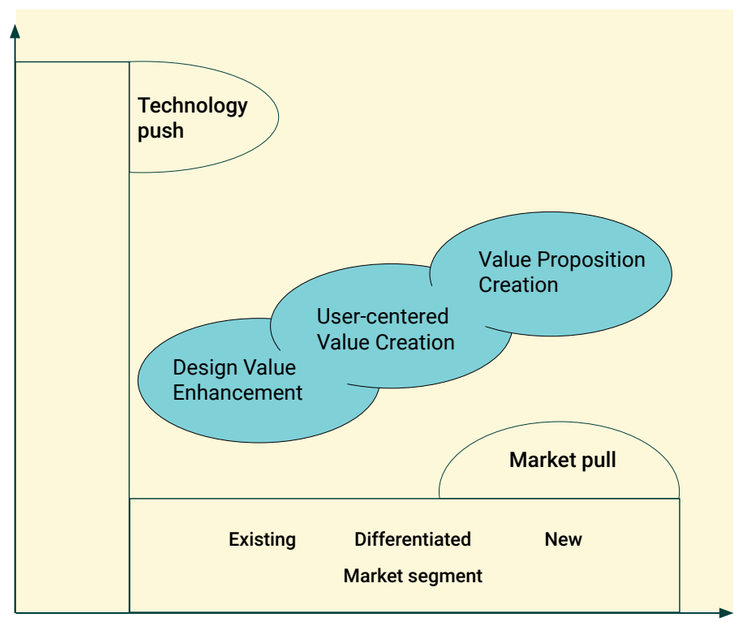


Figure 85. Value creation by three modes of design innovation (Simonse & Hultink, 2017)

Roadmap

Time

Q1
Horizon 1

Q2-Q3
Horizon 2

Q4-Q5
Horizon 3

Design goal:

Physee will design a service to inform the updated knowledge to the stakeholders in a customized and collaborative way.

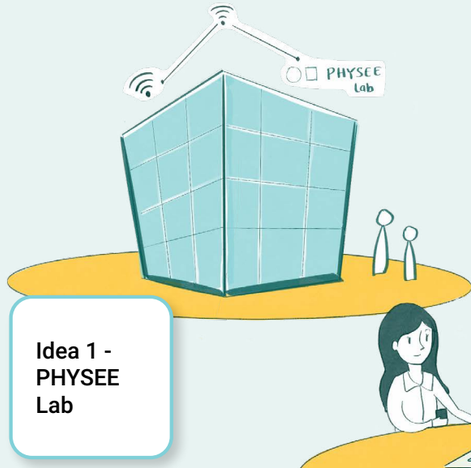
Launch

Idea 0 - PHYSEE Trix

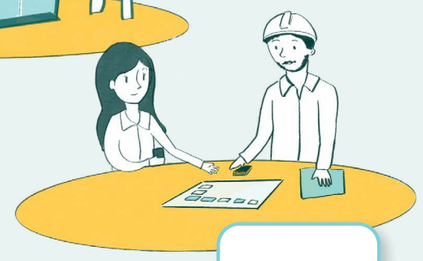
Idea 3 - Product Demo

Idea 2 - 3D content

Idea 4 - PHYSEE Pedia



Idea 1 - PHYSEE Lab



Idea 5 - Interactive workshop

The Strategy

1. **Enabling the knowledge source**
2. **Making the adaptive & modular knowledge**
3. **Engaging different audiences**

Company's needs

Human Resources	Liabilities, Legal	Commercial team expansion

Figure 86. PHYSEE Insight design roadmapping

Chapter 7 - Key takeaways

- The main solution of this project is called **PHYSEE Insight**.
- By creating service positioning, we can know how PHYSEE Insight can play a role within the company.
- PHYSEE Insight can reduce the number of communication and increase the rate of interest.
- We can not discuss all proposed ideas for PHYSEE to tackle tomorrow and for the minimalist sake of this graduation project. Therefore, mapping out the most benefits and newness for PHYSEE is necessary.
- The ideas can be combined and integrated. Two main ideas are proposed in this report: PHYSEE website and the interactive workshop.
- In the implementation plan, the ideas are considered based on three modes of information (Simonse & Hultink, 2017) and also divided into three horizons.

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Chapter 8

Concluding the Project

8.1 Conclusion
8.2 Discussion
8.3 Reflection

Image source:
1. Meeting at Physee (author, 2021)
2. Physee

In this chapter, the project is discussed with respect to the research question and the project objective. Firstly, discuss the conclusion of the project. Secondly, discuss the implication and recommendation. Thirdly, sharing the reflection during this graduation project.

8.1 Conclusion

The conclusion of this master thesis project is as follow:

This graduation thesis is a combination of practical and academic learnings. This graduation project has addressed the problems/challenges, such as engaging different stakeholders and delivering different values to align with Physee's values.

The main research question for this thesis research is:

RQ: How could Physee communicate their strategy, value, and structure to the stakeholders and engage them in the process?

In addition, there are five sub-research questions answered in each chapter in this report.

The design approach is used, driven by an academic approach. The design process is the combination between diverging & converging and iterative.

SQ 1 **What are Physee's strategy, value, and structure?**

Physee offers SmartSkin technology which offers three main values such as sustainable, smart, and healthy. The commercial team within Physee is the frontman to engage the stakeholders in one life-cycle process. There are two different business models to sell SmartSkin. As a result, there are different intentions between stakeholders groups.

SQ 2 **What is the (Integrated) Façade value and network in the construction industry?**

There are two topics in the literature review. First, the literature on integrated façade showed that Physee has an important role as the system supplier because they work with multiple stakeholders. They need to consider different façade values such as functional, financial, strategic, and energy. Another literature is about engaging the stakeholders. It is beneficial to know how we can understand the value and network within the façade construction industry.

SQ 3 **How does the existing relationship and communication workflow between the Physee's commercial team and the external stakeholders look like?**

SQ 4 **How can both Physee and the stakeholders are kept informed?**

First, there are different interactions between Physee and external stakeholders. There are 8 type of external actors in total, such as Real estate developer, building owner/ investor, IGU manufacturer, architect, building physicist, main contractor, facade contractor, and e-installer. Some of it has stronger power and interest. Based on that, three archetypes were identified: the decision maker, the consultant, and the executor.

There are two different design challenges brought to the co-creation process. Firstly, it is about the information presentation because Physee has no clear information, so the technology lacks interest. Secondly, Physee needs to solve the stakeholder expectation problem and elaborate their ideas through collaboration.

SQ 5 **How to communicate SmartSkin for different stakeholders?**

The following design statement was presented: *Physee will design a service to inform the updated knowledge to the stakeholders in a customized and collaborative way.*

As a result of the co-creation and validation process, there are six different ideas. The ideas are integrated with each other. Because of that, Physee needs to build a new team called PHYSEE Insight. PHYSEE Insight combines multiple solutions to engage the stakeholders in different points, as seen in chapter 6.2.1. There is three main strategies to build the solutions: Enabling the knowledge source, making the adaptive and modular knowledge, and engaging different audiences.

Finally, the design roadmap is delivered as part of the implementation plan. It is derived from three modes of innovation framework which consisting of three steps. The proposed strategy enables PHYSEE to speed-up the process of engaging stakeholders, scaling-up the information update in easier way, and providing user-centric information.

8.2 Discussion

8.2.1 Implication & Contribution

The implication and contribution of this master thesis research and project consist of two perspectives:

a.) For design domain

This graduation project contributes to several aspects:

- **Methodology:** Within the research phase, adapting the existing knowledge like 'the facade value' into design tools like 'card sorting' is new. It means the theory from another field can help designers to adapt it into a discussion tool.
- **Way of design:** The graduation project is a nice way to stay flexible with the process. There are a lot of iterations that may help designers to sharpen their skills.
- **Stakeholders engagement topic:** There are different needs for each stakeholder. The designer has a dominant skill to understand the pain points and translate them to design opportunities. This research adds contribution to design 3.0 about Organisation Transformation Design.
- **Strategic Designer as a facilitator in non-design environment**. As mentioned in the chapter 6.1, co-creation is an act of creativity shared by designers and non-designers (Sanders & Stappers, 2008). It was proofed that the process of generating ideas is more diverse and impactful (based on the validation insight).
- **Get used to design projects in an online set-up:** The pandemic has forced us to work at home as much as possible. Thus, a designer needs to have more knowledge and practice regarding the online tool. Some tools is more effective than offline. For example, using MIRO board to categorize the insights and documented in a safer way.

b.) For the construction industry

- **The importance of collaboration:** In the initial brief, Physee wanted to inform the stakeholders about their technology. It is a one-communication project. Then, however, the author tweaked it into a more collaborative project or two-ways communication. A collaborative project is quite common in the design field and more interesting to explore. Therefore, it is very useful that this topic is brought up in the construction project.
- **The importance of understanding the stakeholders:** Integrated facade is a new technology in the construction industry. This research contributes to understanding users need by gathering the stakeholders' profile and the social interaction between them and the surroundings.
- **Customer journey helps to gain an overview of the process**: After designing the customer journey, the author received a lot of feedback on how important to have an overview of the SmartSkin project journey.
- There is an **additional finding** which adding a new facade value (Azcaarte-Aguerre, et al., 2018). The framework not only consists of 4 values, but there is operational value. This finding has emerged from a qualitative discussion.

8.2.2 Limitation

The limitation is divided into 2:

a.) Design deliverable

- The project scope is too big for one designer in 5 months. The reason is that this research includes two different business models (direct sales and OEM strategy, see chapter 2.3.2). Hence, the actors involved in the project is somehow different and creates a bit of frustration. In addition, the interview guidelines were different from one stakeholder to another. Therefore, it affected the synthesis process as well.
- Design roadmapping is designed in the last minutes. The design used the time pacing theory instead of building it together with the company. There is no time left to validate the design roadmap.

b.) Context

This research is very explorative because there is no research conducted yet about the clients or partners. Therefore there are a lot of respondents groups or sampling. Hence, this research has limited participant in a short time. Especially when discovering the archetypes. The ideal research at least needs 2 respondents per archetype. Because of the minimum number of respondents, the result might be subjective. Start-up culture, business model changes quite frequent. Some of the data included in this graduation project has not been used anymore in the company. For example, SmartSkin 2.0 is no longer called SmartSkin but SENSE. Because of that reason, the information of this thesis needs to be adjusted within internal Physee.

8.2.3 Recommendation

The recommendation is divided into 2:

a.) For future research

- Research on communication feedback. This research is merely trying to explore the potential of two-way communication. Still, there is more space to investigate how stakeholders give feedback.
- Research on each idea on a deeper level. For example, the interaction between stakeholders in the decision making.

b.) For the company

- Iterate again and again.

The proposed solutions are designed to inspire PHYSEE in the direction they could take. The ideas are in very high-level concepts. To implement more detailed concepts, iteration plays an important role in the project.

- Create clear access to information

There is a lack of consistency of data within the company. Physee needs to make the internal data and information clear to create a better engagement.

- Stay in contact with stakeholders.

The respondents were very enthusiastic about the project. Keeping them is very helpful to bring this project alive.

8.3 Reflection

The reflection that has been observed during this project is divided into three parts.

a.) as a project manager of the graduation project

The graduation project at IDE TU Delft is challenging and exciting because it allows students to choose their assignments. It is a very beneficial experience to prepare students for a real professional job.

In regards to project management, two aspects are observed. Firstly, it was a challenge to create the proper project scope in the beginning. Therefore, the author needs to understand what she wants to learn and combining what the company needs. Secondly, as a manager of a graduation project, there are a lot of unexpected challenges that affecting the schedule, such as getting sick, no response from the stakeholders, office events, etc. Thus, being flexible, patient, and think creatively are the traits that improved the author's soft skills as a project manager.

During the pandemic COVID-19, sometimes it was difficult to work 8 hours a day. Some time less, sometime more. On the other hand, from the author's point of view, the scope of the projects was sufficient for a graduation project. Project management in sufficient time is also part of her key learning. In this project, the author learned how to mitigate a barrier in the design process and caught up in a start-up flexible situation.

b.) as a designer

The project was a complex problem, meaning that it involves many stakeholders. A lot of auditing and iteration in the process makes the data and design outcome stronger. On the other hand, iteration process also improves critical thinking. Moreover, the iteration can make our solution more objective.

The author agrees that the graduation project is also about trying new methods in terms of the design methodology. Try all possibilities but also be very critical, 'why we need these tools?' There were many tools used in the graduation because, in every decision-making process, a designer needs to get as objective data as possible. In addition, tools improve the trustworthiness and validity of design decisions.

Then, 'more people you meet, the more insights you can gather'. It means a designer needs to have encouragement to talk and discuss with more people. This process can create stronger research and, more importantly, getting know the context of the project better.

b.) as Physeeonairs (intern at the company)

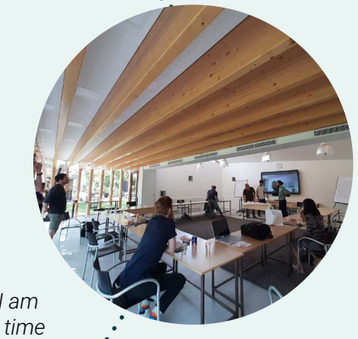
There are some benefits to working as an intern. Not only getting to know the company culture, but also interacting with more people.

First of all, it is easier to know more about the context through internal's events. Although working at home minimises the informal interaction, Physee employees are very open to any question via online message. Furthermore, having a companion helps to improve the working experience in a very efficient way. Compared to the author's previous experience in Indonesia, people always have time. Meanwhile, the Netherlands is different. People are so efficient. In order to prevent the inefficient meeting, it is necessary to conduct several pilot tests. The pilot test is important to make sure that we ask the right question and not miss any questions.

It is nice to contribute to a start-up company which fewer designers. We can contribute to add creativity in the COVID-19 'fatigue' meeting. One of the designer's skills is to guide creative facilitation. When the stakeholders say that the meeting was interactive, it adds more contentment to the designer.

" The storyline was very nice and optimized the way we can brainstorm virtually".

"my bed is so tempting! I took naps very often."



"Strategy day, offline. I am so fortunate to spend time with the team and contribute beyond my assignment."

"Visited PHYSEE office. It took 5 minutes cycling from my house :)"

Author's End Note

"I like my report and end result".

That is what I said to my friend at the TU Delft library.

I know it might be not the same for some students. However, I believe that what makes a good project is that a designer really understands and like their project.

I mentioned on the Preface page about the contentment. Why did I bring this topic? For me, it is important to appreciate and be kind to ourselves. During the pandemic Covid-19, everything can go wrong. I faced a tough situation when I started the graduation project. My close friend left the world, and also, pandemic life sometimes is depressing. I suffered from light anxiety and sleep deprivation in the end of my thesis. I am fortunate because I pushed myself to talk with people. I want to help others, too. I tried to work-life balance as much as possible (this is what Dutch good at, and I learned a lot about this thing). My supervisor always reminds me to have fun. As a hardworking person who lived in Asia for a long time, this is a life-worthy learning.

In the graduation project, I think getting an ideal project is quite difficult. That is the reason I brought the contentment topic. In my previous research, contentment can be found from the project's process, outcome, and/or context. I, once again, agree that I find contentment during working on this project. I am a bit worried at the beginning of the project because I am not so sure if this is something I would like to do. I want to tell other designers that I can find joy from one of these aspects: the outcome, process, or context. There, I can find the contentment.

Well... Master thesis never ends. I think most of the human never satisfied with their work. Jo and Sine always mentioned that I am ambitious. They always remind me to not stressed out of the project. I am very thankful about it. Graduation thesis at TU Delft taught me a lot of life learnings. As a designer, I need to make my scope that fit with the timeline.

Sometimes, I tend to forget to appreciate my work. Neglect the fact that I am good enough. I want to say to all designers and people to treat our project like our baby.

Love your work and yourself.

Thank you for reading. Thank you for your support.

Delft, July 2021
Vivian

"You are not alone"

"You are good enough"

"Be kind to everyone and yourself"

"It is okay to take more break and space"

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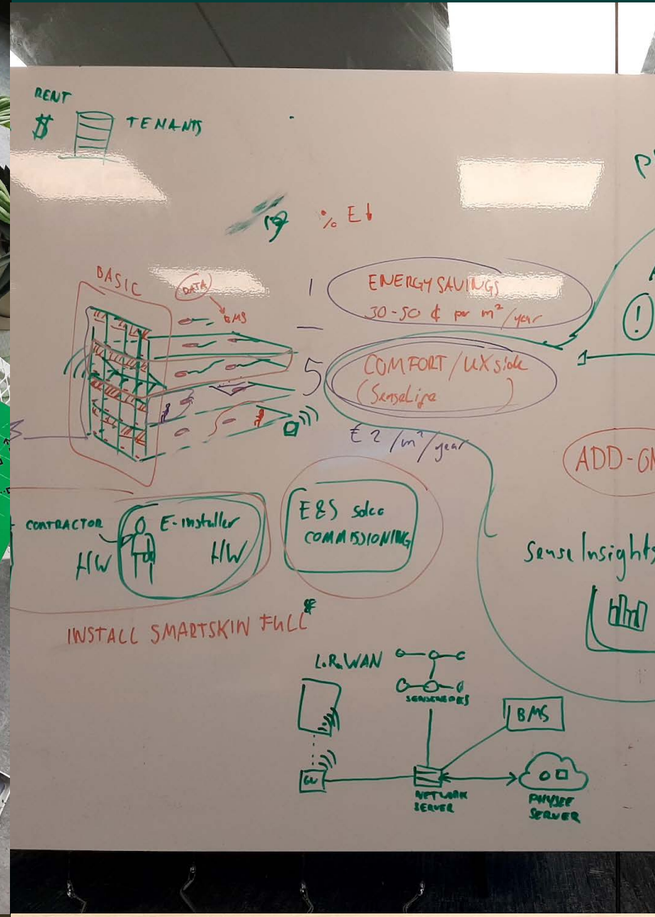
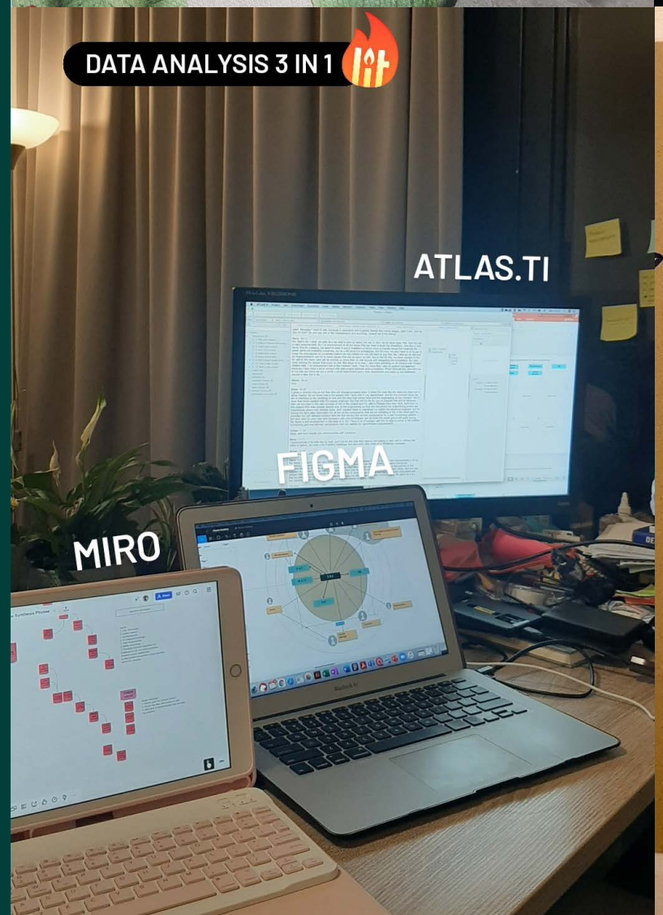
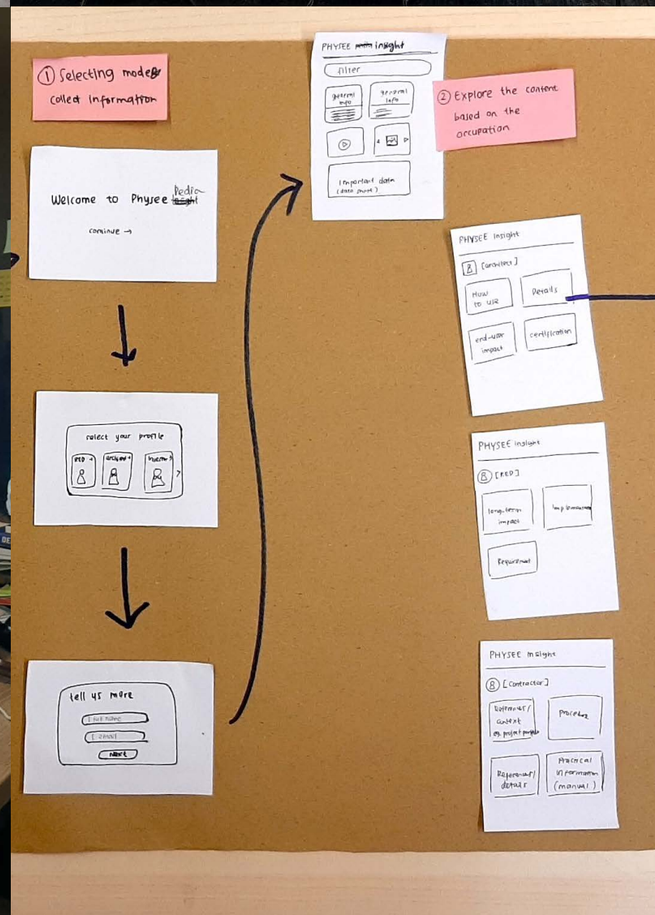
Appendices

The data collection
&
way of thinking and doing







Appendix A

Approved Project Brief & Timeline

DESIGN FOR our future

4729

TU Delft

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 Maretina
initials V. given name Vivian
student number 4773179
street & no. .
zipcode & city .
country .
phone .
email .

