

Evaluating the Global Design System in Its Early Development Phase

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Abstract

A design system is a set of reusable web components sharing common design principles. Generally a design system consists of web component library, style guide, design guidelines and content guidelines. Design systems are used for constructing user interfaces in organizations in order to ensure design consistency and to reduce number of overlapping work. However, constructing a design system is often not easy. Especially more matured organizations often have a lot of design and technical documentation already in place and that complicates standardization. In addition, building a design system usually requires a lot of resources in all kinds of organizations and therefore some optimization is needed.

The goal of this thesis is to investigate how the global design system of the case company could be improved in the future. The results are based on the literature review and the empirical study. In the literature review, the aim was to find out research material on general ways to improve a design system. The empirical study was a case study where the information was gathered through interviews and a survey held in the case company. The interviews were targeted for people working closely with the global design system. On contrary, the survey was aimed for the users of the design system and some of them had also contributed to the system.

The empirical study revealed that having global assets has already been found to be beneficial in the case company. The respondents thought that global assets save design and development work in the organization, because there is no need for rebuilding the web components by product teams repeatedly. The increase in global collaboration was also highly valued. However, it was revealed that the adoption of the global design system has not been fully successful due to low number of guidelines and other global assets. There has also been a lot of misunderstanding when it comes to collaboration between the design system team and the product teams. Possible solutions to address the issues are ensuring enough workforce and other resources on the project and focusing on more comprehensive and up-to-date documentation and guidelines for the users of the system.

The most important conclusion of the thesis is that the case organization should focus on establishing a clear vision of the global design system, because the misunderstandings of the core of the design system are complicating the adoption process unnecessarily. A clear vision of the global design system and spreading it across the organization would raise the confidence of the product teams on the future existence of the global design system and its benefits. In addition, it helps allocating the

company resources into the targets benefiting the global design system the most.

Keywords design system, user interface, design guidelines, global software development

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Tiivistelmä

Suunnittelujärjestelmä koostuu uudelleenkäytettävistä web-komponenteista, jotka jakavat yhteiset suunnittelun periaatteet. Yleensä suunnittelujärjestelmä koostuu web-komponenttikirjastosta, tyyliohjeista, suunnittelu- sekä sisältöohjeistuksista. Suunnittelujärjestelmiä käytetään käyttöliittymien rakentamiseen organisaatioissa, jotta käyttöliittymien ulkoasu säilyisi yhtenevänä, sekä jotta limittäisen työn määrä vähenisi organisaation sisällä. Suunnittelujärjestelmien kehittäminen ei ole kuitenkaan helppoa. Erityisesti vanhemmissa organisaatioissa suunnitteluun ja tekniseen toteutukseen liittyvää dokumentaatiota on jo ennestään paljon, mikä vaikeuttaa toimintatapojen standardisointia. Lisäksi suunnittelujärjestelmän kehittäminen vaatii paljon resursseja kaiken kokoisissa organisaatioissa, ja sen seurauksena kehitysprosessin optimointi on tarpeellista.

Tämän diplomityön tavoite on tutkia, miten tutkittavan yrityksen globaalia suunnittelujärjestelmää voisi parantaa tulevaisuudessa. Työn tulokset pohjautuvat kirjallisuuskatsaukseen sekä empiiriseen tutkimukseen. Kirjallisuuskatsauksessa tavoitteena oli löytää tutkimusmateriaalia yleisistä tavoista parantaa suunnittelujärjestelmiä. Empiirinen tutkimus toteutettiin tapaustutkimuksena, jossa tietoa kerättiin haastatteluilla ja kyselyllä, jotka toteutettiin tutkittavassa yrityksessä. Haastattelut kohdennettiin ihmisille, jotka työskentelevät läheisesti globaalin suunnittelujärjestelmän parissa. Sitä vastoin kysely kohdennettiin suunnittelujärjestelmän käyttäjille ja niille, jotka olivat myös mahdollisesti osallistuneet järjestelmän web-komponenttien kehittämiseen.