Your master programme (only select the options that apply to you):
IDE master(s): IPD / DBL / SPD
2nd non-IDE master: .
individual programme: - - (give date of approval)
honours programme: Honours Programme Master
specialisation / annotation: Medisign / Tech. in Sustainable Design / Entrepreneurship

SUPERVISORY TEAM **

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

** chair Dr. Sine Çelik — dept. / section: DOS / MOD
** mentor Prof. Dr. Jo M.L. van Engelen — dept. / section: SDE / DFS
2nd mentor Joris de Jonghe (Head of Marketing and Business) — organisation: Physee — city: Delft — country: The Netherlands

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.
Second mentor only applies in case the assignment is hosted by an external organisation.
Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

comments (optional)

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

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

chair Dr. Sine Çelik date 18 - 02 - 2021 signature

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: 22 EC
Of which, taking the conditional requirements into account, can be part of the exam programme: 22 EC
List of electives obtained before the third semester without approval of the BoE:

(X) YES all 1st year master courses passed
( ) NO missing 1st year master courses are:

name J. J. de Bruin date 18-02-2021 signature MB

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)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- 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 ?

Content: (V) APPROVED ( ) NOT APPROVED
Procedure: (V) APPROVED ( ) NOT APPROVED

remark: title is vague, 2x a with a capital letter, please adapt

comments

name Monique von Morgen date 2/3/2021 signature

TU Delft

Personal Project Brief - IDE Master Graduation

Designing A Strategy and Learning Toolkit in A Project Cycle — 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 — 16 - 07 - 2021 end date

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, ...).

Physee is a technology company that offers smart engineering solutions for the global energy transition. Physee's solutions aim to activate existing materials, for undiscovered, sustainable impact. Roughly 90% of people's time is spent indoors, leading to the demand for better air quality and energy supply. Physee's mission is to develop smart and sustainable solutions that transform buildings into healthy and energy-positive ecosystems. By harnessing the sun's power and gathering data from the sensors, balancing energy production and consumption, transforming buildings into smart, powerful, and sustainable eco-systems. Physee is developing two different technology for upgrading the functionality of glass, the Coatings technology: and SmartSkin.

The value proposition of Physee has changed from just producing clean electricity to the addition of smart sensors, energy storage, and climate control. The introduction of the 'SmartSkin' concept compliments the Coating technology benefits. SmartSkin is a smart and sustainable facade innovation that increases comfort and reduces a building's energy consumption by up to 25%. As a consequence, larger incumbents in the construction and real estate sector joined as critical stakeholders. The expansion to new partners, including glass manufacturers, real estate companies, building designers, and e-installer, made it possible to deliver the new integrated smart window concept. The transition towards a circular business model leads Physee to many new partners other than the commercial and technical enterprises.

As the business model evolving, the involvement of stakeholders has a huge implication. Managing the stakeholder has become more critical with specific systems and approaches to align with them and integrate the message. The flow-through from company strategy, values, and structure/processes affects vital stakeholders, which also influences the key outcomes the company is looking for (Scholes & Clutterbuck, 1998) (see figure 1). Besides, the number of clients keeps increasing year-by-year and globally spread. Physee must educate the client more frequently.

The marketing team is developing a PHYSEE Academy service (the initial assumption is to design an online platform) to offer documentation of the technologies and, more specifically, inform and train the people who need to interact with the technologies. This platform is so far nonexistent and offers the opportunity to design. The user groups are divided into three: Physee employees (RnD, Marketing, Sales, Production), partners (glass industry, contractors, e-installers, BMS suppliers, data-engineers), and the customers (real estate developers, architects, house owners, building manager tenants) (figure 2).

References:
PHYSEE. (2020b). Greenhouse Solutions. Retrieved from www.physee.eu/greenhouse-solutions/greenhouse-solutions
Scholes, E., & Clutterbuck, D. (1998). Communication with stakeholders: An integrated approach. Long range planning, 31(2), 227-238.

space available for images / figures on next page

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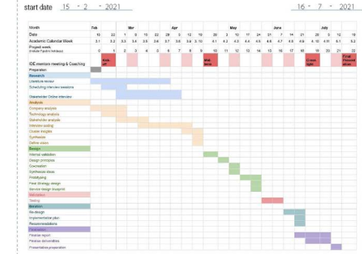
Personal Project Brief - IDE Master Graduation

PLANNING AND APPROACH **

Include a Gantt Chart (explain 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 — 16 - 7 - 2021 end date



Important date:
Kick-off meeting 15 February; Midterm 19 April; Green Light 21 June; Final presentation 16 July.
The entire day is 100 working days, 7 public holidays.

The overall project is divided into 6 phases: Research (7 weeks); Analysis (2 weeks); Design (5 weeks); Testing (2 weeks); Re-design (2 weeks); and Reporting (2 weeks).

In the first week, I will conduct a stakeholder interview at Physee Academy. The research phase is done extensively due to its complexity, which involves three main stakeholders (internal employee, partner, and client). Besides the interview, there will be an extensive literature review. Expert interviews may be needed. It also contains company analysis, products (SmartSkin), existing workflow, supply chain, and other necessary information for this project.

Then, there will be an analysis phase, which is done together with Physee team within two weeks. Eventually, a vision is defined. In the design phase, there will be a co-creation session between the designer and Physee employees. Then the designer will execute the prototyping with the help of Physee design team (if available). After that, the prototype will be tested on three main stakeholders, followed by the synthesis of the activity's insights. The design is upgraded in the re-design phase, and finally, the deliverable will be written on a report and presented.

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introduction (continued): space for images

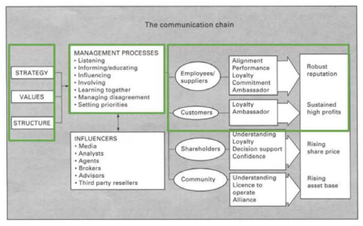

image / figure 1: Research scope based on the communication chain (Scholles & Clutterbuck, 1998)

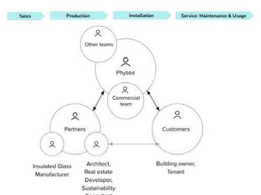

image / figure 2: Project context and scope

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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.

The scope of the research is to investigate the problem within one project cycle but in this project, I will investigate the most interaction with SmartSkin process, which is in production and installation (figure 2).

Two main key problem areas for this graduation are:
1.) Physee needs to inform and train many different stakeholders on different topics. Often there will be overlaps in the spreading of information between various stakeholders. They need to find ways to present the right bulk of information to the right stakeholders in the right order not to overwhelm or confuse them or others. Besides, Physee future is to expand outside the Netherlands, now to Asia, which implies their communication workflow. Therefore, they need to have a particular system to share knowledge and enabling two-way communication.
2.) Physee needs to deliver different values of each stakeholder (figure 2) and want to align with the Physee value and (sustainable) business model. For example, architects claims thought leadership on sustainability and smart building; Real Estate Investors need to understand the impact on sustainability scores of SmartSkin for their asset portfolio. Because of this, one of my approach from academic perspective is also to include the sustainable design theory into the communication gap.

Initial research question: How could Physee's (sustainable) strategy, value, and structure be translated into a communication strategy within stakeholders?; How could the solution enable collaboration with the different needs of stakeholders?

The solution space will be composed by creating a design for a service design (including tools) to enable effective communication and collaboration.

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.

Designing an information platform for different stakeholders (Physee's employee, partners, and client's) by understanding the core business value in Physee. Two outcomes of the project are the communication strategy and service design.

1.) Communication Strategy
Instead of providing UX Design's detail, as mentioned in the initial brief, I will first investigate the Physee Academy's potential from the user's perspective (Pull strategy). I will uncover the needs and pain points when interacting with SmartSkin by conducting user research. Then, I will deliver a strategic roadmap to understand the underlying value of the Physee Academy and the future vision of Physee Academy. A roadmap is used to facilitate the design team to develop the platform.

2.) Service Design
Service design is the secondary outcome that I will test for the stakeholders. The service design will provide how the end solution looks like. Therefore, the deliverables would be the service blueprint and the service design scenario of the Physee Academy.

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Personal Project Brief - IDE Master Graduation

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.

I was always fascinated with the Dutch sustainable technologies and dreamed of working on them. TU Delft is the best place to fulfill my career aspiration and understand more about innovation and the sustainability approach in design. I want to learn how technology changes align with the future trend and needs and create a social impact. That is why I chose TU Delft for my master's study.

During my third semester, I became an enthusiast about entrepreneurial and organization design. I am wanting to learn more about managing people. Besides allowing me to become a project manager by myself, the graduation project is also something I want to do related to managing people's expectations. That is why I decided to work with Physee because they also have a project that addresses this topic. Besides, I also have an interest in the energy transition.

The graduation project, for me, is a project to learn and explore:

1. Apply sustainable design/business theory/framework in the project;
2. Update new skill, working with different silos/departments, then synthesize their needs and translate to product/service/system;
3. Apply tools and techniques to collect information on customer behaviour, competitive behaviour, market trends and technological developments;
4. Translate product/service line strategies, mission statements, brand identities and information on the firm and its external network of strategic partners into design and engineering guidelines;
5. Deliver the strategic input to the team;
6. To be more critical and understand how to plan and conduct a complex research topic.

FINAL COMMENTS

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

Important date:
- Kick-off meeting 15 February = presenting the proposal
- Midterm 20 April = presenting the research phase update
- Green Light 21 June = presenting the deliverables (go/no-go moment)
- Final presentation 28 July = public presentation

Lenght of the project:
- 100 working days,
- 7 public holidays,
- 3 personal holidays.
- 5 days working at Physee

The overall project is divided into 6 phases:
- Research (7 weeks);
- Analysis (2 weeks);
- Design (5 weeks);
- Testing (2 weeks);
- Re-design (2 weeks);
- Reporting (2 weeks).

Plan:
In the first week, I will conduct a stakeholder interview at Physee Academy. The research phase is done extensively due to its complexity, which involves three main stakeholders (internal employee, partner, and client). Besides the interview, there will be an extensive literature review. It also contains company analysis, products (SmartSkin), existing workflow, supply chain, and other necessary information for this project.

Then, there will be an analysis phase, which is done together with Physee team within two weeks. Eventually, a vision is defined. In the design phase, there will be a co-creation session between the designer and Physee employees. Then the designer will execute the prototyping with the help of Physee design team (if available). After that, the prototype will be tested on three main stakeholders, followed by the synthesis of the activity's insights. The design is upgraded in the re-design phase, and finally, the deliverable will be written on a report and presented.

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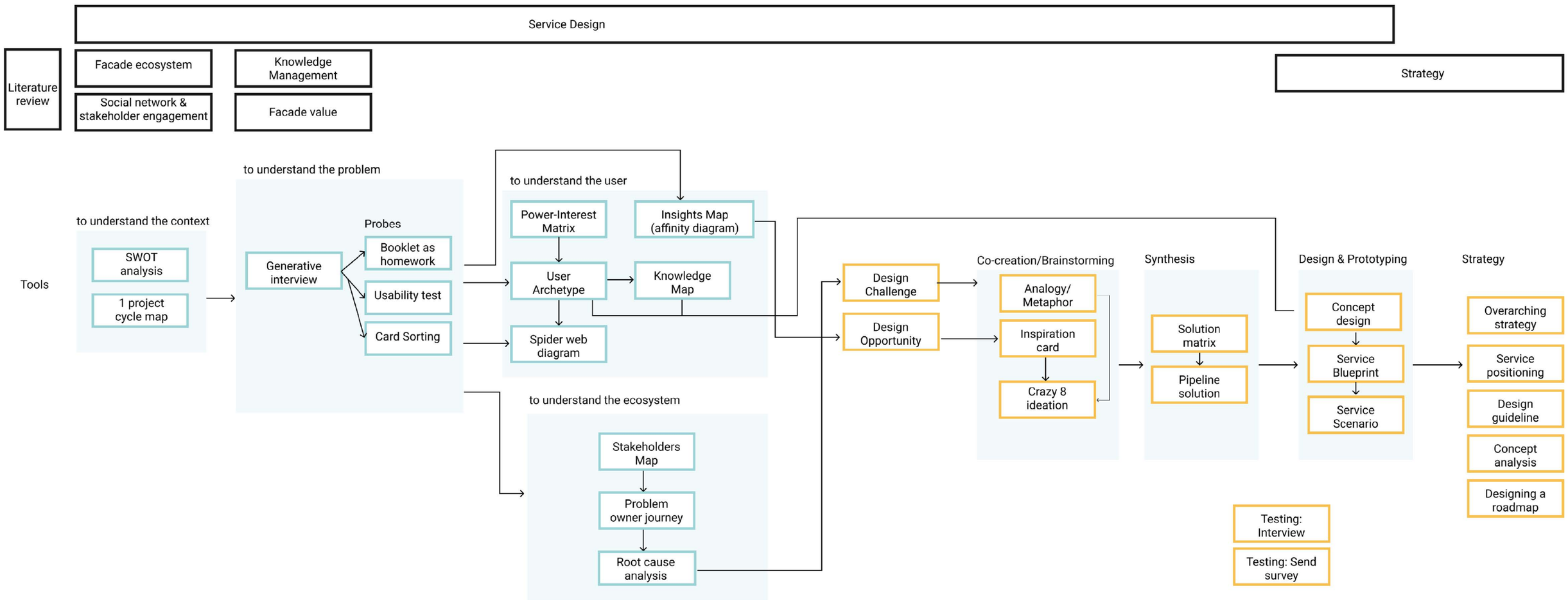
Appendix B

Extensive diagram: Tools in the project

The methodology in this research is very iterative. The diagram is made to show the tools that were used in the project.



Appendix C

About the Smart Skin

PHYSEE SmartSkin 1.0 is an innovative solution for façades that consists of a fully transparent window capable of generating clean electricity and collecting environmental data (SmartWindow), joined to an intelligent grid connection (EESY). This solution stores and distributes power, communicates data and calculates ideal room settings to increase the comfort level and energy efficiency of buildings. SmartWindows integrate strips of c-Si solar cells in the window-spacer that harvest solar radiation and produce electricity that can be transferred through a nano DC-grid to multiple 3rd party façade applications such as ventilation, integrated sun-blinds, dynamic shading glass units and others. The window-spacer also hosts a set of sensors that collect internal and external environmental data (including temperatures, sunlight, CO2 concentration) and transmits it to EESY where it is interpreted, analysed and communicated to the connected devices that control the conditions of the room. The result is a façade composed by connected SmartWindows that locally produce and consume clean energy, providing the users with a unique experience of comfort.

Commercial Department

	Marketing and Lead Generation (M&LG)	New Business (NB)	Execution and Support (E&S)	Partnership and Pricing (P&P)
Description	Focusing on the brand identity and getting the traction of the future client.	Getting the client from traction to the execution.	Getting SmartSkin in buildings on time and in full; making sure installed systems generate impact; standardizing procedures to outsource & become scalable; supporting product development with user, partner, and client insights.	Identify strategic opportunities to partner on sales or development; close and maintain legal arrangements; and in charge with the contracting & pricing
Key Actions	• Marketing campaigns • Website, Social media & PR • Community building, On --/Offline seminars • Lead generation (inbound) • Data driven market insights • Opportunity identification (outbound)	• Pipeline management & momentum • Strategic Account management • Sales support / consultation/simulations • Commercial proposals & Pricing • Solution architecture • Co development new functionality (HW/SW) • Product owner Pre-Scan	• Own client relations (internally and externally) throughout customer journey • Tailored support from lead to operation of the system • Provision of information for engineering and installation • Commissioning and customizing upon delivery • After sales services to maintain and improve performance.	• Business Development of major partnership, legal, patents, • Software & IP, • Pricing models/agreements.
SmartSkin related task	• Identify ideal target customers • Create attention for and knowledge about SmartSkin • Leverage customer success stories to build trust	• Pre-Scan services where Physee give the information about the impact of using the SmartSkin in the building. The deliverable is the drawing and the number of the energy that is reduced. • Pricing strategy and sales pitches	• Project management/engineering* • Support/Commissioning* • Acc.mgmt (Owners/Facility • Develop network of licensed project partners (e installers, façade/main contractors) • Provide 2nd line project support/engineering • Continuous improvement processes & products • Product owner PC/PEP	**Idem**
Goals	Increase number of qualified leads 2. Increase sales effectiveness 3. Support of “PHYSEE inside” partnership sales 4. Realize market driven innovation 5. Seamless support for clients from start to finish… and beyond	Actively drive sales funnel with scalable processes 2. Determine deal specific sales strategies 3. Build relationships with counterparts in DMU 4. Support sales partners with pre scans and consults 5. Create project specific solutions and pitch commercial proposals 6. Own client relations (internally and externally) throughout customer journey	• Standardizing SmartSkin Wireless procedures • Moving away from the construction site • Becoming certified and trusted partner • Building up support organization to support such as installation by partners, remote commissioning of systems, and operation of SmartSkin “*we’re doing this, we are standardizing our procedures to outsource our work as much as possible so that we also can become more scalable, and that with less people, we can do more projects*”	

Appendix D

Internal Stakeholders Data Collection (Participants, Interview plan)

To understand the internal stakholders and internal problems, I conducted interviews. Instead of interviews, there are 'project update' and 'informal coffee meeting' with Physeeonairs.

The aim of the internal interview is mainly to understand what is the pain and gain for each team; to understand the role of each stakeholders; to understand the communication workflow; to find out what they struggle to achieve their goal.

Method: Semi-structured interview. The participants receive a digital booklet of 3 assignments (time to fill it out 10-20 min). Then, they need to send it back before the interview session. Beside the stakeholder listed below, the writer also conducted some informal meetings with other teams and departments to gain insight about what is happening in the company.

For the people who get the booklet:

#	Name	Department	Role	Interview time
1	Joep	Partnership & Pricing (P&P)	Head of Partnership & Pricing	45 min
2	Joris	Marketing & Lead Generation (M&LG)	Head of M&LG	30 min
3	Maike	Marketing & Lead Generation (M&LG)	Marketing manager	30 min
4	Maarten	New Business (NB)	Sales	60 min
5	Rahul	New Business (NB)	SmartSkin engineer	30 min
6	Solco	Execution & Support (E&S)	Head of E&S	60 min
7	Stijn	Execution & Support (E&S)	Project Manager	30 min
8	Rene	Execution & Support (E&S)	Project engineer	60 min

Because of the diverse departments, I wrote some different questions which makes it a semi-guided interview. Not al questions are suitable for the respondents.