Empiirisessä tutkimuksessa selvisi, että globaalin suunnittelujärjestelmän resurssit ovat jo nyt olleet hyödyllisiä yritykselle. Vastaaajien mielestä globaalit resurssit vähentävät suunnitteluun ja kehittämiseen käytettävää aikaa organisaatioissa, koska tällöin ei ole tarvetta rakentaa web-komponentteja toistuvasti uudelleen yrityksen sisällä. Globaalin yhteistyön kasvua arvostettiin myös paljon. Tutkimuksessa kuitenkin huomattiin, että globaalin suunnittelujärjestelmän käyttöönotto ei ole ollut täysin onnistunutta, koska ohjeistuksen ja muiden resurssien määrä koettiin riittämättömäksi. Yrityksen sisällä oli myös väärinymmärryksiä liittyen kollaboraatioon suunnittelujärjestelmän kehitysryhmän sekä tuotetiimien välillä. Mahdollisia ratkaisuja näillä ongelmille on varmistaa riittävä työvoima sekä muut kehitysresurssit globaalin suunnittelujärjestelmän projektille sekä keskittyminen kokonaisvaltaisempaan sekä ajantasaiseen dokumentaatioon ja ohjeistukseen tuotteen käyttäjille.

Diplomityön tärkein johtopäätös on, että tutkittavan yrityksen tulisi keskittyä

määrittelemään globaalille suunnittelujärjestelmälle selkeä visio, koska väärinymmärrykset suunnittelujärjestelmän ydinasioista vaikeuttavat tuotteen käyttöönottoa tarpeettomasti. Globaalin suunnittelujärjestelmän selkeä visio ja siitä tiedon levittäminen organisaatiossa nostaisi tuotetiimien varmuutta tuotteen olemassaolosta vielä tulevaisuudessa sekä sen hyödyistä. Lisäksi se auttaisi allokoimaan yrityksen resurssit niihin asioihin, jotka hyödyttävät globaalia suunnittelujärjestelmää eniten.

Avainsanat suunnittelujärjestelmä, käyttöliittymä, suunnitteluohjeistukset, globaali ohjelmistokehitys

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1 Introduction

1.1 Background and motivation

According to [Yew et al. \(2020\)](#), the term "design system" refers to a library consisting of reusable components that share common design principles. They state that a design system usually consists of a component library, a style guide, design guidelines and content guidelines. Design systems became popular in the software industry in the 2010s due to the rising market needs for usable and unified design of websites and applications ([Churchill, 2019](#)). The main benefits of using a design system are that it ensures design consistency within and across applications and decreases the number of overlapping development work needed in the company ([Churchill, 2019](#); [Suarez et al., 2018](#)).

However, constructing a design system can often be challenging for organizations. Design systems developed by organizations are often large projects and they are for example vulnerable to issues in iterative development, documentation and performance ([Suarez et al., 2018](#); [Vesselov and Davis, 2019](#)). In addition, organizations have a tendency to not have enough thought on the needed resources in development and how a design system should be adopted across the organization ([Vesselov and Davis, 2019](#)). To tackle these issues, there is a need for investigating organizations and their environment when developing a design system, and also design systems overall.

The case company of the thesis has had design systems for several years. However, every country where the company is operating had their own localized design systems, although the operations in different countries do not have large differences. As a result, the design was not unified across countries and there was a lot of overlapping work in the organization. In multiple countries, the design system was also not mature enough or could not be used on different platforms. The organization wanted to change these ways of working which started the initiative of developing a global design system.

The company of the thesis started working on the global design system in the beginning of 2021. The idea of the global design system is to work as a building tool for web, mobile, app and TV development so that any digital product could be built using reusable web components. Designers and developers globally should be able to contribute to the system, and as a result the best and most successful work could be used all across the company. The main goals of the system are to reduce overlapping development and design work, and to unify the design and brand of the company. If the company is able to reach these goals, it could also reduce the overall operational costs of the company and enable downsizing in the digital sector.

The motivation of the company for this thesis is to find out how well the global design system has met its goals. However, the project is still in its very beginning and therefore the focus will be in the adoption of the global design system instead of making precise measurements about the possible cost savings of the company or finding out if the design and brand are now fully unified across the countries. The company is especially interested in finding out if the system has reduced overlapping development and design work, and whether there are any organizational or cultural

challenges that prevent the benefits. With this focus, the results of this thesis will also be beneficial in the future development of the global design system.

1.2 Research problem and questions

The research problem of the thesis is connected to the motivation of the company. In order to know if the global design system has met its goals for the early development phase, we need to find out the current status of the system. That is further applied into the further development of the system. Therefore, the research problem is to find out how the current status of the global design system could be improved in the case company.

- **Research problem:** How could the status of the global design system of the case company be improved in the future?

The motivation of the company includes which benefits the global design system has accomplished so far and what challenges the project is facing. In addition, the possible solutions for the current challenges are investigated. These goals of the thesis form its research questions.

1. **RQ1:** Which benefits has the global design system accomplished so far?
2. **RQ2:** Which challenges has the global design system met?
3. **RQ3:** What are the possible solutions for the challenges of the global design system?

1.3 Scope of the thesis

This thesis uses a literature review, interviews and a survey as its research methods. The thesis aims to get answers to each of the research questions by using all of the research methods, as stated in Table 1. However, the methods are not used similarly as a data source for every research question. For example, the literature review is used to find out common benefits and challenges of design systems, while the interviews are a tool to investigate benefits and challenges relevant to the design system under research. The results of these research methods are used in the survey to mainly prove the concept although new benefits and challenges may also be found.

	Literature review	Interviews	Survey
RQ1	X	X	X
RQ2	X	X	X
RQ3	X	X	X

Table 1: The mapping between the research questions and the research methods.

The scope of this thesis is focused on the global design system of the case company. The aim is not to study design systems in general, although the literature review

naturally gives that kind of results. Instead, these results are applied to the context of the design system under research. The investigated solutions for the challenges of the design system are also only possible solutions. They are not tested in the case company and therefore it cannot be ensured if those solutions will actually solve the challenges.

1.4 Structure of the thesis

This thesis consists of six chapters that are further divided into sections and subsections. [Chapter 2](#) explains the research methods that were used in the thesis. It includes its own sections for the literature review and the empirical study. Empirical study is further divided into subsections for case study, interviews and survey. In the case study subsection, the chosen empirical study method is explained in a broader manner. In the interview and survey parts, the conduction of these studies are explained in more detail.

[Chapter 3](#) presents the results of the literature review. First, it delves into the background of design systems by discussing the origin of the term "design system" and the history of the usage of design systems. After that, the literature review goes into the research questions by presenting common benefits and challenges of design systems found in literature. Possible solutions for challenges are presented in a form of guidelines found in literature for building a successful design system.

[Chapter 4](#) is about the results of the empirical study. In the first section, interviews are gone through in the order of the used interview questions. First, the background of the global design system of the company is gone through in detail by discussing the current status of the system and its goals. After that, the research questions are taken into account by presenting the results related to the benefits, the challenges and the future of the global design system. The second section is focused on the survey results. The structure of the survey was more straightforward, and therefore the subsections discusses only the benefits, the challenges and the possible solutions found in the survey. The third section is a summary of these two and it aims to find commonalities between the interviews and the survey.

[Chapter 5](#) is reserved for the discussion part. This chapter summarizes the main results of both the literature review and the empirical study. It also discusses their similarities and differences. [Chapter 6](#) is the part for conclusions. The chapter aims to find the most important results of the thesis in a larger scale.

In addition, there are some attachments. Attachments [A](#), [B](#) and [C](#) show the interview templates used with different interviewees. Attachment [D](#) shows the survey layout.