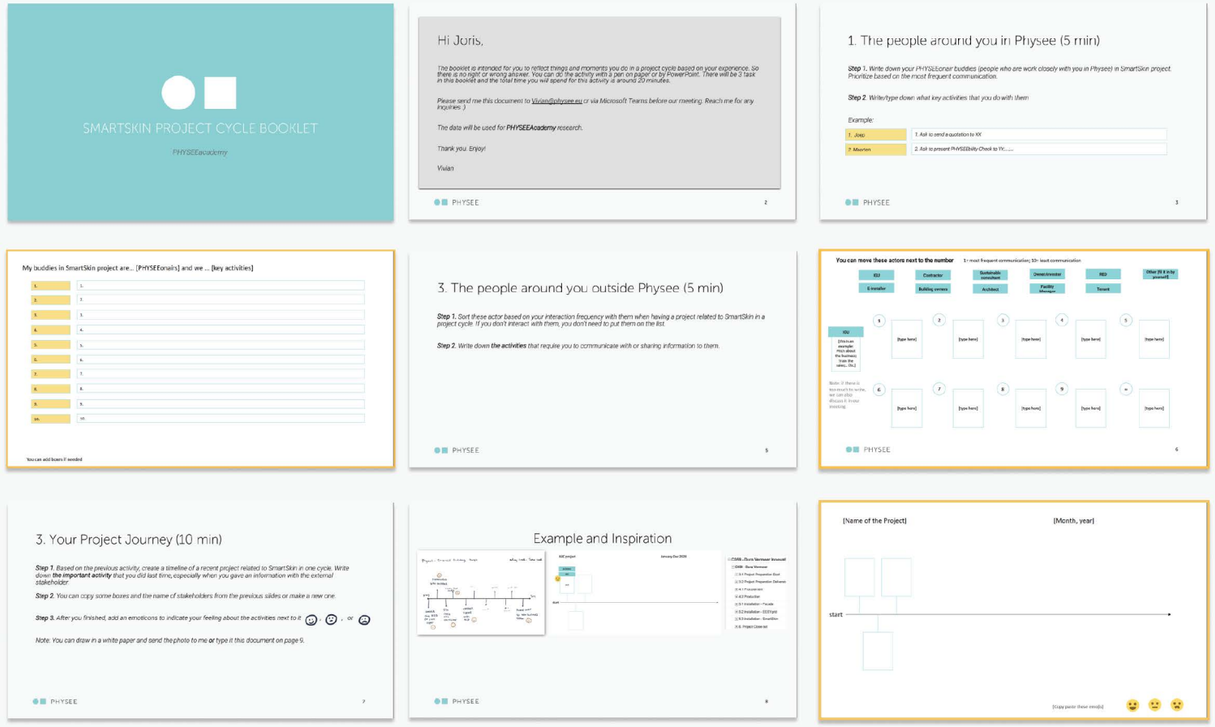
Because the fast-paced work environment, I only have 30-60 min interview perperson. In order to save more time in the session, I asked the participant to fill out a booklet that consist of 3 assignments (total time 10-20 min). The participants sent the booklet back before the interview session.

Interview Preparation: Stakeholder & Project Journey Booklet
Internal Stakeholders (around 20 min)

Goal:

Know their network inside and outside Physee;

Understand their project journey.



Sample Answer

1. Understanding the network and social interaction within Physee

My buddies in SmartSkin project are… [PHYSEEonairs] and we … [key activities]

1. Solco	1. Ask anything in case I need a second opinion on important project decisions.
2. René	2. Ask to order components for project and help him find the required specifications.
3. Carlyn	3. Ask to make project engineering drawings for project that will specify the components for procurement (ask to René).
4. Maarten	4. Ask to hand-over a contract and demarcation for project Pharos.
5. Joep	5. Ask for a check on a written contract/document from a legal perspective.
6. Anagha	6. Ask to update engineer drawings for project based on 3rd party feedback.
7. Rahul	7. Ask for energy impact on a design decision together with project engineer (Carlyn & Anagha)
8. Lawrence	8. Ask for support or 2nd opinion on (electrical) engineering. (together with Carlyn & Anagha).
9. Heidi	9. Ask for all kind of support while using the EESYadmin tool.
10. Willem Jan	10. Ask to produce certain products and deliver them to a project/client.
11. Wai-Man	11. Report to Wai-Man all risks and issues related to Smartskin system.

You can add boxes if needed

2. Understanding the network and interaction between Physee and the stakeholders

You can move these actors next to the number 1= most frequent communication; 10= least communication

Sustainable consultant

Architect

RED

1	2	3	4	5
Ask for updating planning on project execution	Confirm delivery of IGU's and receive volt measurements	Communicate engineering drawings and have them execute accordingly	Request interior floor plans and respond to system errors	Communicate on system performance.
Contractor	IGU manufacturer	E-installer	Tenant	Facility Manager (external)

IGU

[this is an example: Pitch about the business; Train the sales;.. Etc.]

Note: if there is too much to write, we can also discuss it in our meeting

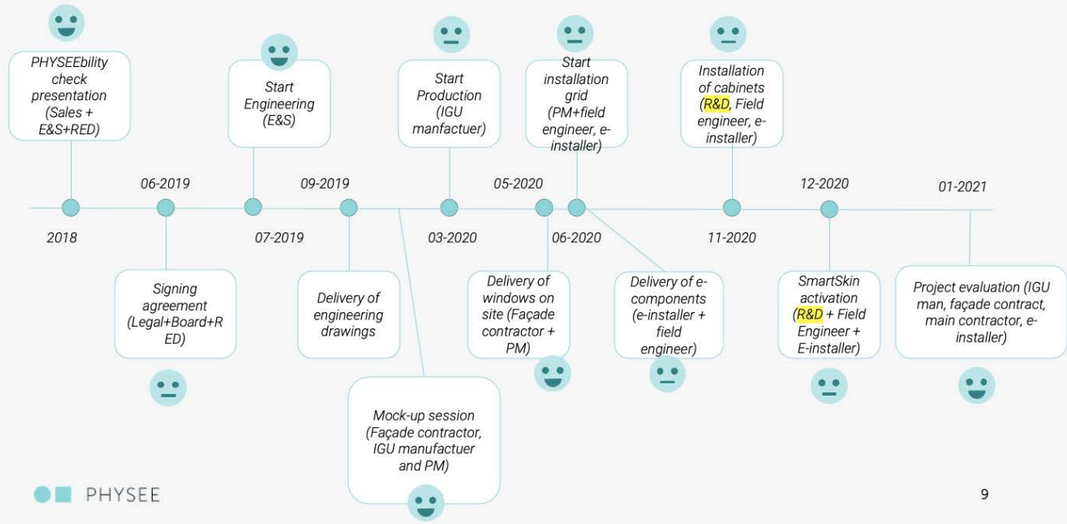
6	7	8	9	10
Ask and order e-components	Discuss maintenance contract/after sales	[type here]	[type here]	[type here]
suppliers	Owner/investor			

PHYSEE

6

3. Mapping the workflow (for user journey)

Pharos – C028



Semi-structured interview

Check-in and Introduction (2')

1. Thank you for participating; What are you up to?
2. Introduce Physee Academy; the focus of my project is SmartSkin 2.0;
3. The purpose of this conversation is to understand the relationship of each person in Physee and the external stakeholders, that is the reason I am sending you a booklet. And I'd like to make the Physee network and knowledge map out of it.
4. Permission to record.

Internal stakeholder and Physee communication (10')

1. Please explain your network in Physee.
2. Tell me about SmartSkin 2.0 **sharing knowledge** at Physee.
    a. What do you think about it?
    b. How do you usually share the knowledge within the organization?
    c. What are the tools you use?
    d. What is the challenge in communication at Physee at the moment?
        i. Why is it a challenge?
3. If the project is about SmartSkin 2.0, who is the people that is the most important/influential?
    a. In what way they are important?
    b. Which team will interact with your team?
4. How do you **receive** the data/feedback from your stakeholder/colleague within Physee?
5. What tools do you usually work with to store your data?
    a. Why do you use it?
    b. What are the improvements from the tools you used?

External stakeholder communication (15')

1. Please tell me the network with the stakeholders listed on the booklet.
2. If your work-related only for **SmartSkin 2.0**, will it be the same?
    a. Why is it the same, or why is it different?
3. What is your role and goal in terms of the relationship between you and this stakeholder?
    a. In what way you have the most communication with stakeholders [number 1]?
4. What is the challenge when communicating to this stakeholder?
5. What **kind of** information/data that you **share** with your stakeholder?
6. How do you **share** the information/data with your stakeholder?
    a. What are tools do you usually work with to **share** your data?
    b. Why do you use it?
7. What tools do you usually work with to **store** your information/data?
    a. Why do you use it?

Workflow (5')

1. Please tell me about your project journey and also how do you feel and think.
    a. Why do you put happy emoji in…
    b. Why you put neutral emoji in…
    c. Why you put sad emoji in...
2. What is the feedback that you **receive** from them?
    a. How do you **receive** the information/data from your stakeholder?
3. What is the improvement needed for the 'sad emoji'?

Validating the network map (Joris, Marteen, Solco)

1. Asking if there is there information that is not correct

Physee Academy (2')

1. What do you think the input that the stakeholder will share to you?
2. If there is Physee Academy, what are the things you want to include (think of information) to help your work?

For Joep & Joris: **NSG Training (4')**

What do you think is the challenge in the NSG Training at the moment?
How can it be improved if we have the Physee Academy?

Closing (3')

1. Do you want to add/share something regarding the communication and network?
2. Provide a contact for external stakeholders?
3. Thank you for your time. If you have any feedback or idea, please let me know.

Appendix E

Internal Interview Data Analysis
(How to code, Root cause analysis, Findings)

The participants are selected based on the archetype below. The interview is conducted for the Archetype 1 and 3.

Due to the limited Dutch language of the researcher, the role play is conducted to understand the Archetype 2. Archetype 2 is the target user who are working on site and not used to use a computer/online interview to work with. The role play is conducted with Execution and Support team because they work with them most of the time.

Atlas.ti
number of coding:

	E&S	M&LG	NB	P&P
	53	7	15	4
! 18	13	1	3	
:(32	20		10	1
Insight 3		1	2	

! = need
:(= pain point
insight

Colour coding (MIRO board)

Marketing & Lead Generation

presenting new solution

" it's very hard because you talk to people and present and present new solutions. You have to have a big reach and just by simple email, like like we updated our product. You don't get the message across so you need to speak to people present to people say" Tim, RED

Presenting new solution means to update the information to the client, but Physee has no updated data yet

can not show data yet

"Yeah, I think there's a lot going on. I mean, we, we used to say, we used to focus a lot on power generation. But now we say, we're not we focused only on data. But we can't show any data yet. We don't really have anything to prove yet." Maike

share to different target user

"Yeah, so we have a three target groups, right. And I mean, it depends, we share information for two reasons. One is brand identity, and the other is sales." Maike

Needs:
1. Determine the product naming or package
2. Clear benefit and value

Partnership & Pricing

large company is scared to work with small company

"Given a very young company, a new company, it's really key that we make a really good impression the first time. And the first thing you notice, is a bit of a cliche. But especially because we're working with very large corporates, they find it a bit scary to work with companies that are deathly young."

help client to get the full understanding

"is they're interested, but they always find it difficult to really understand what the product is about. Okay, right. So to really get to the full understanding, I think that's, that's something that they really need to help them with."

New Business

ROOT Cause Analysis

36-37 projects pipeline

RED hard to understand technical perspective

Unattractive business case

Too risky technology

No incentive to apply the technology (lack of subsidies or no demand for this technology from future building users)

It is important to present the data for what stakeholders are seeking for

show the certification

Unclear proof/data

how can they reap this benefit

Unclear whether Physee's technology will increase the building value

Investor

energy certification (to make a higher value asset to the RED)

Improve RED business model

comfort increase

Unclear data hinders the decision making

Physee not able to provide the real benefit because it is under development product

Pre-scan tool

trust issue

developers are hesistant

because

Don't understand the benefit

because

energy saving is not enough to show the benefit

Intangible benefit

unclear benefit

"The main challenge, I think the main challenge is that the product benefits are not 100% clear" Nietin

Benefit that is not clear:

- why sensor in the window
- pre-scan data
- comfort

Needs:

1. Giving attractive business case
2. Clear technology explanation
3. Show number as the evidence
4. Know "What is comfort?"
5. Clear benefit information for Physee and for the client

Design challenge:

1. How could we show the value of our technology in more persuasive?
2. How might we prove that SmartSkin is not a risky technology?

Execution and Support

ROOT Cause Analysis

Misalignment client's expectation

so

Underestimate by client

Delay

so

Don't know what will happen in the project (future context)

so

1. The project was underestimated by the client but they don't know what will happen in the future.

Professionally come when Physee can meet the client's expectation

More hours spend

so

Going to the site to check manually

so

negotiate the contract

so

Less professional

Needs:

1. Clear information
2. Guided manual

3. Standardization
4. An integrated drawings
5. Clear Responsibility
6. Better contracting
7. Providing foolproof equipment for processes on site and reduce interface between project stakeholders.
8. Keep update the standard of the SmartSkIn within the company.

9 Need a way to access the information in more efficient way

10. Stay focused (not getting much question on site)

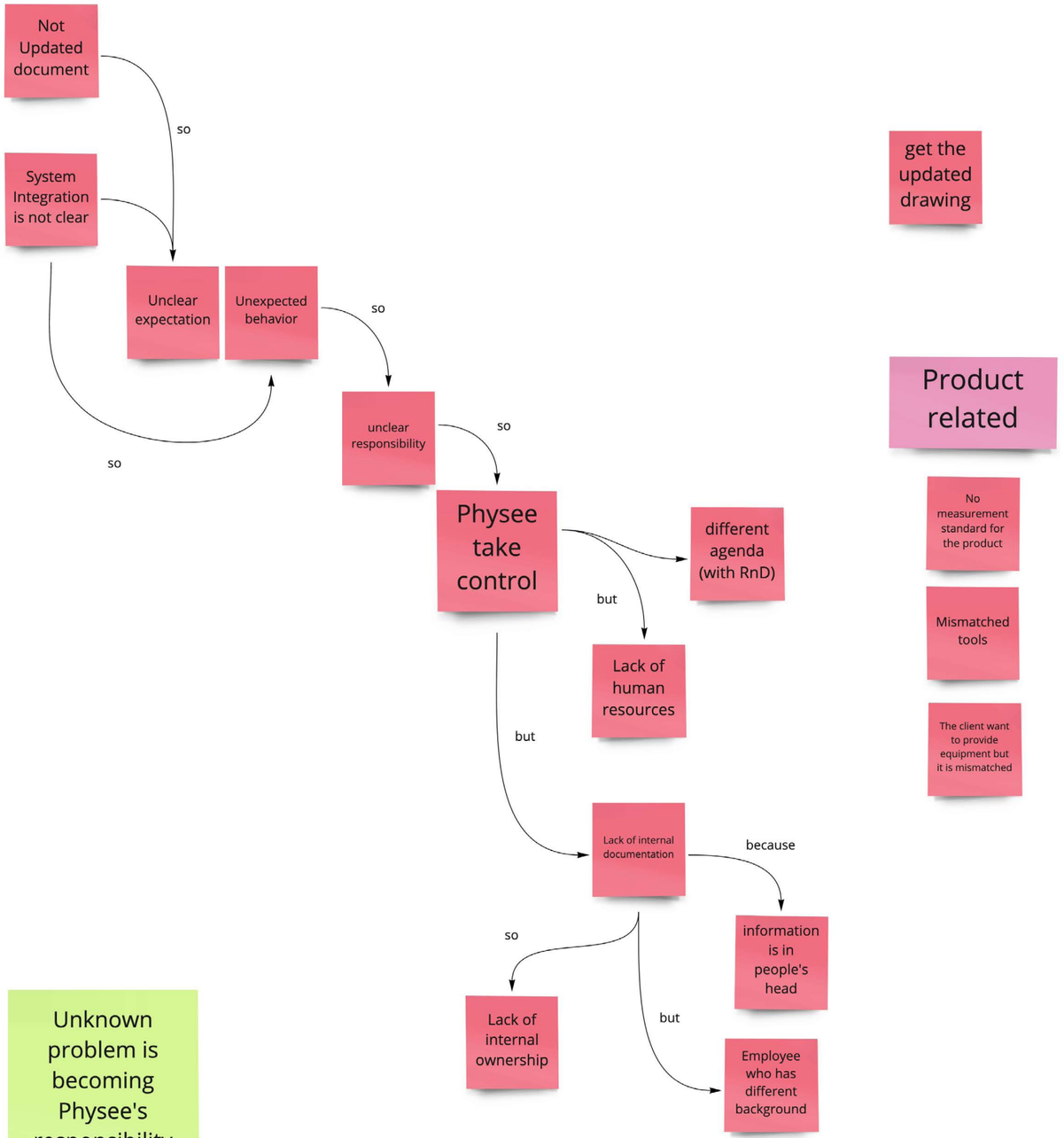
Design challenge:

1. How to solve the problem onsite?
2. How to find their information on site?
3. What kind of standardization that can solve the problem?

encyclopaedia FAQ

booklet

Knowing our system means and how we reach a well working system



Information is not well-documented. at the same time there is a limited human resources to fix the problem

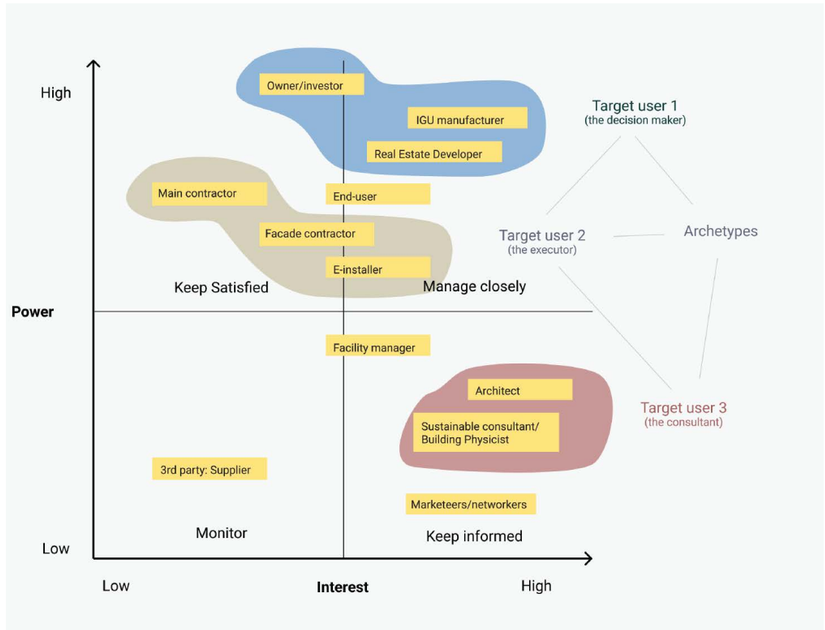
Appendix F

External Interview Data Collection (Participants, Interview plan & guide)

Participants

The participants are selected based on the archetype below. The **interview** is conducted for the Archetype 1 and 3.

Due to the limited Dutch language of the researcher, the **role play** is conducted to understand the Archetype 2. Archetype 2 is the target user who are working on site and not used to use a computer/online interview to work with. The role play is conducted with Execution and Support team because they work with them most of the time.