2 Research methods

2.1 Literature review

The literature review is mainly based on research articles found using Scopus abstract and citation database, ACM Digital Library and Google Scholar. Most of the articles were found with a keyword "design system", and limiting the articles to the ones published during the last five years. Some articles and books referred were found using the snowball method, in which new sufficient resources are found from the resources of articles already being used as a resource. In some cases where the snowball method was used, the initial resource was a master's thesis instead of a research article.

After finding an article with a relevant title, its abstract was read and the whole article was skimmed through. If the article seemed suitable after that, it was read more precisely and the choice of using the article as a resource was based on that. The journal where the article was published and the number of citations were also noted, but not found as important as the content of the article, especially because most of the articles about the thesis topics had been published very recently. When it comes to the books used as a reference, the choice was based on the titles of the chapters, the publisher and the number of citations.

2.2 Empirical study

2.2.1 Case study

Case study was chosen to be the research method of this master's thesis. It is a widely used research method in software engineering because it aims to study contemporary phenomena in a real-life context (Runeson and Höst, 2009). According to Flyvbjerg (2006), case studies will not necessarily provide reliable information in a broader context, but that is not the goal of this thesis. Instead, the research problem of this thesis is very context-specific because it studies a global design system project of the case company, and therefore a case study is very suitable for this master's thesis.

In a case study, the usage of "multiple sources of evidence" is ideal (Runeson and Höst, 2009). Therefore, this master's thesis is combining qualitative and quantitative methods. This approach was chosen because it improves the reliability of the research (Runeson and Höst, 2009). The qualitative part consists of three interviews held with the key persons of the global design system project of the case company. The quantitative part is a survey which is aimed for employees, mostly developers and designers, who have used the global design system or contributed to it. The survey includes also a qualitative part because there are some questions requiring an open-ended answer.

In addition to combining qualitative and quantitative methods, Runeson and Höst (2009) are suggesting the usage of triangulation. In triangulation, the aim is to collect the same data using different methods or data sources in order to test validity (Runeson and Höst, 2009). As stated before, different research methods were used, but in addition, the results of the literature review and interviews were used as a

source when the survey questions were constructed. As a result, it was possible to prove if the results of those studies were applicable for the users of the global design system as well.

2.2.2 Interviews

The goal of the interviews was to get information about what the core people of the global design system project think about the benefits and challenges of the system. The possible solutions to the challenges which the organization has already proposed or the interviewees think could help to solve the challenges in the future were also discussed, but they were not one of the main topics.

The interview part of the thesis was done in the semi-structured format. Semi-structured interviews were chosen because they combine interview questions with specific objectives and new question ideas coming to mind during the interview (Hove and Anda, 2005). The interviews were individual in-depth interviews in order to delve into individual opinions and experiences (DiCicco-Bloom and Crabtree, 2006). These techniques enable gathering as much information as possible from the individual perspective about the global design system and understanding the subject and organizational context well.

		
Product Owner	Design Lead	Global Digital Experience Manager
Analyzing and supervising the global design system project	Leading the global design system team and design community	Higher management
Prioritizing opportunities	Guiding and helping the designers	Improve customer experience globally
Identifying risks	Advancing collaboration and contribution	Exploiting common assets and capabilities
Advancing the adoption		

Figure 1: Summary of the interviewees, their roles and responsibilities. The pictures are not representing the actual genders.

The possible interviewees were narrowed down to the key people of the global design system project because they have the widest knowledge on the subject. The final selection was chosen based on DiCicco-Bloom and Crabtree (2006) to maximize the depth and richness of the data to the research questions. In practice, this means that all the interviewees are working in different roles and as a result have different

perspectives on the project. Two of the interviewees also worked with the design system team itself and one did not in order to have diversity in viewpoints. The Figure 1 is showing a summary of the interviewees.

The first interviewee was the product owner of the global design system project. They were responsible for analyzing and supervising what has been done so far in the project, and what could be the best ways to move the project forward in the future. Their work involved prioritizing opportunities for the design system team to be worked on, creating a roadmap for the product and identifying possible risks for the success of the project. They had also been working on advancing the adoption of the global design system in the company. The length of the interview was 85 minutes and the interview questions are presented in [Appendix A](#).

The second interviewee was working as a design lead of the global design system project, and also as a design lead for the design community of the company advancing the collaboration between designers working in different countries. In the design system team, they were responsible for guiding and helping the designers of the team, and advancing collaboration between designers and contribution for the global design system. The interview took 70 minutes and the interview questions can be found in [Appendix B](#).

The third interviewee was working as a global digital experience manager of the company. They worked in the higher management and were responsible for the platforms such as websites, apps and social media in a global level. Their job was to find out how the company could provide a better customer experience globally by exploiting common assets and capabilities. The global design system project was one of the units they were managing on a higher level. The length of the interview was 40 minutes and the interview questions are shown in [Appendix C](#).

The interview questions were constructed after choosing the interviewees. As a result, the interview questions are slightly different in terms of who was interviewed. The goal with having different interview questions was to highlight the special knowledge the interviewees have in different subjects. Otherwise, the interview questions aim to be well aligned with the research problem and questions. They also took advantage on the first iteration of the literature review. This practise made it possible to have more knowledge on the subject beforehand and based on the [Hove and Anda \(2005\)](#), it eases the process of choosing which follow-up questions should be asked during the interview.

All the interview questions were open-ended because the goal was to explore the subject of the global design system in the organizational context. The order of the interview followed the one presented by [Runeson and Höst \(2009\)](#), so that first the interview objectives were presented, and after that the more easy background questions about the interviewee and the system were asked. After that, the main subjects of benefits, challenges and solutions were gone through. The interview questions were verified by two senior researchers for not being leading or otherwise having a bad academic style. The thesis advisor also verified if the questions were understandable enough in the organizational context.

All the interviews were recorded and transcribed, as recommended by [Hove and Anda \(2005\)](#). After the transcriptions were written, they were gone through and the

sentences were categorized under the codes "background", "status", "goals", "benefits", "challenges" and "future". These categories were drafted based on the interview questions. This practice is aligned with [Runeson and Höst \(2009\)](#), who suggest going through the transcriptions and giving a code representing a certain theme to the parts of text. Continuing the example of [Runeson and Höst \(2009\)](#), after that the first set of hypotheses were made by creating sub-codes inside the initial codes. This was done by looking for phrases having a similar topic inside the codes. The analysis was created based on these sub-codes, but the process was iterative for the whole writing process. As a result, some phrases switched their sub-code or even the original code if a more suitable one was figured out during the process.

2.2.3 Survey

The goal of the survey was to gain better understanding of what the users of the global design system are currently thinking of the global design system. They were asked about the benefits and the challenges of the system and also if they had some solutions to propose. The survey questions were highly based on the results of the initial literature review and the interviews. Particularly, the checkbox options were taken from the earlier resources in order to see if they are aligned with the experiences of the users. The process of using qualitative approach before constructing a survey is highly recommended by ([Boynton and Greenhalgh, 2004](#)).

The details of the survey were constructed based on [Boynton and Greenhalgh \(2004\)](#). The same survey was used for all of the respondents, and the possibility of misunderstandings was minimized by gathering feedback of the survey from the thesis advisors and a university researcher. Close-ended questions were used to validate earlier results of the research and open-ended questions to gather new qualitative data from a new perspective. The questions of the survey were phrased shortly and into the point in order to make following the survey easy and to avoid frustration ([Boynton and Greenhalgh, 2004](#)). In addition, most of the open ended questions were made voluntary in order to gather more qualitative data from the respondents that did not have strong opinions or much time to answer the survey.

Figure 2 represents the roles of the respondents in the organization. 63 % of them were developers, 23 % designers, 3 % product owners and 10 % stated their role to be other. Those that chose the option other described their roles to be an architect and an user experience lead. The roles of the respondents are well aligned with the organizational structure and there is no huge bias to any direction. However, the role affects the experiences with the global design system and as a result, it affects the results of the analysis.