Pilot interview

Role	Name	Experience		Date of interview
Building contractor	Monica (26 y.o.)	Ex-construction project management for 3 years in Jakarta, Management student, TU Delft		29 March 2021

Role	Name	Experience		Date of interview
IGU Manufacturer (NL)	Jaap [redacted]	2 years in Pilkington, NSG as an account manager. First time doing a project with Physee	Confidential	Friday, 9 April 2021
RED	Tim [redacted]	2 years in COD as a project		Tuesday, 6 April 2021
Architect	Feyza [redacted]	Architect (BSc, MSc.) Work in comfy 5 years		
Building Technologist	Kitty [redacted]	Adviseur at abt		9 April 2021
Building owner				
Facade contractor	Roleplay with Stijn (ex. Facade constructor)	Had not working with Physee		Tuesday, 30 March 2021
Main contractor	Roleplay with Stijn (ex. Facade constructor)	Had not working with Physee		Tuesday, 30 March 2021
E-installer	Roleplay with Joseph	Had working with Physee		Friday, 2 April 2021

addition:
Jackson, architecture master student at TU Delft, 2 years working experience in China
Fangxiang, architecture master student

External Interview Guide
45 minutes semi-structured interview

5 min

Introduction

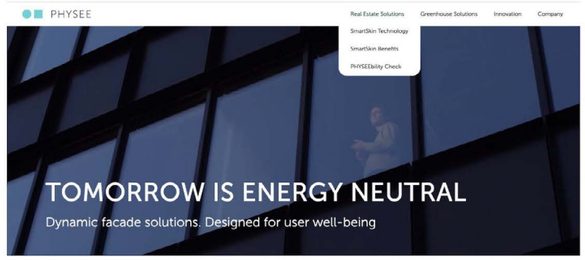
20 min

The interview will cover 3 topics:

1. Their understanding of SmartSkin 2.0

2. Knowledge management

Know what is the missing info about SmartSkin

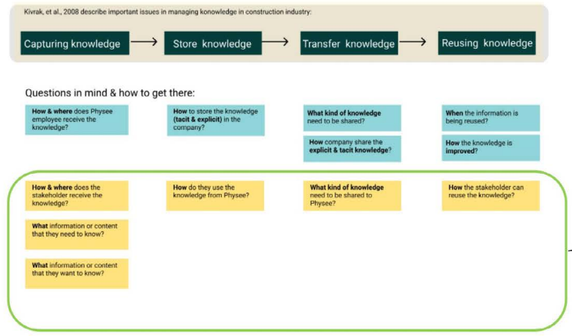


Usability test

for someone who don't know PHYSEE

Usability primarily addresses tangible and explicit knowledge. It has little to say about the implicit or intangible.

Know how they behave on the knowledge management



HOW?

Asking these questions

- capturing
- store
- transfer
- reuse/share

Know how they can/want to contribute to the knowledge in the ecosystem collaboratively

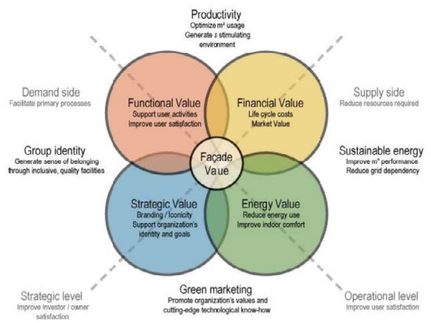
Collaboration

15 min

Goal

3. Understanding the stakeholders' value

Know what is the HIGH TECHNOLOGY FACADE value that they concern the most and the reason behind it



HOW? card sorting is used to probe someone to talk more

card sorting

Show 4 cards about Physee value in functional, financial, strategic, energy.

A card sorting session also offers a structured way of identifying current knowledge deficiencies. (https://www.steptwo.com.au/papers/kmc_usability/)

5 min

Closing

Introduction

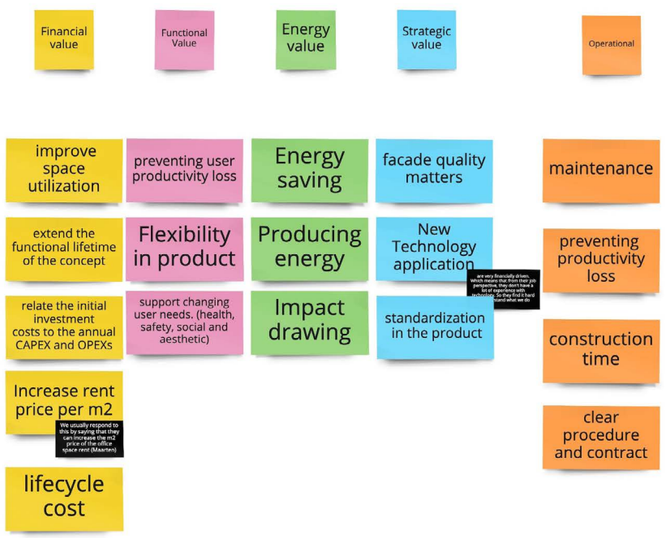
Happy easter. Introduce my name and role in Physee. Goal of the interview.
All information discussed between us is confidential. We will only use it for academic purposes.
• If during the conversation, something is unclear, or you have any other questions please don't hesitate to ask.
• The complete 'activity' will take around 35 minutes and have 2 activities.
It is a casual interview so there is no right and wrong answer.
• Before we start, we would ask your permission for us to record this call

Could you introduce yourself a bit?
What do you know about (SmartSkin at) Physee so far?

	New people	NSG (training session)	People who had worked with Physee
Topic	Have you ever go to our website? discovering Physee website for 5 minutes	1. What is the difference in the information that we give compared to the other glass offering that you know? 2. Give a score of our training 1-10. What can be improved? (probe : time, quality, media) 3. How do you expect to know further information besides presentation? Why?	1. Let's talk about your project experience: What makes the project of the facade become challenging? 2. How do you usually learn/approach a new (facade) technology in your work? 3. What are the challenges to learn new technology in your work? What can be improved? 4. How do you expect to know further information about this technology? Why?
capturing	1. What do you know about SmartSkin at Physee so far? 2. What are the confusion? 1. Did you capture new information regarding your knowledge about Physee? 2. How do you see the clarity of the SmartSkin information on our webpage? 3. What is the difference in the information that we give compared to the other glass offering that you know? 4. How do you expect to know/learn this information? Why? Is it by man, robot, video, booklet? 5. How do you expect to know/learn further information? Why?	1. .How do you usually learn new technology in your work? 2. What are the challenges to learn a new technology in your work? 3. What are the main barrier/risk that you can think of when you get to know a new system or new product in the project? 4. How do you usually store the information about a new product or service?	1. Tell me a bit about your work-related with SmartSkin in Physee? 2. What is the difference in the information that we give compared to the other glass offering that you know? 3. How did you capture the information about SmartSkin? 4. How do you communicate the information of SmartSkin in your team? 5. Give a score of your experience understanding our technology (1-10). What can be improved?
store	6. What are the main barriers/risk that you can think of when you get to know a new system or new product in the project? 8. How do you usually store the information about a new product or service?	6. How do you usually share the information with your colleague?	1. What are the challenges when you worked with Physee? 2. What positive feedback that you want to convey to Physee?
reusing/sharing	9. How do you usually share the information with your colleague? **10. How do you finally decide to use a certain supplier/partners?**	7. How do you finally decide to work with a certain supplier/partners?	

Collaboration

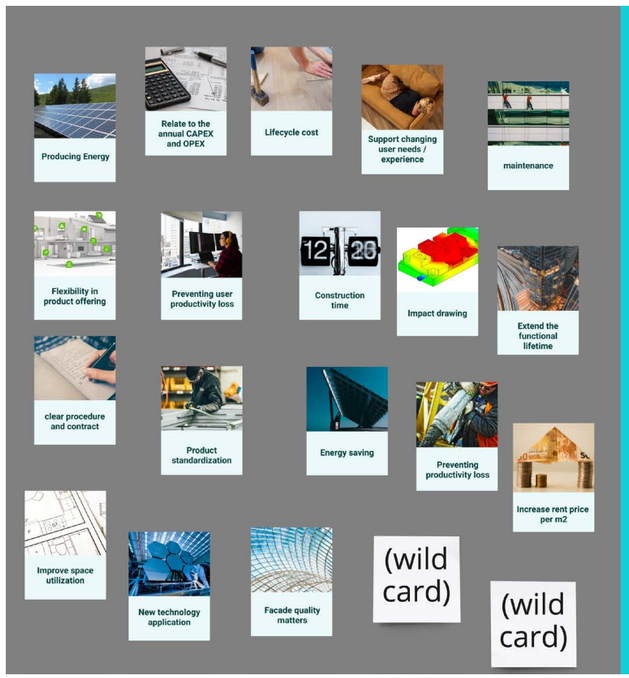
1. When do you have a good collaboration with a supplier?
2. When do you have a bad collaboration with a supplier?
3. How do you typically collaborate with supplier that you have not worked before?



Question:
Imagine that you want to work with a **high tech** facade glass supplier.
1. Related to job/role: What is the 3 most important factor that you want to know from our offering?
2. What are the 3 least important factors for your job?

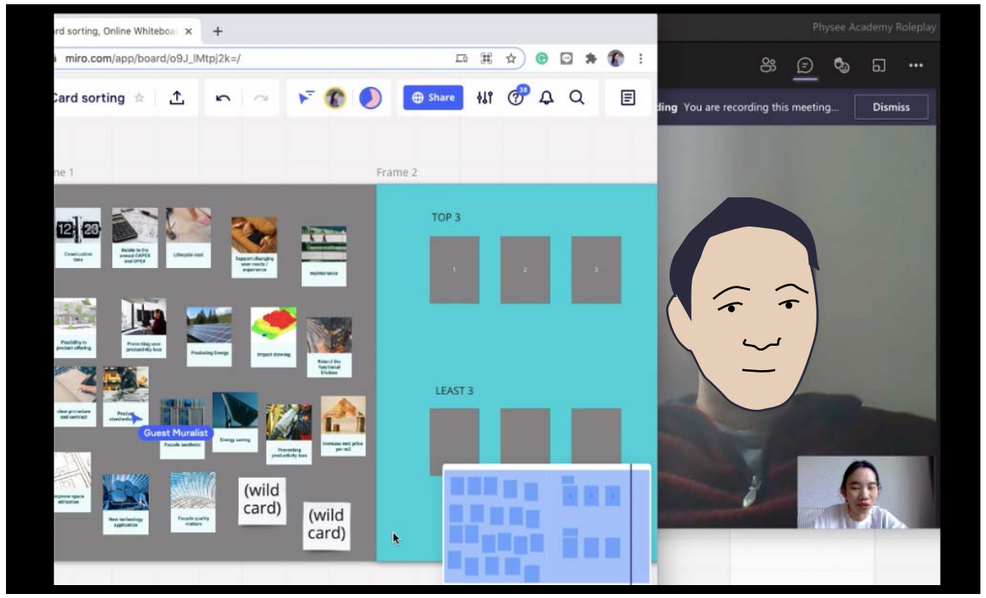
https://miro.com/app/board/o9J_lMtpj2k=/

translated into the cards with visuals



Closing

1. Thank you for your participation.
2. Do you have any questions?
3. Do you want to keep updated on our project?
4. Do you also interested to participate in the testing in June?



Card Sorting explanation:
Card sorting is a method to get know the stakeholder's preferences easily. The cards consist of images and description. Each participant need to sort the card based on top3 and the least 3 important.

Appendix G

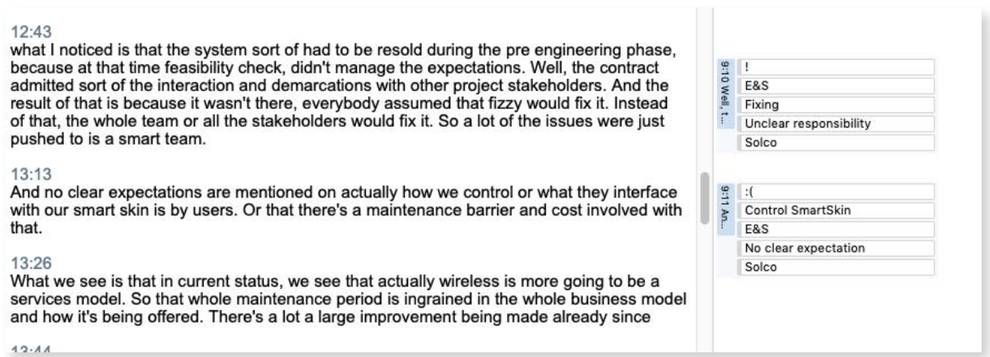
External Interview Data Analysis
(How to code, findings, affinity mapping)

Data analysis

How to code

1. Using Atlas.ti to code the quotes

I used Atlas.ti because it is helpful to code the quotes in organised way. When I want to look it back, it is also convenient to type the key words on the search panel. The disadvantages of these platform are: not integrated to the other platform, needs more knowledge to learn.

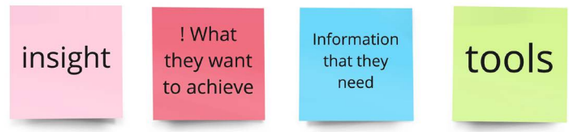


	! 19	:(4	information 30	insight 19	tools 5
architect 11	2		8	1	
BP 13			9	6	
e-installer 10	4		3	2	1
facade contra... 4	2		1	1	
IGU 7	3	1	1	3	
Investor 2					
Main contractor 13	2		3	5	3
RED 18	6	3	5	1	1

I conducted data re-analysis on MIRO and categorise the findings into 4 type of coding: Insight, What they want to achieve, Information that they need, and Tools.

2. Copy the quotes and the label to MIRO board. Compile it to the knowledge and insight map

Quote coding



Stakeholder codes

Real Estate Developer (RED)

Tim, 27 y.o.
Work for 2 years in a Real Estate Company

About the interviewee
Tim works in a Real Estate Developer company based in Amsterdam. The company is active in four big cities in the Netherlands. They develop all kinds of buildings, mostly residential projects, office developments, and hotel developments. The company consists of 10 people, and they are one of the largest real estate developers in the Netherlands. Tim had several discussion with Physee about the technology and how it works but has not done any project with them yet; his work focuses on a residential building. He is interested in the new facade technology.

Summary of RED interview
Facade is not a big challenge in the whole project of RED. They really open to the innovation. The consideration to choose a facade is cost efficiency, and they also consider the number of material used in the building. They also really dependant to the investor decisions.

Physee is align with (their) company vision

"from my perspective, and also from [our company], we have to go to enable to imply new innovations in tomorrow's buildings.... But from a normal developers perspective, the new solution has to be cost efficient, and there's to the better solution than we have now."

"We have to initiate new unit initiatives that are more sustainable. And the end investor should take it anyway. Because we think this is our vision and we want to make this sustainable building".

open mindedness create more opportunity

"But I think as the smart buildings perspective, we are more open minded now, as an industry to view these things as, as good as, yeah. realistic"

background in architecture so know the technical issue

So now the thing I understand that a bit another technical and non technical backgrounds, I have a background in architecture. But I think I know the basics of your censoring and how this connects to the inside and outside into the building building management system

first time to talk with glass company

"So it's actually the first time that we talked about a glass company before it's a strange thing, because we would like to have one person, that's our contact person as a contractor, and he talks to all the other subcontractors such as the glass manufacturers."

get approval from investor

"And the end, investor determines also the requirements of the building"

"Or the other fourth is that we have to initiate new unit initiatives that are more sustainable. And the end investor should take it anyway. Because we think this is our vision and we want to make this sustainable building."

Physee present new solutions

How to understand PHYSEE new technology:

" it's very hard because you talk to people and present and present new solutions." (need to keep update)

update every half year with Physee

Presentation

"I think every every half year that we have Physee. The project has changed slightly, so it's getting better to update story. But now we're just just by just by presentation"

which is complex and new

"It's hard because like, the technology is so complex or new. In the beginning, it was. And in the beginning, everybody understood the I think the technology everybody understands. So putting solar panels, solar panels is common. is a common ground now. putting solar panels in the inside of a window

good business case

believe that SmartSkin is real

financial

"But is it is it I think, after five minutes of explaining your project, you want to talk financials. So yeah, that understanding is crucial."

Sustainable measure by government

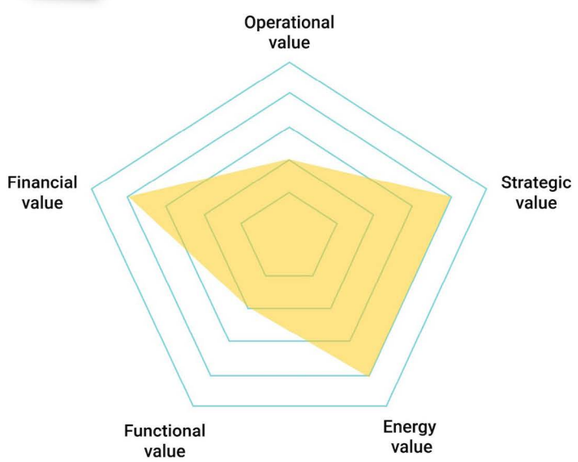
viability

"But if I look at the project, I'm on now that that facade is not really a challenge, it's, you have to choose, mostly the the ideal combination to obtain the sustainable measures obtained by the government. But it's very strict actually in Amsterdam. So we are trying to figure out what is the best facades, also the most cost efficient for which we can. "

financial gains, the sustainable gains, see what it costs, and then we can make a revenue decision.

choose material for architecct, building physicist, residential

And to lay, let's say, the business case, or a new proposal in a really concrete form. So we can say yes or no, takes quite a while to become there to get there. But think now with your brochure yet you are making you're getting that fixed. Because I think that's the challenge for smart building partners is to, because everybody's busy always to really, in the short time, see what the product product is what it is, like, see the financial gains, the sustainable gains, see what it costs, and then we can make a revenue decision.



TOP 3


relate the initial investment costs to the annual CAPEX and OPEXs

influence on sustainable scores (BREEAM, BENG)

Energy value


facade quality matters


Producing energy

LEAST 3


preventing productivity loss


standardization in the product


extend the functional lifetime of the concept

Insulated Glass Unit (IGU) Manufacturer

Jaap
Work for 1 years in the building glass, before was in the automotive glass at the same company.

About the interviewee
Jaap is a sales from an IGU Manufacturer. He and other sales from other branches (NL and outside NL) are working with Physee to resell the technology of SmartSKin. He follows the SmartSkin training session.

Summary of IGU interview
The interview mainly discussed the training session with Physee. He felt the online session is easy to follow but less interaction and less opportunity to ask the question.

SmartSkin is an eye opener

"Because I think you Like smartscreen and technology application number one's very interesting. For me, it's an eye opener. "

good collaboration is clear, information out changing

good collaboration is reach the same goal

Used to work in glass for automotive before

Need to learn many thing about glass

learning time is long

write down FAQ

"So that is what what standing out and in the future, we will, we will get in touch with these customers. And for me, it's very interesting to have this discourse first. But there are a lot of lots of loose ends. So it's not for me a total package that I understand and that I have to bring on with with a new customer. So I have to, to learn more. First,"

So, to get more feeling about this and when you have constant conversations about these projects with with customers or with people they say are calling with questions and some questions you can seek it up and come back with with answers and some questions I have to do to get in with you".

Relation to architect is not that direct. They only contact the IGU if there is a question (e.g. about glazing)

too much participant create less interaction which leads to limited question

50 people versus 1:1 in other company

interactive session

"I have to discuss with our product manager of this, of that product group. One on one session. Now, it's more interactive. And that's the thing that is of course hard because it's very practical to get on site with 50 or 60. Colleagues, an interview or another interview training, yeah, but it's not that indirect and there are some some possibilities question of words,"

phone

discuss

"And I get to waste my time also more with respect to time at to get in touch with colleagues conversation about and that is the learning process there are things that at that point, they are not clear enough for you getting the info not not directly and later on there about this subject maybe call a guy of Physee or maybe a college of mine, call, how does it work? Again, we go into depth in this moment of that subject"

get involve with the customer

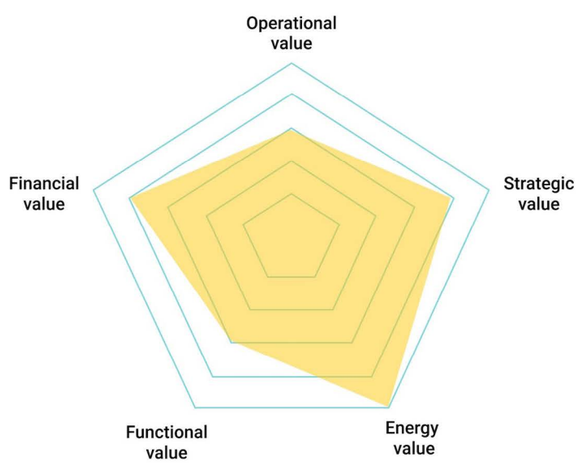
want to know customers' reaction, needs, and insight

technical

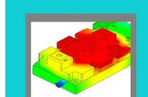
clarity, good communication

same goal

"when there is clarity, where there is information out changing. Whether is good partnership, of communication so when you reach the same goal, it's not in total time of course, the same goal, but something so called samenwerking . To be honest, to be clear, to be the ones to help each other to getting some timing make out of there."



TOP 3


Impact drawing


New Technology application


lifecycle cost

LEAST 3

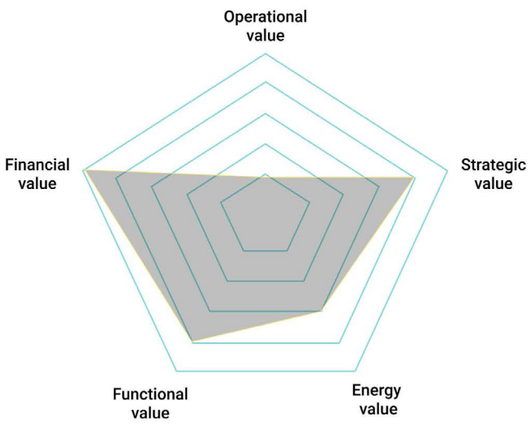

facade quality matters

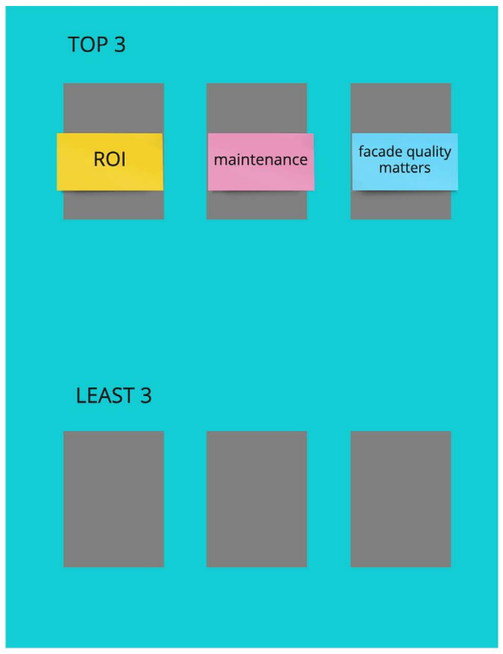

construction time


maintenance

Investor and/or Building owner

No interview was conducted. the data is based on other stakeholders' assumption.





Architect (AR)

Feyza (3x y.o) & Jackson (29 y.o)

About the interviewee
Feyza is a technology consultant but she has experienced to be an architect. In addition, to validate the thought, I also interviewed Jackson, an architect in China and studying in the Netherlands.

Summary of Architect interview
The architect has an idealist mindset. They have their own value for their design. It is essential to nudge them what is Physee can benefit their needs.

Self motivation of sustainability impact the choice

"I will partner up with the companies who are also more into meeting these standards as well."

aesthetic impact to building

Variety of end product (offering)

" in a sense that if it's a product offering, so do I have a wide range of opportunities to consider? Or am I somehow supposed to make a choice?"

technical detail

"Maybe it's also how my brain works. Also, you know, to know more about the technical details as well, but it's so the first introduction is more conceptual."

system integration

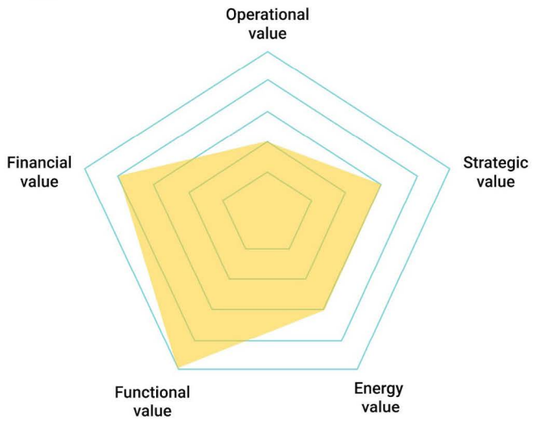
"n, because I will let the sunlight in instead of blocking it. But I mean, I'm just curious about, you know, how the people will be will have the freedom to control it individually as well. Okay, so these are the things that I'm thinking about? I mean, can I use any type of blinds? Any type of fabric material, any type of motor and control? With this system?"

how to use the tech in the design

"so do I have a wide range of opportunities to consider? Or am I somehow supposed to make a choice? Or not make it or simply, it's about that? Is this one product that I need to have to, you know, stick to? Or do I have a wide range of opportunities? In this sense, with your technology? It's one product, but as I told you, does it offer me other possibilities?"

how to use

" it's a very interesting product that I want more about. And as I told you, the conceptual part is raising em quite a lot of interesting information. And I'm curious about it. I want to, I want to have some more information. "



Jackson

Sustainability is an additional value

Jackson

There are some type of architect. If they care about technology in their design, they will choose high tech"

how impact is measured

"let's say I am using in my home, let's say 100 units of tourists that are very much interested about how they store 2% is measured. I mean, like claimed."

how it works

check the (green) standard

"Because of all the standards and accreditation that you have just stated here. If I'm an architect, and I'm designing an office building, and if this office building is going to is being expected to meet these brand standards, or well standards, then I will be, you know, happy to see it. Because with this technology, it's also possible to reduce the energy and also control the blinds automatically, then I will be interested to see while using it, if I can meet these standards, okay."

Building Physicist (BP)

Kitty, 43
Sustainability consultant

About the interviewee
Kitty is a sustainability consultant in a multidisciplinary firm that focus on the knowledge areas of structures, civil engineering, engineering, building physics and installation technology.

Summary of BP interview
Kitty has not know anything about PHYSEE. She had know some principles of smart glass. When she discovered the website, she hardly find the technical details and benefit details of SmartSkin.

expecting the smart glass principles

there aren't a lot of real products on the market

more info = more real

"the information that you get is more like possibility studies or so in every situation, the information that you get is quite low. And also the specs are not clear. Like here, you don't have to do the amount of power that the PV can generate, or the electricity gain that you can get with glass."

"So I was making smart skin I was expecting like, a lot of different, different different options. So maybe I was just expecting the wrong thing. Okay, because all those smart glass principles are already used that the word smart for glass has been used for a lot of time, a long time now".

Is it fixed or dynamic coating?

skeptical because less info

"I'm also quite skeptical about how how to use it, you know,"

why involving end user?

what is the benefit

"But the other data I didn't get really good like you generate data in which the users can understand how much energy they use, or how much energy to the glass gains. Yeah. And why? Why do they want to use they want to know that? What's the benefit for that? Maybe I should go to smart skin benefits".

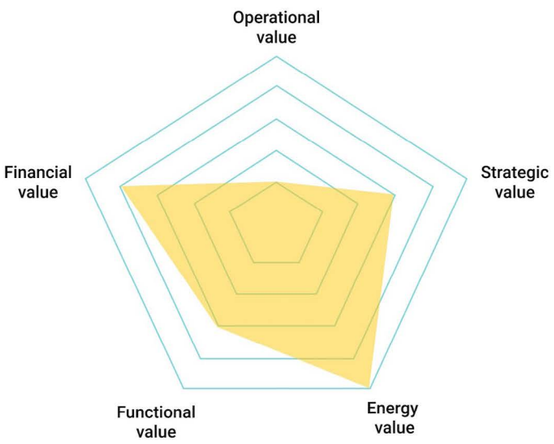
Technical specs

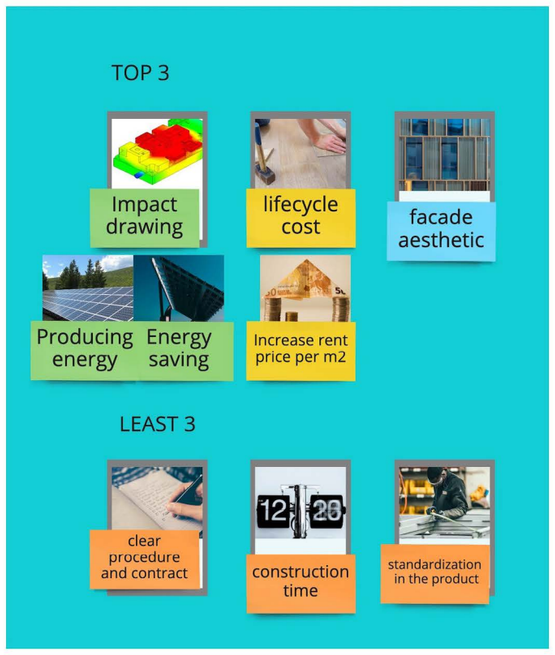
Type of building

" I cannot get the information that I would need to see if it's actually usable in the building that I'm, for example, working on. While not getting those specs on mine.... So I would rather have much more technical details before using it".

how much energy it generates

"Okay, it could be interesting to have that smart technology and I I like the idea of the Sun shading. I think that's very interesting. And that's something to keep in the back of my mind. But I would, I would not the electricity gain that's not specified for me".





Facade Contractor (FC)

No name (Role play by Stijn, ex-contractor)

About the interviewee
The Facade contractor is mainly working in the field.

Summary of FC interview
FC wants to get things done. They know different ways to construct the facade. However, with the cable on the SmartSkin, they need details and information. They are open to working together on how to install the facade.

want to know everything

want to know available data

Because the market is always changing. And we want to show that the data that main contractors can always reach out to us that we're not standing still. I think everybody likes to do a fancy new technology project every once in a while and we want to be included. We also like to learn but not too much. In a project we like to do it step by step"

Get things done smoothly

"I'm very afraid that the product doesn't work after we install it. And the main contract is very strict to us, because we have to close the sale at a certain time. And then if the windows don't work or break, then we have a problem with because we need to order them again. And then we do not close for sale on time. And we ended up in a fight with a main contractor. So I really want to see some documents where they state that this product is qualified. And also, yeah, isn't sensitive for failure or breakage."

mock up session is important to test out the product

"We have seen in the past dealing with new project that they find something out later, and that we have to open things up again. But we didn't calculate for all this work towards the main contractor. So we are making a lot of course we're not getting paid. And that's not something we desire."

If they deliver on time, but I think everybody says that also, when they are open, so when they share their programs, and also if if they are delaying that they let us know on time. And also that they are helpful to solve solutions to problems. So if we are facing, we're dealing with a product on site that doesn't work that they also help us to get it working again"

more detail information

Data sheet

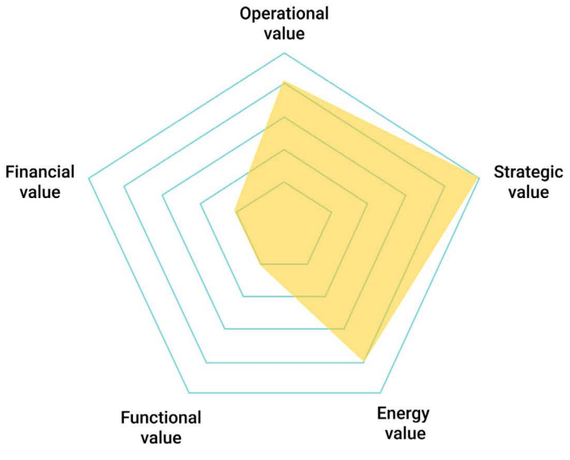
" ly will ask more into detail because I need way more information. So for example, the datasheet is not enough. I want to know everything."

more than data sheet

" I see in the data sheet we received, there's a cable coming out of the corner. I'm a little bit confused, because they're now also talking about wireless. But for this project, we have a cable. And this is very difficult for us, because we have to make the facade waterproof. But we have to run a cable through it for every windows. So I would really like to see exactly what this cable is and how it's going inside. And maybe we should. Yeah, I would like to see the product and maybe also build it one time in a mock up session together with"

part of portfolio

"if it's different for every profile or every window, then it will cost us a lot of extra money. So the more standard the better. And finally, I would like to know, because we are also doing this project as well, we also part of our portfolio."



Main Contractor (MC)

No name (Role play by Stijn, ex-contractor)

About the interviewee
The main contractor mainly work in the field. They are really dependant to the facade contractor.

Summary of MC interview
The main Contractor wants to get everything done. They are not familiar with working with Physee, but it does not matter because they listen to the facade contractor. They are happy to work when the guidance is clear.

Contract makes the responsibility clearer

"I would like to see a little bit more and a little bit more explanation from them that they really can promise to deliver on time. And maybe they should also be included in our contract with them."

work with the party who is familiar with Physee

"I feel mainly handed over to the subcontracted partner part. So like the installer and for safe contractor that I want to see, before I continue with Physee, I want to be sure that they are the respected party, and that they have shown that everything works".

meet deadlines

project portfolio

What is the product

How to install

Energy use

Number

choice is dependent to other stakeholder

"I'm gonna ask my climate consultant to have a look at this website they seem like a professional party all day they also have some projects oh actually follows I know it's next to the highway if you drive to them".

"To be honest, the architect defines everything for us. So we are just executing what is on the paperwork."

Features

practical information

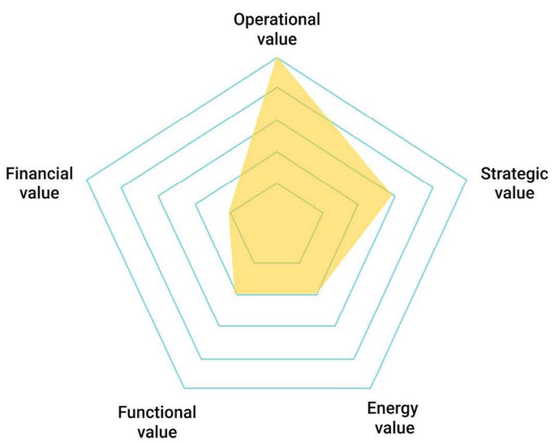
Data sheet

Drawing that can be accessed by some people

Paper work

hiring process, work with same parties

"we always work with the same parties. But we don't talk too much by them. This is always done with the facade contract. Okay. So we just hired a facade contract, and then the facade contractor buys the glass. So we are not involved that much.



E-installer (EI)

No name (Role play by Joseph, a field engineer who is working with the e-installer)

About the interviewee
EI is working in the field. Usually, they are hired by the main contractor to install the cabling system. Because they now need to install SmartSkin, they are hired by Physee. They work closely with facade contractor because their work is dependant and parallel to the facade contractor job.

Summary of EI interview
Their experience with smart facade is limited. Sometimes EI works based on their intuition and experience. If they need to install SmartSkin, which is new for them, they need guidance. They value standardisation.

they see the drawing and execute

Who is responsible? Just ask Physee for new knowledge

"It's difficult for us to know who's responsible for what do we go to the facade installer, or do we go to Physee? Probably, I just call Physee to ask them."

know how to install

" I'm not interested apart from how do I install it and how do I make sure it's working? The rest I don't really mind. I've got to check. Do do the individual windows work? And then once I attach another cable to them, do they work somewhere else? That's That's all I'm interested in knowing I'm not interested in the system as a whole. "

make sure it is working

work intuitively

" I think things are a lot more intuitive. already installed for normal things, normal projects, because we do it 100 times."

need a standard

instruction manual

drawing

responsibility

clear procedure

what do I have to check? How do I have to check it? And what results should I see? And what do I do when I don't find the result? So I do want that's what I mean by clear procedure, installation procedure and maintenance procedure. Which work should I do as well? Which work Shouldn't I do as part of my contract?

So we'd like to have clear instructions. The way that the product is installed is also like, not exactly standard. So, cabling inside windows

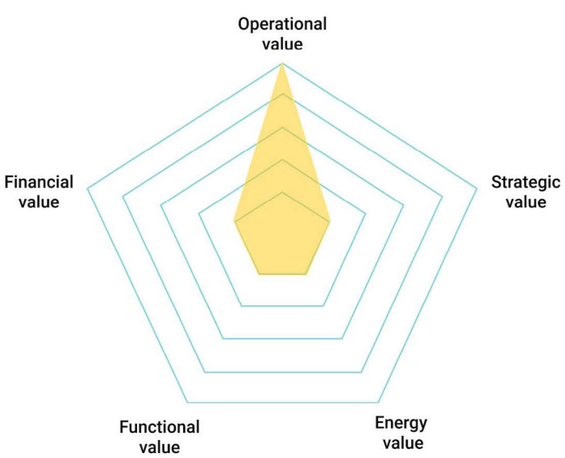
"think it would have to be the product is not something that we used before. So we just don't it's not clear how we're supposed to install it."

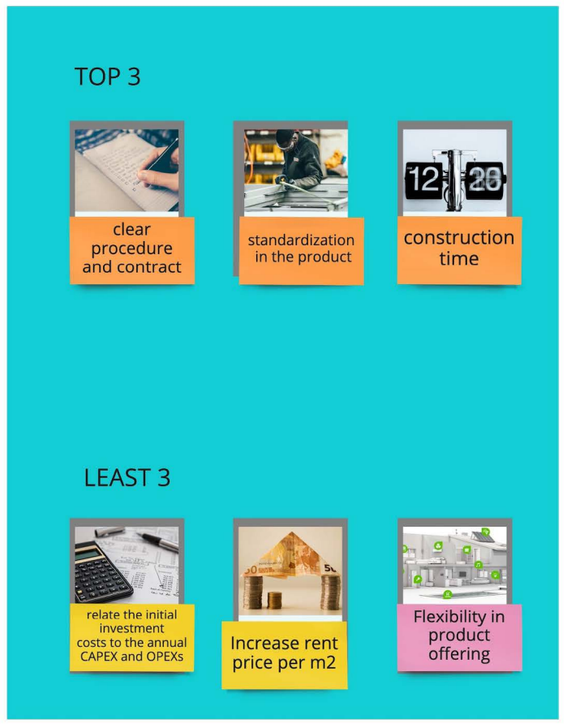
more detail info

Physee technology is not intuitive

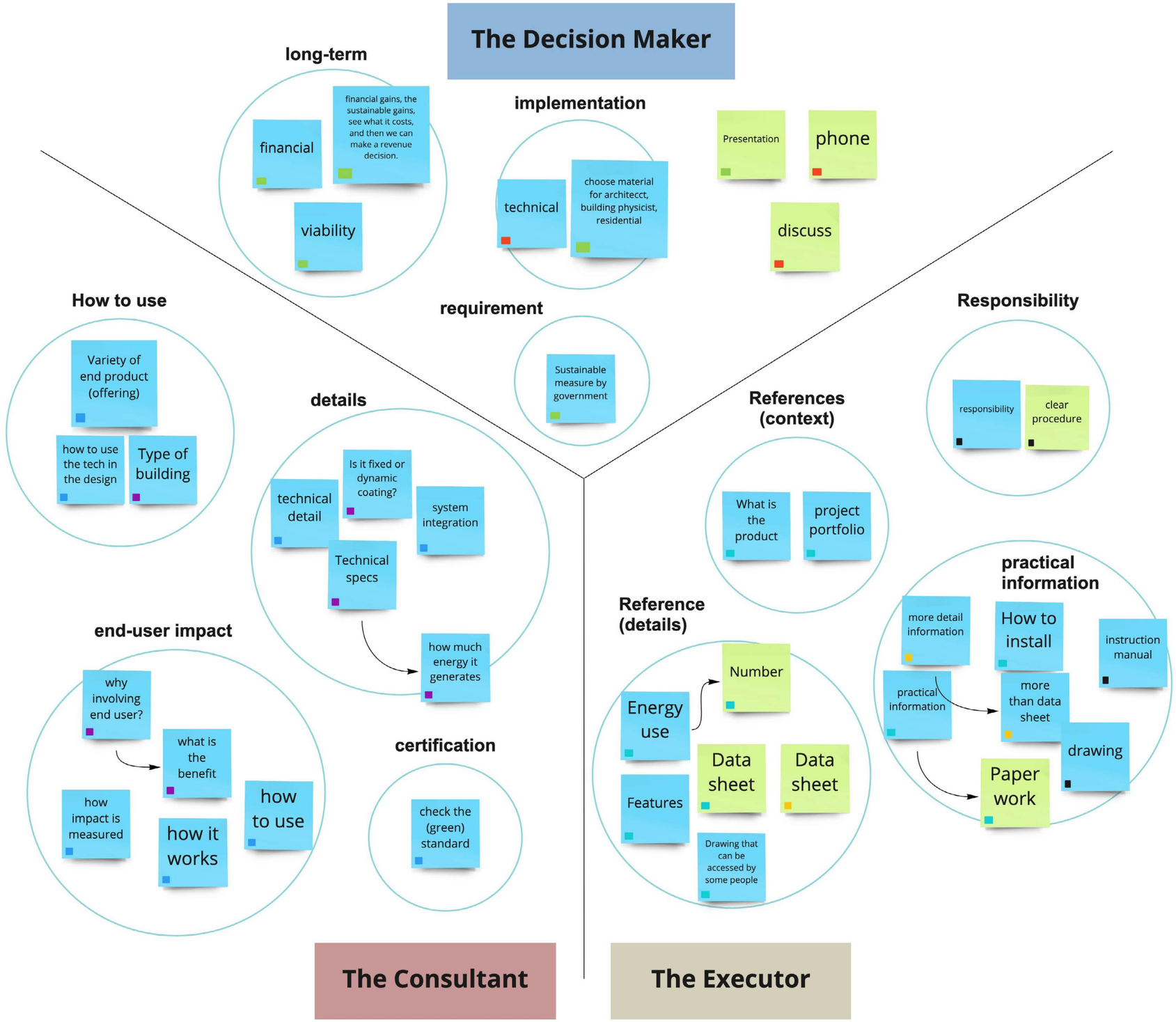
I think sometimes some of the details are not provided, which they should provide.