Figure 3 represents the countries where the respondents worked. 50 % of the respondents were working in Sweden, 23 % in Finland, 17 % in Norway, 7 % in Lithuania and 3 % in Estonia. The number of Swedish respondents can be explained by the fact that the Swedish product teams were part of the initial pilot team of the global design system. Sweden was also the most common location of developers and designers in the organization. Estonians and Lithuanians are the least involved in the project, and that explains the low number of respondents from those countries. It is

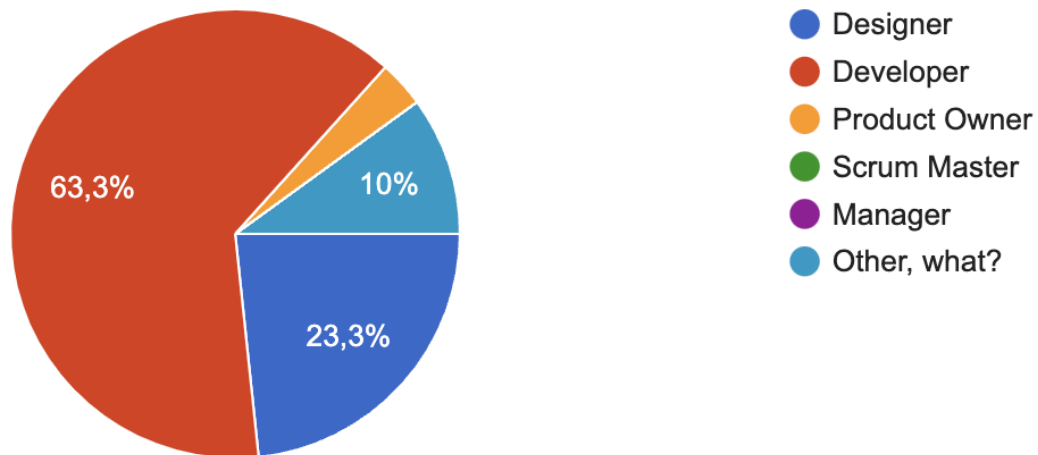


Figure 2: Summary of the roles of the respondents.

also possible that those respondents are participating in the development projects of some other country. In addition, there were zero respondents from Latvia. However, it was learned afterwards that Latvia has no development itself although it is one of the markets of the company.

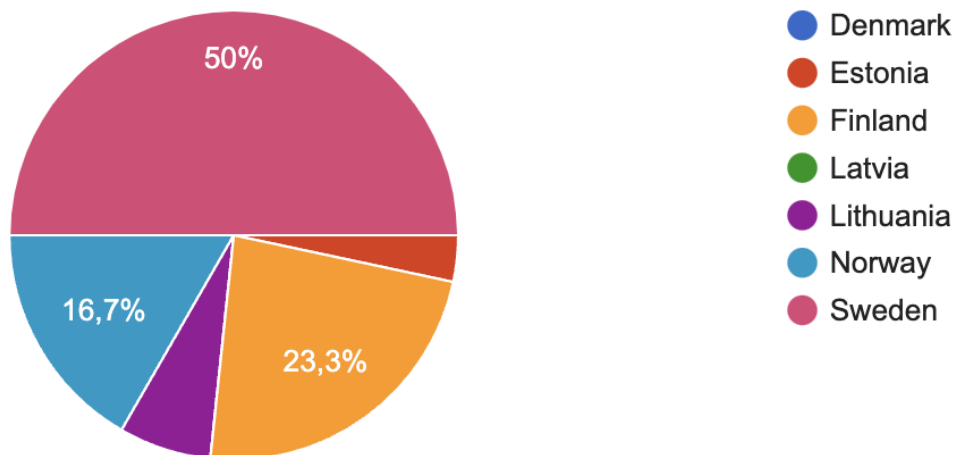


Figure 3: Summary of the countries where the respondents were working.