"But this isn't intuitive then we have to go and look at drawings and maybe drawings are incomplete or we missing you know, slight details."

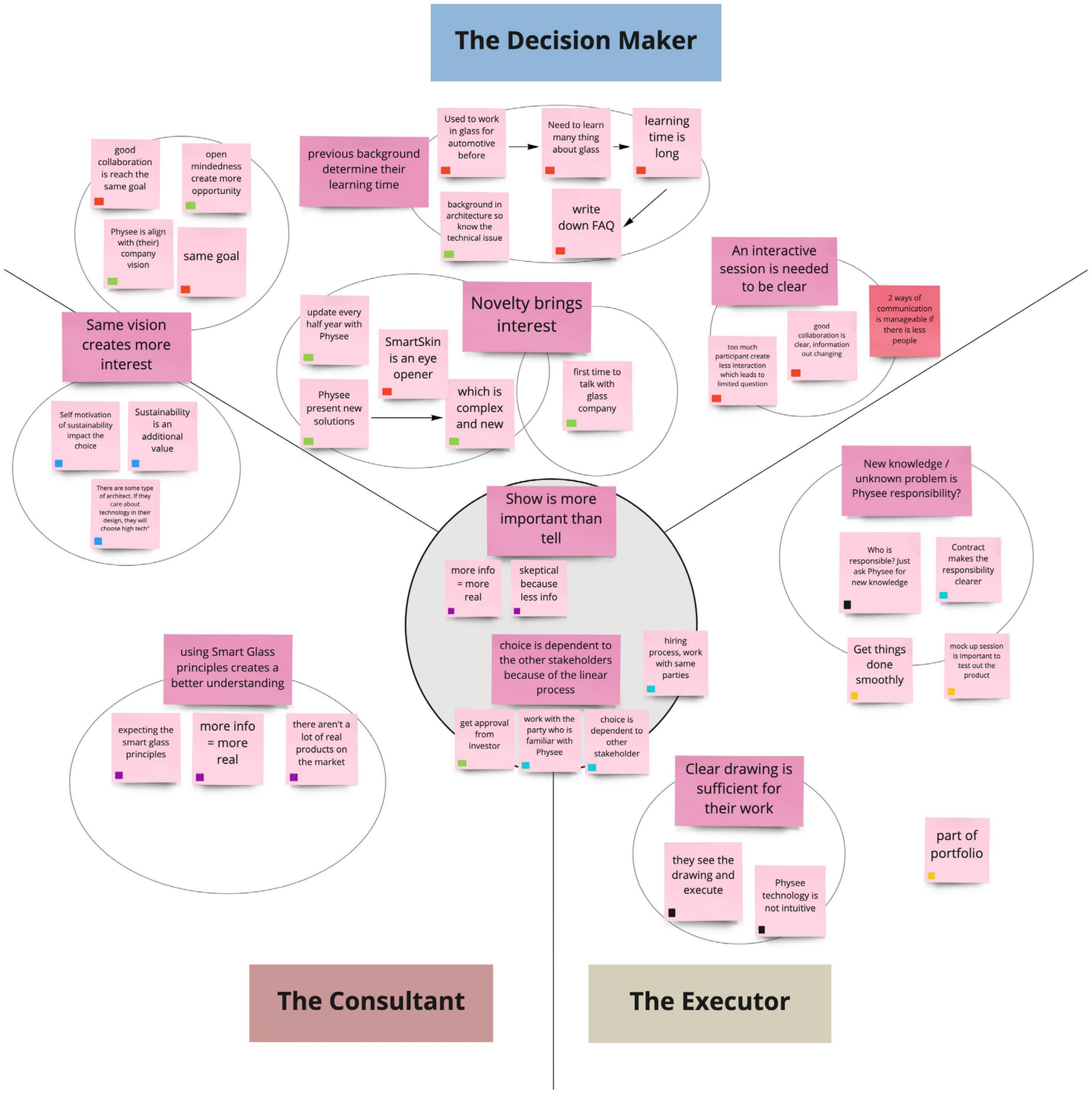




Knowledge Map

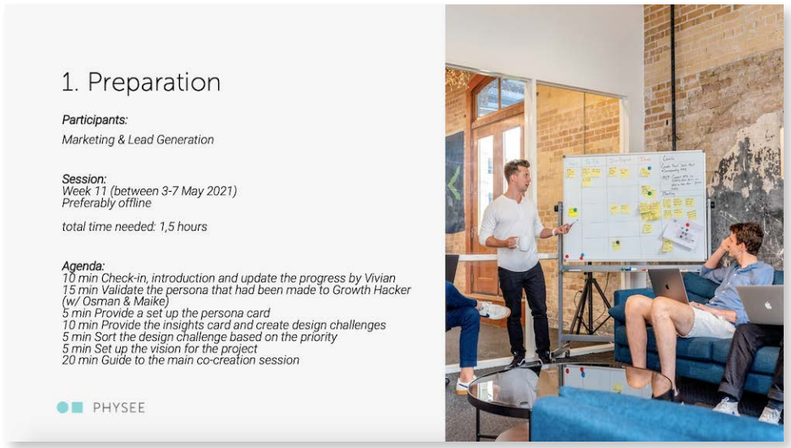


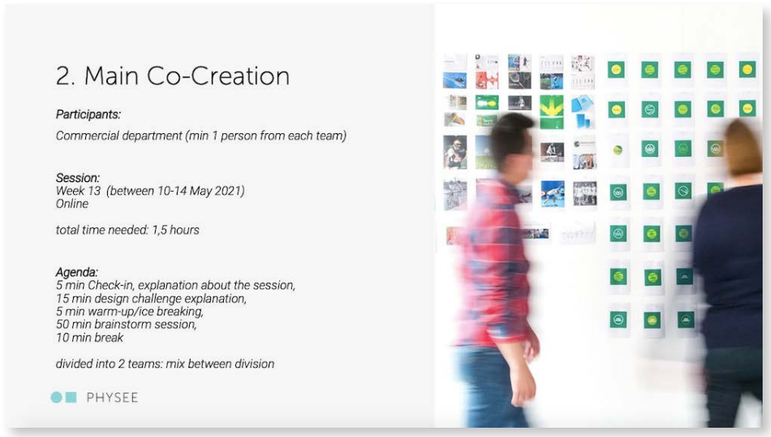
Insight Map

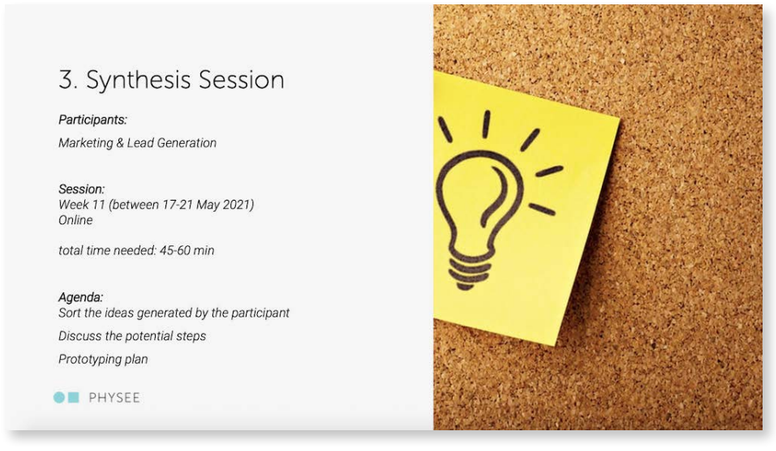

The Decision Maker
previous background determine their learning time
Used to work in glass for automotive before
Need to learn many thing about glass
learning time is long
background in architecture so know the technical issue
write down FAQ
good collaboration is reach the same goal
open mindedness create more opportunity
Physee is align with (their) company vision
same goal
Same vision creates more interest
Self motivation of sustainability impact the choice
Sustainability is an additional value
There are some type of architect. If they care about technology in their design, they will choose high tech"
Novelty brings interest
update every half year with Physee
SmartSkin is an eye opener
Physee present new solutions
which is complex and new
first time to talk with glass company
An interactive session is needed to be clear
too much participant create less interaction which leads to limited question
good collaboration is clear, information out changing
2 ways of communication is manageable if there is less people
Show is more important than tell
more info = more real
skeptical because less info
choice is dependent to the other stakeholders because of the linear process
hiring process, work with same parties
get approval from investor
work with the party who is familiar with Physee
choice is dependent to other stakeholder
New knowledge / unknown problem is Physee responsibility?
Who is responsible? Just ask Physee for new knowledge
Contract makes the responsibility clearer
Get things done smoothly
mock up session is important to test out the product
using Smart Glass principles creates a better understanding
expecting the smart glass principles
more info = more real
there aren't a lot of real products on the market
Clear drawing is sufficient for their work
they see the drawing and execute
Physee technology is not intuitive
part of portfolio
The Consultant
The Executor

Appendix H

Co-creation workshop planning





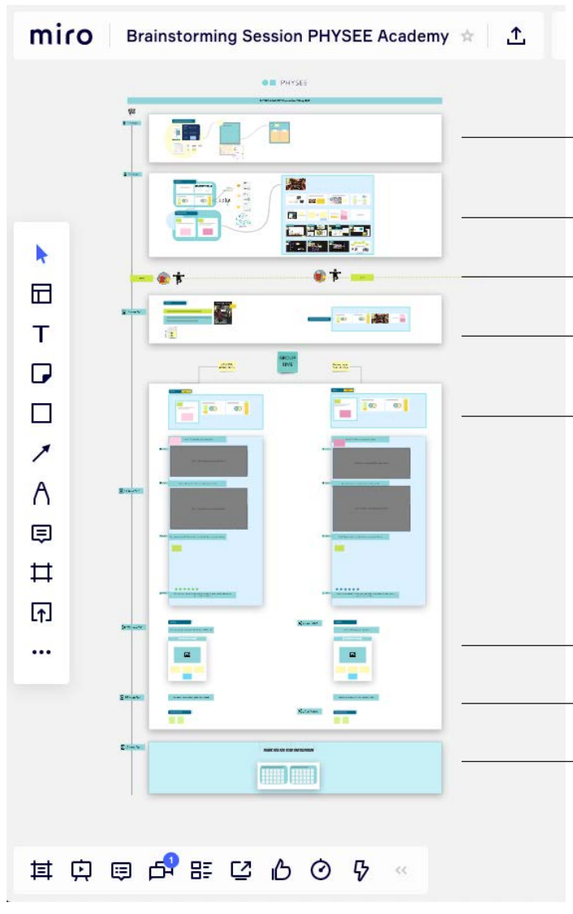


Appendix I

Co-creation online set-up

main facilitator: Vivian
co-facilitator: Osman & Aishwarya

MIRO
https://miro.com/app/board/o9J_lGOouQc=/



Co-facilitator guide

The co-facilitators will brainstorm together with the participant and facilitate the process if there is any question. The co-facilitators will support the participant in creating ideas, clustering the ideas, and guiding the pitching session.

There will be 2 breakout rooms in the online session. People in each breakout room will solve one design challenge.

10 Ice breaking session, how to use MIRO

15 min introduction & briefing

5 min break

5 min energyzer

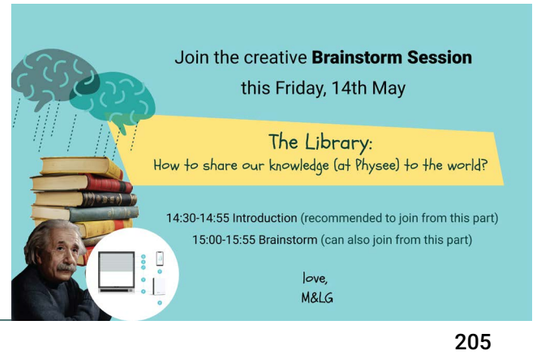
25 min brainstorming (crazy 8, adding analogy questions/ SCAMPER, dot voting)

10 min idea development

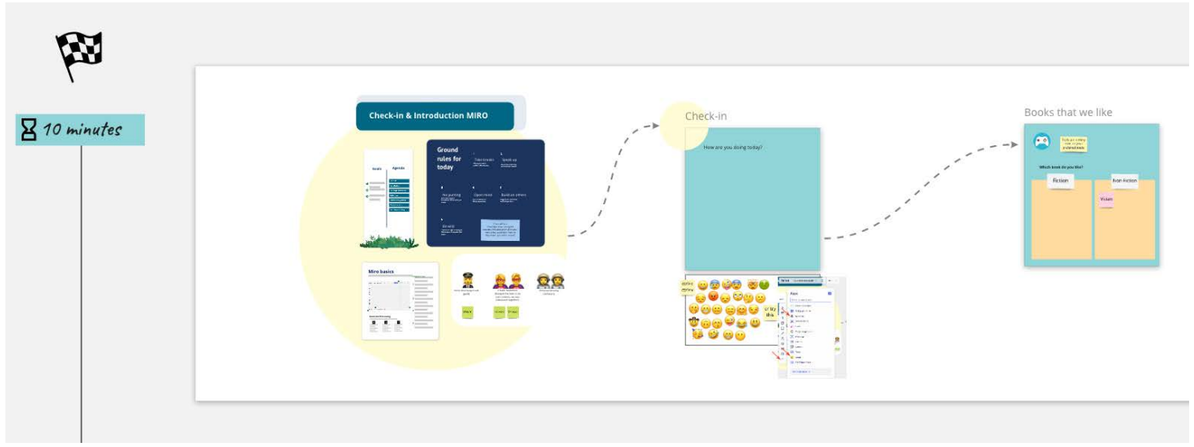
10 min pitching session

5 min wrap up, feedback session

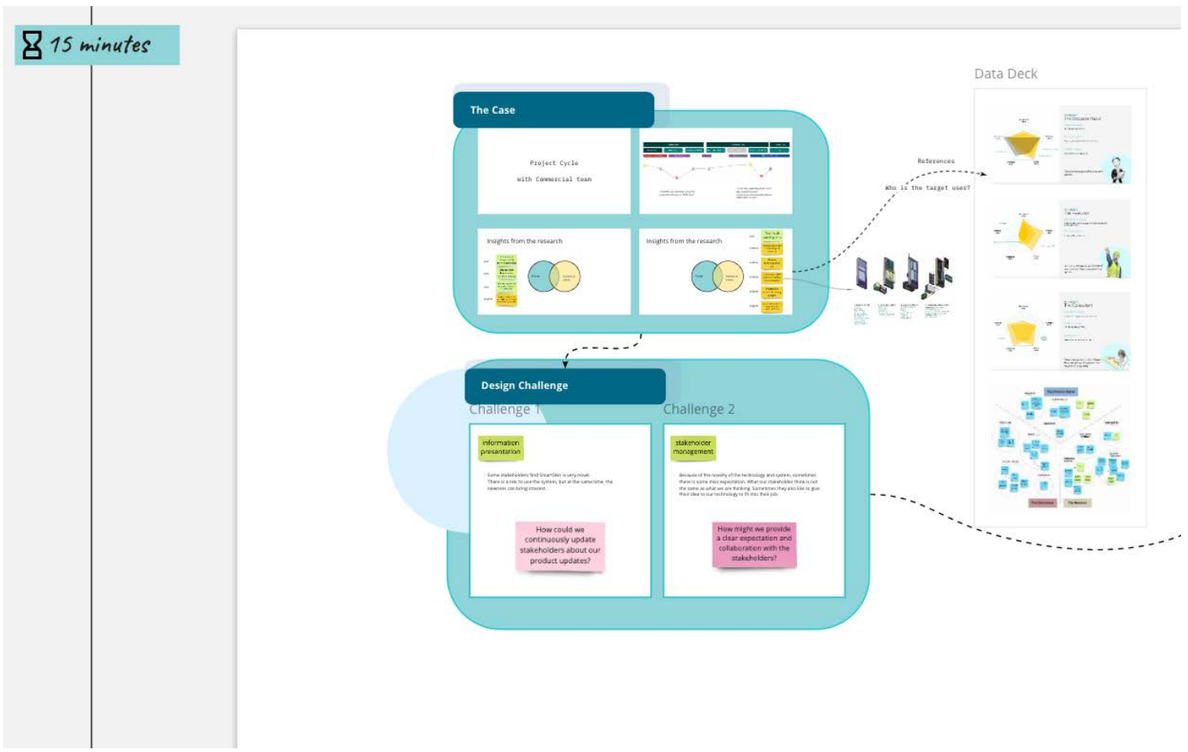
Invitation poster ->



1.) Check-in & Introduction
Ask the participant condition, feeling, try to use MIRO.
Explain the goal of the session.



2.)
Explaining the pain point, findings from the internal & external interview. Give a short explanation about the archetype. Introduce two design challenges.