3 Results of the literature review

3.1 Design system as a term

Design system refers to a set of reusable components that have shared design principles (Yew et al., 2020; Suarez et al., 2018). Components of a design system are parts of reusable code which can be used as a building blocks of the application user interface (Suarez et al., 2018). However, Edelberg and Kilrain (2020) state that different stakeholders of an organization having different expertise or business goals can understand the term "design system" differently. They are giving an example where people working with branding of an organization are possibly seeing a design system only as a branding guideline instead of considering all the parts of the system.

According to the interview study results of Yew et al. (2020), the most common artifacts belonging to a design system are component library, style guide, design guidelines and content guidelines. Other parts which can be included are design token libraries, accessibility guidelines and interactive prototyping tools (Yew et al., 2020). However, Vesselov and Davis (2019) think that a design system consists of layout, styles, components, regions (or design paradigms), content and usability. Instead, Edelberg and Kilrain (2020) divide the items of a design system to tangible and non-tangible items. The examples of tangible items are branding guidelines and color palettes when non-tangible items are for example brand values and best practices.

Churchill (2019) mentions in her article that a design system can offer guidance to for example components, layout, colors and typography but also to nonvisual modalities such as voice and haptic feedback. Moore et al. (2020) discuss this aspect of design systems as well by stating that most of the design systems are for graphical interfaces but some have been developed for conversational interfaces too. Due to their focus on conversational interfaces, their definition of the core components of a design system are also very different because they state that a design system consists of a design philosophy, interaction patterns and a content format. As a result of these findings, it can be stated that there is no consensus in the literature of what a design system consists of.

Vesselov and Davis (2019) states that it is a common misunderstanding to think that style guides, component libraries (or pattern libraries) and design systems are all the same thing. However, they argue that the difference is that a design system includes "the processes and philosophies behind the design decisions" and it covers the whole organization. A style guide and component library are only parts of a more comprehensive design system (Yew et al., 2020). Design systems also always include codebase whereas style guides and component libraries are often static (Vesselov and Davis, 2019).

These days organizations are both using design systems developed by other companies, such as Google's Material Design, and developing their own design systems which are matching the brand of the organization. The decision to start building an own design system is usually dependent on the size and age of the company because large companies have enough resources to have a dedicated design

system development team (Yew et al., 2020; Vesselov and Davis, 2019). On the contrary, small companies and startups tend to use open source design systems of other organizations (Yew et al., 2020).

Resource	Artifact of a design system	Definition
Yew et al. (2020)	Component library	A set of styles and components that can be used and shared across applications of the organization (Vesselov and Davis, 2019).
	Style guide	Documentation that defines how the brand is stylistically applied to interface elements (Vesselov and Davis, 2019).
	Design guidelines	Sets of recommendations that support designers to achieve the best possible results when developing an application (Häkkinen and Mäntyjärvi, 2006).
	Content guidelines	Guidelines for the voice and tone of organisations and the mechanics for grammar and writing style (Atlassian, 2021).
	Design token libraries	Visual design attributes (e.g. colours) are stored in a way that they can be shared across platforms (Yew et al., 2020).
	Accessibility guidelines	Guidelines for helping developers and designers to create more accessible applications (Calvo et al., 2016).
	Interactive prototyping tools	Tools used in design system development that support design prototyping and collaboration (Yew et al., 2020).
Vesselov and Davis (2019)	Layout	Measures that form the spacing and grid system.
	Styles	Core aspects of the visual language, such as colours and typography.
	Components	Core elements of the interface, such as buttons.
	Regions	More comprehensive design paradigms, such as navigation.
	Content	Information regarding voice, tone and writing.
	Usability	Rules for accessibility and internationalisation.
Moore et al. (2020)	Design philosophy	Comprehensive vision and goals of the system. Provides guidelines for interaction and design principles to help the designers.
	Interaction patterns	The core of the user experience within a design system. Includes reusable components.
	Content format	Helps the content designers to generate new content for particular use cases.

Table 2: The definitions of the artifacts of the design system listed by different resources. Yew et al. (2020) are not defining all the artifacts so the definitions are taken from other resources.