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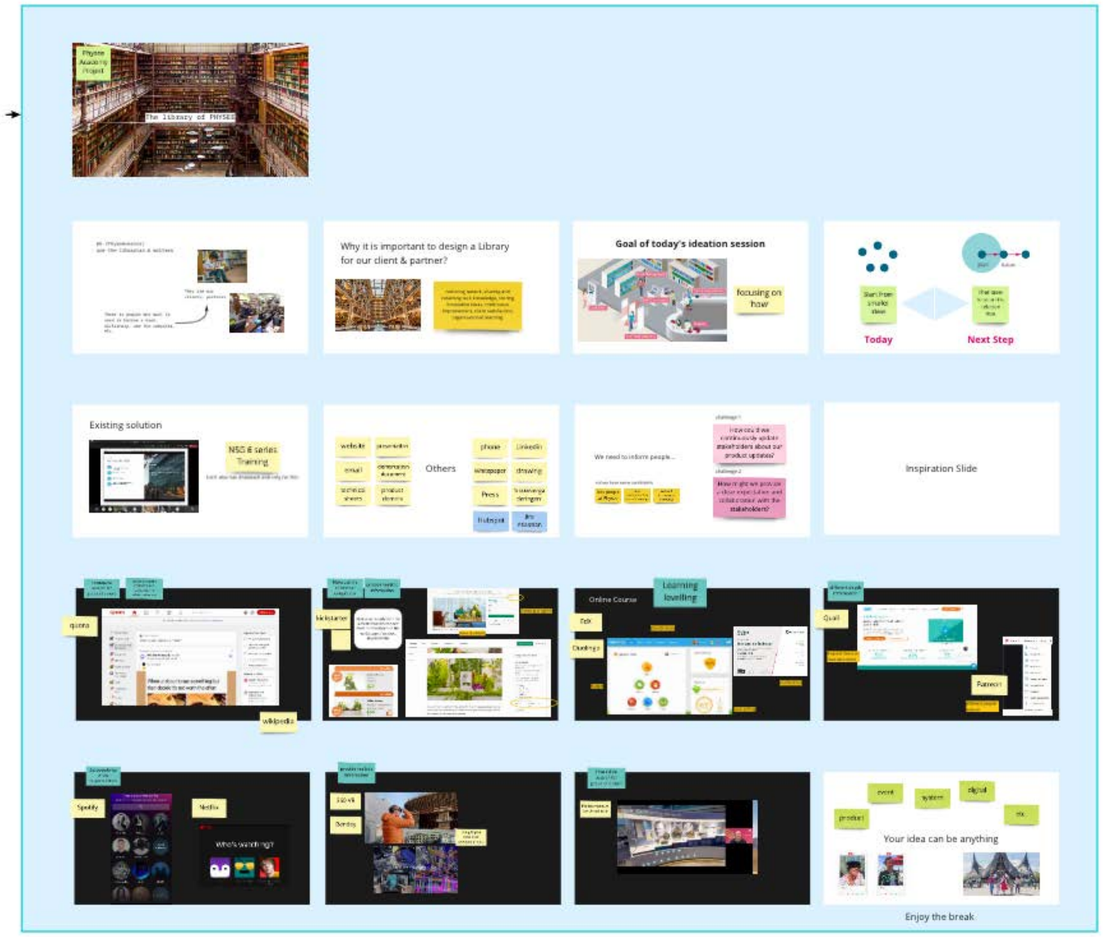
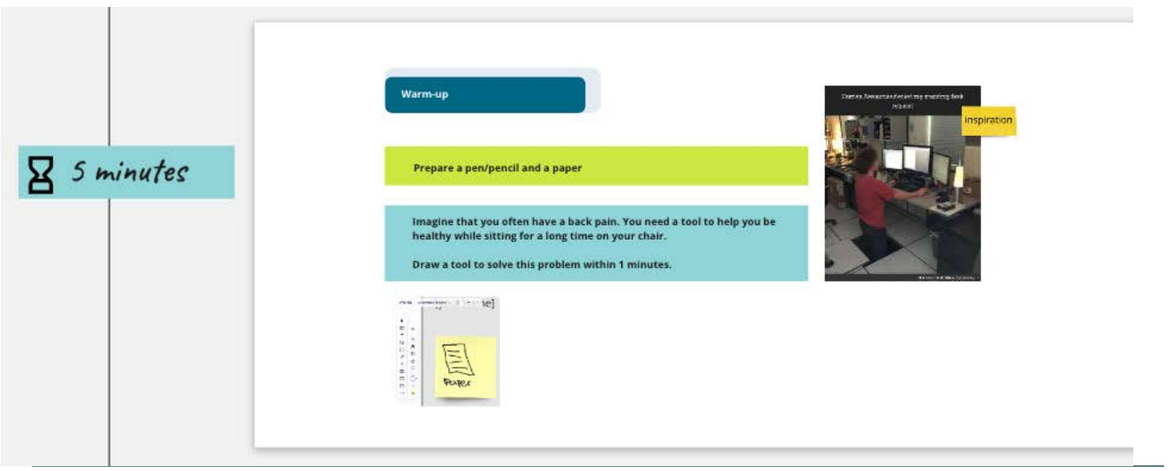
3.)
Explaining the goal of the session and give the ideas inspiration



4.)
Break & ideation warm up



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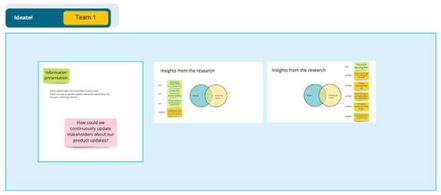
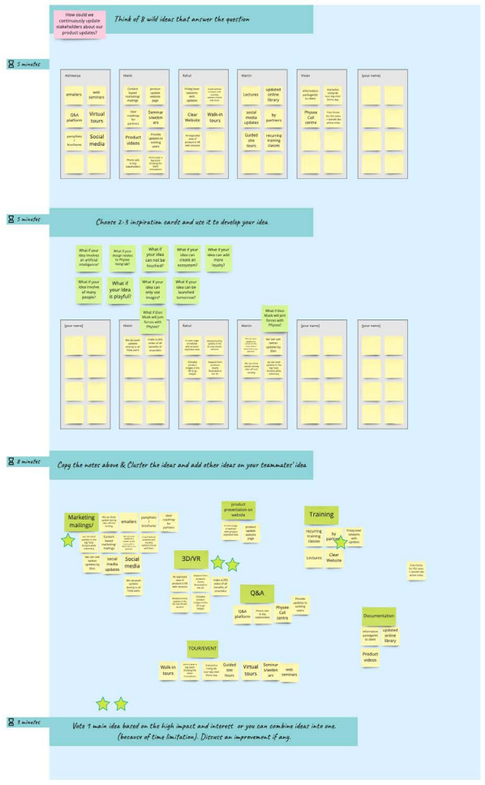
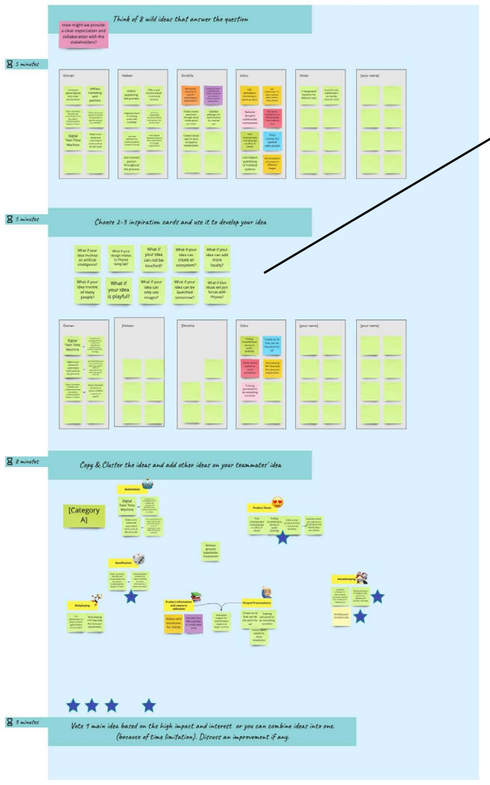
Team A

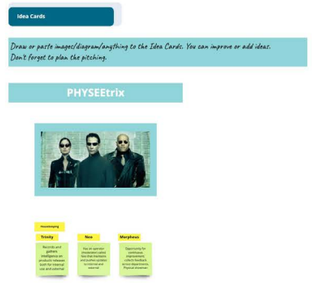


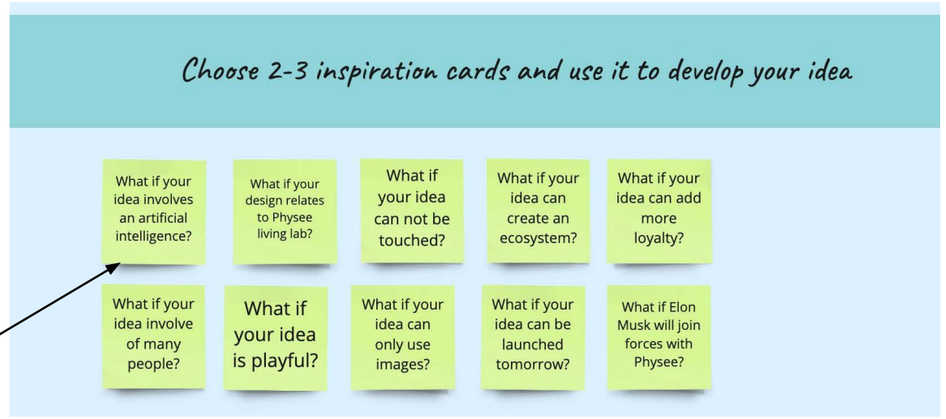


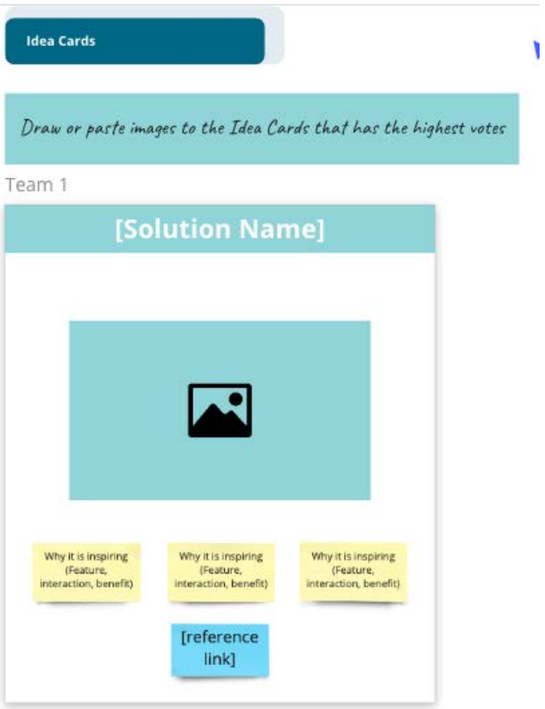
10 minutes

Team B

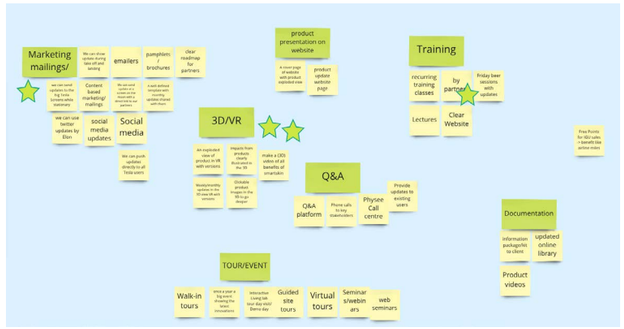


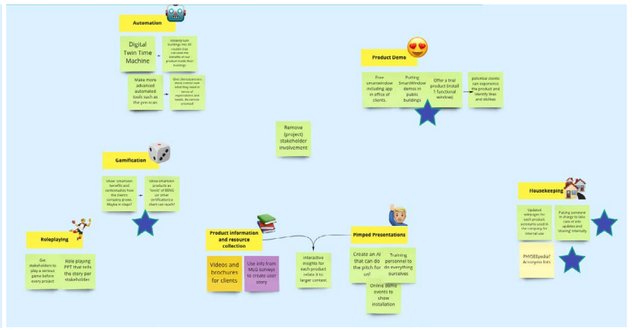




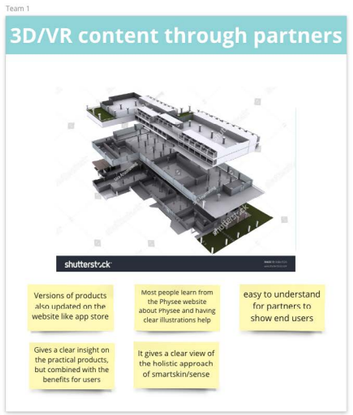


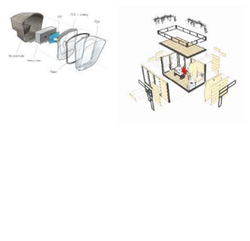
Come back to the main Teams if you are ready to present



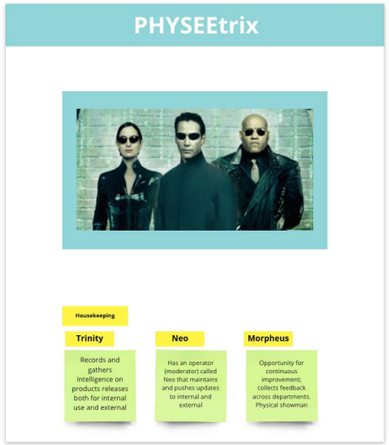


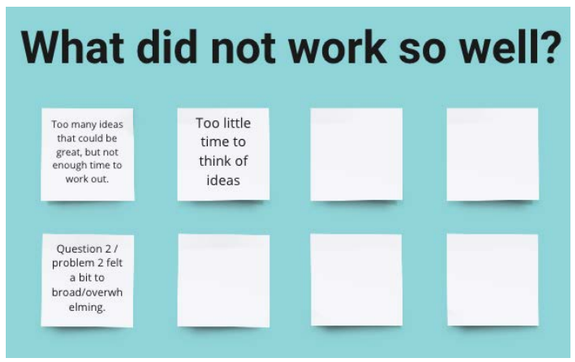
Team 1





Team 2





Appendix J

Ideas after co-creation (before the validation)

There are 8 eight ideas that the author want to test.

Implicit Knowledge (Platform based)

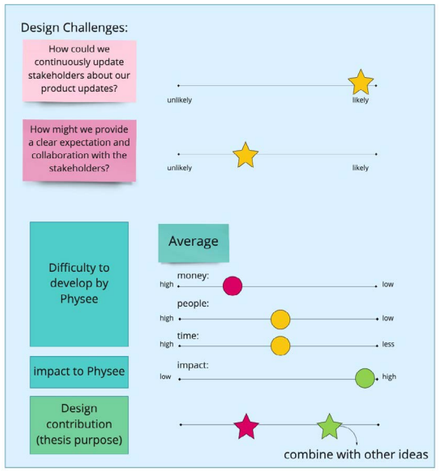
Explicit Knowledge (Ecosystem based)

Idea 0 - PHYSEE Trix
A project management team who is incharge in managing the library

Phase:

Preparation

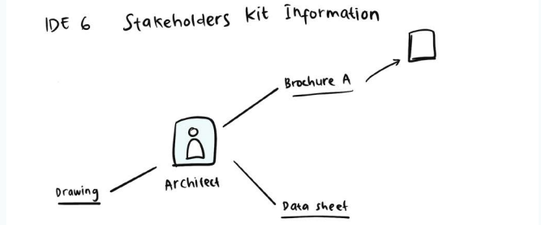
Description:
PHYSEEtrix is a team that focus on the information flow within the company and from company to the external stakeholders. they give a realistic and up-to-date information.

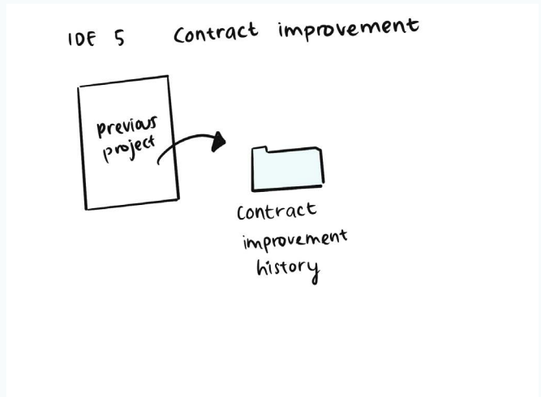


PHYSEE internal comments:

Can be integrated with the existing role (e.g. quality assurance team, and sales team)

Idea 0 - PHYSEE Trix
Stakeholders kit and contract improvement





Phase:

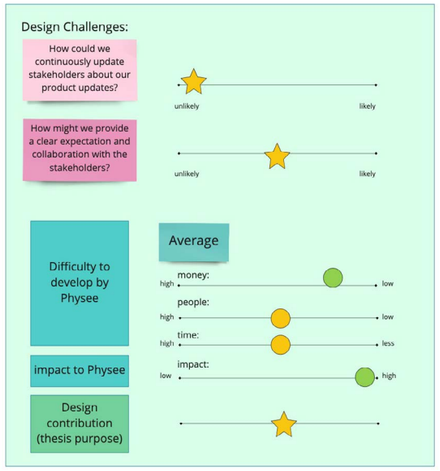
Preparation

Description:
The stakeholder kit is a list of stakholders and what they want to see.

The contract improvement is a way to save the preivous contract and feedback in a certain document

Why it is not working:

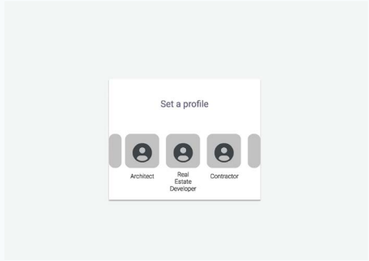
PHYSEE might need to elaborate their current system using *JIRA* as the project management tool.

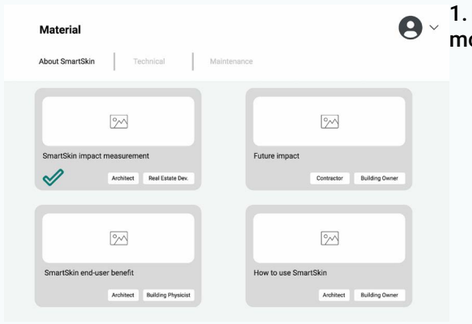


PHYSEE internal comments:

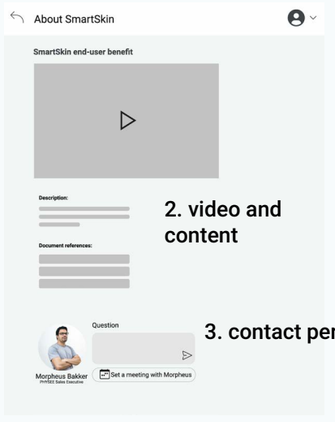
Can use the existing platform.
As Physee use Jira and Atlassian an integration could be made for this idea.

Idea 2 - PHYSEEpedia
A list of lesson for different stakeholders in a website



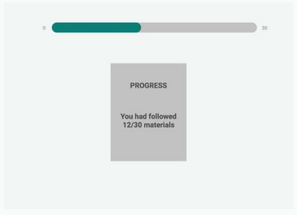


1. Different modules



2. video and content

3. contact person



4. leveling

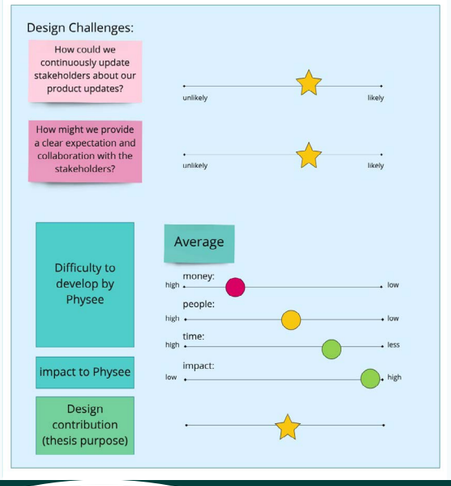
Phase:

Preparation | Execution

Description:
It is a list of lession which provide some materials that is personalised to the role of the stakeholders. The lessons are categorised based on the goal.

Benefit:

XXX



PHYSEE internal comments:

Consider the confidential information. Score system: is it for nudge them?
Can we use the existing platform like EdX for company?

User's comments:

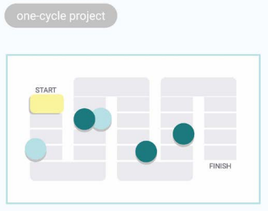
It is not fruitful to follow a course like to just understand a product. They wish to receive a simple solution.

Idea 3 - PHYSEE Cycle roleplay
A project management team who is incharge in managing the library

Booklet

for writing down the wish list of other stakeholders, or other notes during the workshop.

Will be sent or printable



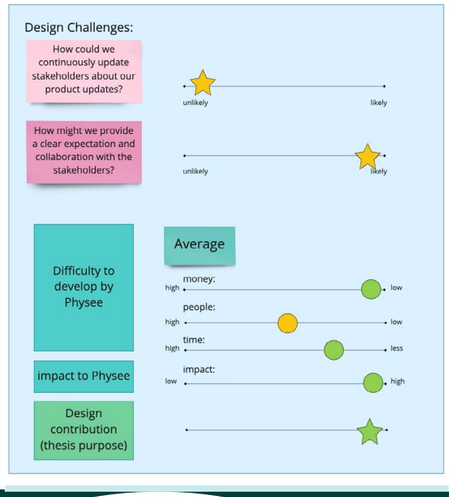
For showing how the project looks like and how to mitigate risk.

Phase:

Execution

Description:
It is an interactive workshop based on role play. The goal is to allow clients and partners to think of project expectation upfront.

Benefit:
have the shared goal, prevent the mismatch communication in the project.



PHYSEE internal comments:

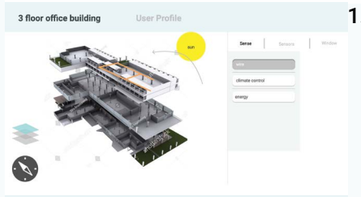
Can be part of marketing tools.
Needs more validation/testing.

User's comments:

Afraid that one stakeholder will be dominant. Interesting because not like a traditional sales project because enables discussion. Naming 'workshop' seems takes a long time.

Idea 0 - PHYSEE Trix
A project management team who is incharge in managing the library

1. building info



2. user info

3. interior info

4. comparison before and after SmartSkin

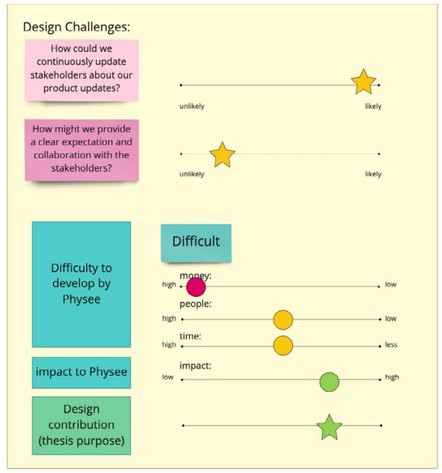
Phase:

Preparation

Description:
It is a 3d image that is modular. If there is a new feature or innovation in the product, Physee can add the feature in the building 3D image easily.
It can be like an exploded view.

Benefit:

Clear illustration, show the workflow based on the stakeholders' need (e.g contractor want only know the wiring).

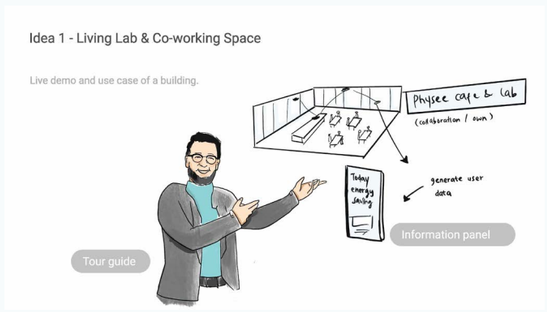


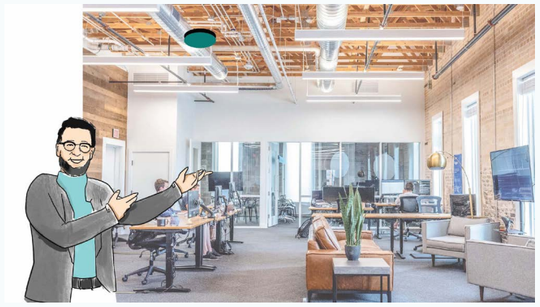
PHYSEE internal comments:

It is the most interesting idea but it is too difficult and takes time. Show the smartness

User's comments:
don't do something that architect tools can do (e.g. grasshopper). Make it very simple. Comparison is helpful. An animation also works.

Idea 0 - PHYSEE Trix
A project management team who is incharge in managing the library





1. offline

2. online

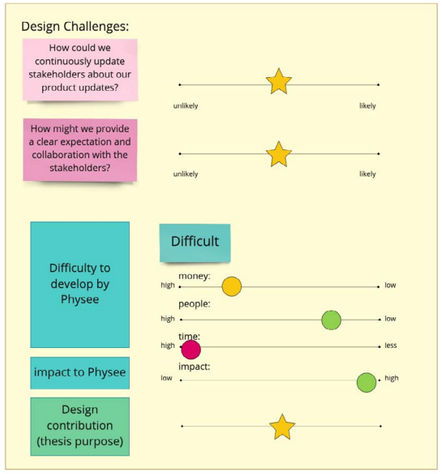
Phase:

Preparation

Description:
PHYSEE can collaborate with a co-working space and implement their tech over there. They provide a package of tour if a stake-holder want to have a short visit. Physee can provide a specific place to tell their innovation (e.g. like in a poster)

Benefit:

Showing the real system that being used. Convince the client and partner.



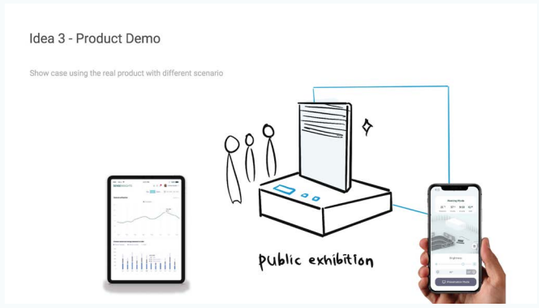
PHYSEE internal comments:

Online is not desired. It is too futuristic.

User's comments:

Offline: Very interesting idea because they can also bring their client to the location to see by themselves.

Idea 0 - PHYSEE Trix
A project management team who is incharge in managing the library



1. 1:1 scale

2. miniature

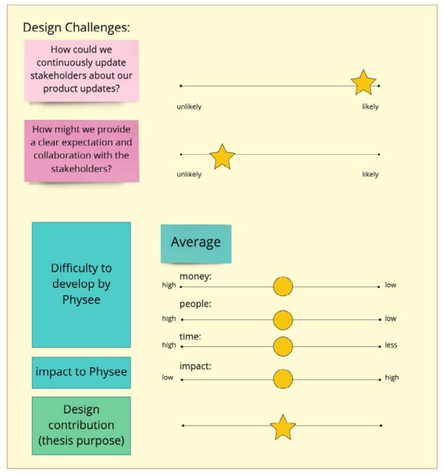
Phase:

Preparation

Description:
It is a product demo that involves the usage of software application.

Benefit:

People can see different scenario within a short-time period. For example, they can understand what will happen if the system in winter and summer.



PHYSEE internal comments:

The miniature is as complex as the 1:1 scale.
Need more knoledge to make the miniature.

User's comments:

This idea seems limiting the oppotuniy.
Interesting in a conference.

Appendix K

Solution Validation Technique

In the next page, there are 3 types of testing:

1. Interview guide (Semi-structured)

2. Survey for constructor

3. Survey for sales (IGU Manufacturer)
It is related to the OEM business model in chapter 2.3.2.

Testing Guide & Scenario

(Thank you for participating in my research again) or (tell me a bit about yourself)

The goal of this meeting is to get feedback and validation from you, as our partner, about the solutions that help the client/partner to understand more about our technology.

I am in charge of Physee Academy, a solution that aims to transfer the knowledge to the external stakeholders.

Before we start, I will explain to you a bit about my research findings. [explaining the research]

The solutions that I will show you are very diverse. There are 5 different ideas with different goals. I need you to think about what you like and dislike and is it helpful and applicable to your job industry? I will ask you to score some aspects of the idea. You can answer as honestly as possible. And you can also ask questions.

a. What is your score about Physee professionality now? (1-10)
b. What is your score about the clarity of information of Physee that you know? (1-10)

IDEA 1 - Living Lab & Co-working space

1. Imagine that you are not from COD Bright (take out COD glasses for a while), Physee asked you to come to an open house of a cafe or co-working space. You as a Real Estate Developer are invited to come and have a guided tour to see how Physee technology works. Will you join?
2. What is the information that you want to know as RED?
3. Now you are COD Bright, what is your expectation towards the (Amsterdam) project with Physee?

IDEA 2 - 3D content

1. Does 3D content attract you as a person to find more about Physee?
2. How easy do you think the solution is? Can you give a rate from 1-7?
3. Which feature is useful for you?
4. Do you think this idea is applicable in the RED environment or in the construction industry?

IDEA 3 - Product Demo

1. What do you think about the general idea?
2. Is trying the application by yourself helps you to make a decision in your job?
3. Do you think you are the person who is more interested to see the real product on site than on video?

IDEA 4 - PhyseePedia

1. What do you think about the concept of an online course set up in general?
2. Is it helpful to get a compilation of information that you can learn on one platform?
3. Are you excited about it?
4. Does the feature of video help you to understand Physee more than reading a text?
5. Which kind of video do you want to see more? An animation video or real person talking on the video?
6. Does the feature of chat and set a meeting also helpful?
7. Do you think it is applicable in the RED environment or in the construction industry?

IDEA 5

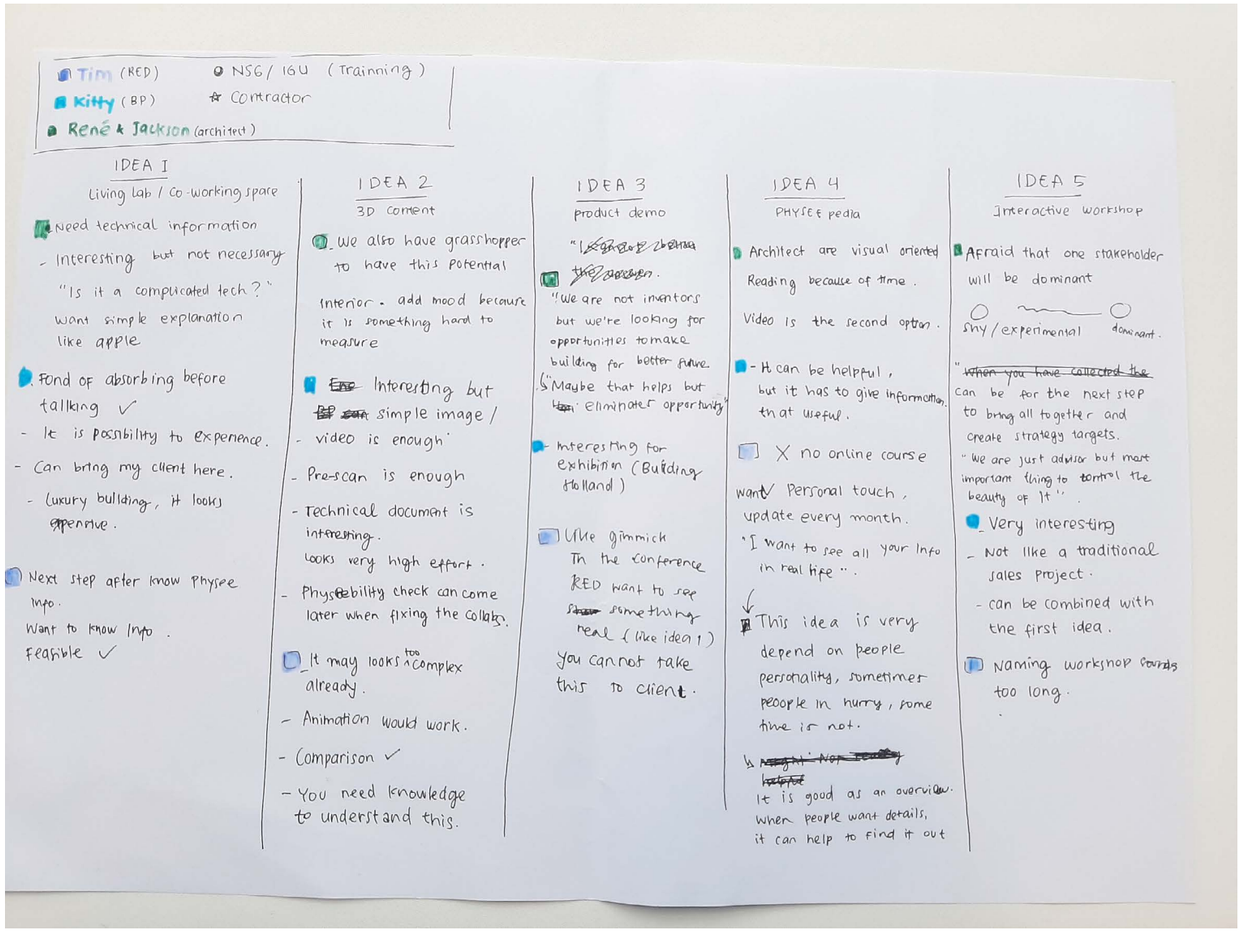
1. What do you think about the interactive workshop idea? How do you like it?
2. Do you think it is applicable in the RED environment or in the construction industry?
3. As a real estate developer, which stakeholders that you probably want to do the workshop with?

All ideas

1. Which is the idea that is the most relevant for your role as a real estate developer?
2. Which is the idea that you like and dislike the most?

What is your feedback about this session?

Thank you for your time.



Learning about Physee

Beste heer/mevrouw,

Bij PHYSEE streven we ernaar om de manier waarop we informatie delen met partners voortdurend te verbeteren. We zouden graag uw voorkeuren ontdekken door u vragen te stellen over hoe u graag werkt.

De vragenlijst duurt 3-5 minuten.

1. Naam

Enter your answer

2. Beroep *

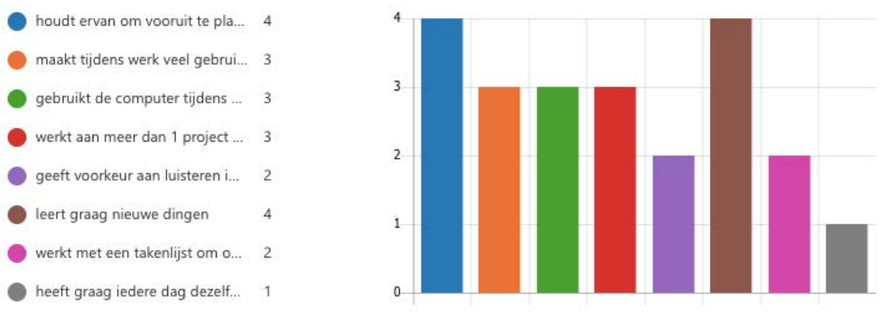
Enter your answer

3. Hoeveel jaar werkt u in de bouwsector? *

Enter your answer

4. U... (meer dan 1 antwoord mogelijk)

More Details



5. Scenario 1: U gaat werken met verschillende producten van PHYSEE. Wij leveren informatie over de installatie van het product, bijvoorbeeld over het installeren van ramen, sensoren, en kabels. Welk media past hiervoor het best bij u? (meer dan 1 antwoord mogelijk)

More Details

6. Scenario 2: Tijdens het installeren van een PHYSEE product loopt u tegen moeilijkheden aan en weet niet wat de volgende stap is. Wat doet u eerst?

More Details

7. Scenario 3: U gaat een nieuwe facade installeren waar u nooit eerder mee heeft gewerkt. Het systeem wordt verbonden met het internet. PHYSEE nodigt u uit om een 'product demo' bij te wonen. Bij deze product demo wordt uitgelegd hoe het product geïnstalleerd wordt, en hoe het systeem eruit gaat zien. Is een dergelijk product demo voor u waardevol?

Score	Category
10	Promoters
8	Passives
8	Passives
8	Passives

8. Scenario 4: U gaat een nieuwe facade installeren waar u nooit eerder mee heeft gewerkt. Voorafgaand wordt U door PHYSEE uitgenodigd voor een interactieve workshop met spel elementen. In deze workshop werkt u samen met PHYSEE en andere belanghebbende om een tijdlijn, budget, installatie, en verwachtingen te simuleren. Zou u hieraan meedoen?

Score	Category
7	Passives
8	Passives
4	Detractors
8	Passives

9. Bedankt voor het meewerken aan de enquete. Heeft u nog vragen voor PHYSEE?

More Details

1
Responses

Latest Responses

"Fijn bedrijf om mee samen te werken ."

NSG Training Improvement

We will show you 3 ideas to improve our training. 17 questions, estimated time to complete 5-7 minutes.

Your participation in the survey is completely voluntary and all of your responses will be kept confidential.

* Required

General Info

1

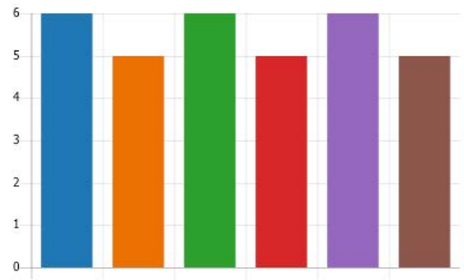
Name

Enter your answer

2. Which training you had attended?

More Details

SmartSkin Introduction	6
PHYSEEBILITY CHECK	5
A Typical Project	6
Technology	5
Sales, pricing, and warranties	6
FAQ and actions PHYSEE & NSG	5



3. How is your experience in our previous online training with Physee?

More Details

7
Responses

★★★★☆
4.00 Average Rating

Idea 1 - PHYSEEpedia, Physee online training workshop

The goal of PHYSEEpedia is to share information about SmartSkin via one platform. The user can go through the document and learn about SmartSkin with their personal time preferences.

1. log-in in our website or integrated with the project management software
2. You can choose different information in one platform
3. You can watch video, read the description, get a link to a certain document, and get a contact with a Sales from Physee

4. How might PHYSEEpedia as a platform can help you to understand the whole concept of SmartSkin?

Score	Category
7	Passives
8	Passives
8	Passives
8	Passives
5	Detractors
8	Passives
7	Passives

5. Are you interested to use this platform where you will learn through video and read the description by yourself?

Score	Category
6	Detractors
9	Promoters
8	Passives
7	Passives
6	Detractors
7	Passives
8	Passives

6. If you are having any difficulties, there will be a contact person on the webpage. Do you think it is helpful?

Score	Category
7	Passives
10	Promoters
7	Passives
10	Promoters
5	Detractors
8	Passives
7	Passives

7. Would you prefer to use Physeepedia rather than live online training?

More Details

Yes	3	
No	0	
Maybe	3	
Other	1	Both

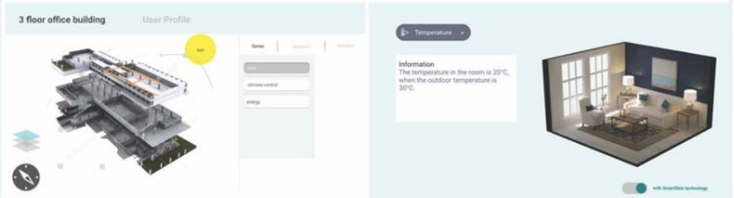
8. Do you have any comments about the idea?

7 Responses

ID ↑	Name	Responses
1	anonymous	no
2	anonymous	always actual information, and it's easier to get the right information I need at that moment.
3	anonymous	
4	anonymous	the best solutions its life training, second one on-line
5	anonymous	No
6	anonymous	Online training offering will be useful
7	anonymous	No

Idea 2 - SmartSkin Building Simulator on Website

The goal of an online simulator is to show how SmartSkin works in a building. When we want to update our technology, the simulator will show the improvement of our product. So you will keep updated.



1. Can try out different of scenario in the building and the image will show the details of the technical part and the impact to the user by using Physee SmartSkin.

2. Can see what will happen if a building looks like without and with SmartSkin (comparison)

9. How might this idea help you to understand the whole concept of SmartSkin?

Score	Category
7	Passives
7	Passives
7	Passives
7	Passives
4	Detractors
8	Passives
7	Passives

10. How might this idea help you to explain the whole concept of SmartSkin to the client?

Score	Category
7	Passives
8	Passives
8	Passives
8	Passives
4	Detractors
8	Passives
7	Passives

11. Will you use it?

More Details

Yes	2
No	0
Maybe	5

12. Do you think it might help you to see the SmartSkin (system) update/changes in this platform?

More Details

Yes	6
No	0
Maybe	1

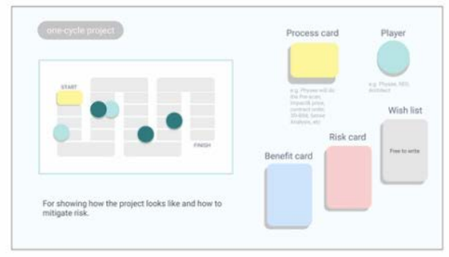
13. Do you have any comments about the idea?

7 Responses

ID ↑	Name	Responses
1	anonymous	no
2	anonymous	no
3	anonymous	
4	anonymous	no, its ok
5	anonymous	NO
6	anonymous	The comparison should show the differences, SmartSkin vs. no smart facade, this should give the customer a good impression
7	anonymous	It's a good idea

Idea 3 - Interactive Training

The goal is to create an understanding of what will happen within the project (mitigate risk, learn about the procedure). It might be a 2 hours workshop (offline/online).



1. The session will be in group. Physee will facilitate the session

2. Each people choose their role. The participants will go through the process in the project and discuss about the risk, benefit within the project.

14. How might this idea help you to understand the whole project of SmartSkin?

Score	Category
8	Passives
7	Passives
5	Detractors
7	Passives
6	Detractors
9	Promoters
6	Detractors

15. How might this idea help you to mitigate risk within the project?

Score	Category
7	Passives
7	Passives
5	Detractors
7	Passives
5	Detractors
9	Promoters
5	Detractors

16. How likely are you to follow this interactive training?

Score	Category
8	Passives
7	Passives
5	Detractors
8	Passives
7	Passives
7	Passives

17. Do you have any comments about the idea?

More Details

6
Responses

Latest Responses

"No"

"Very helpful for the first projects"

"No"

Appendix L

Ideation