3.2 History of design systems

The roots of design systems lie in component-based development which was first introduced in the 1960s (Suarez et al., 2018). In component-based development, software systems are built by assembling earlier developed components which has been prepared for integration in the development phase (Crnkovic, 2001). The approach became more popular in the 1990s when software development needed to start to cope with the increasing complexity of software and quick changes in the field more widely (Crnkovic, 2001).

Style guides, which are artifacts of the most design systems, became popular in 1990s due to the rise of user-centered development (Gale, 1996). In the background of the change to more user-centric view was the growing numbers of personal computers and the Internet, and the tools developed to better answer to the needs brought by these changes, such as CSS, JavaScript and graphical user interface design tools (Vesselov and Davis, 2019). In that time style guides were written documents which defined the style the organization should follow. Gale (1996) states that the objectives of a style guide are to promote visual and functional consistency, promote good design practice and reinforce company branding. These objectives are also directed to modern design systems.

In 2000s, developers started to find building web sites page by page problematic because changes done in one page needed to be repeated in all the pages (Vesselov and Davis, 2019). According to Vesselov and Davis (2019), this became a real concern because as the complexity of the websites started to rise, the teams had to start thinking more about performance, scalability and maintainability of the websites they were developing. As a result of these concerns, organizations started to develop reusable components and building websites using them instead of building entire pages at once. In addition, development of Agile methodology affected the software development because in the 2000s developers and designers started to work together iteratively instead of doing handoffs to each other (Vesselov and Davis, 2019).

According to Churchill (2019), the modern way of developing design across products and platforms became popular around 2011. Nowadays, many of the most successful companies pay plenty of attention to design and appreciate the value good design can bring to the organization (Vesselov and Davis, 2019). The modern way of developing design includes applying the component-based approach to design in addition to the development (Suarez et al., 2018). It also requires seeing the products of the company and their goals as a whole while doing development in small pieces (Vesselov and Davis, 2019). As a result, the first design language, Material Design by Google, was launched in 2014. Later Material Design has been referred as the first design system since the term became popular due to the publication of Atomic Design in 2016 (Frost, 2016).

3.3 Benefits of design systems

A design system has benefits for both organizations internally and users of organizations' applications and platforms. These benefits are gone through separately in the

subsection 3.3.1 about benefits for organizations and 3.3.2 about benefits for end users. All the benefits of design systems are summarized in Table 3.

Benefit	Description	Resources
Reduced amount of needed development and design work	The usage of reusable components reduces the amount of overlapping work in an organization.	Churchill (2019) Gale (1996) Vesselov and Davis (2019)
Reduces maintenance	The changes done in a design system are repeated in all applications using a design system.	Gale (1996) Suarez et al. (2018)
Make prototyping easier	Development teams can prototype and iterate ideas faster with reusable components.	Edelberg and Kilrain (2020) Suarez et al. (2018) Vesselov and Davis (2019)
Design consistency	Organization is able to present its brand similarly regardless of the application or platform.	Gale (1996) Yew et al. (2020)
Decrease technical and design debt	The usage of the design system helps the teams to avoid short-term solutions.	Suarez et al. (2018)
Increase in cross-functional collaboration	A design system has potential to reduce disagreements between people because it aims for a common purpose and to prevent handoffs.	Churchill (2019) Suarez et al. (2018) Vesselov and Davis (2019)
More consistent work and less errors	As a result of standardization of components, employees make less errors and their productivity is improved.	Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Learning process is eased	Junior developers and designer are able to use reusable design and components and learn from it.	Churchill (2019) Moore et al. (2020) Vesselov and Davis (2019)
Better user experience	The development teams have more time to work on user experience and gather feedback from users.	Novák et al. (2019) Vesselov and Davis (2019)
More predictable applications	Consistency makes applications more predictable and easier to understand for the users. It also decreases the cognitive load and increases usability.	Gale (1996) Moore et al. (2020) Suarez et al. (2018)
Support for accessibility	Adding accessibility aspect to a design system makes the user experience better for all the users.	Crabb et al. (2019) Suarez et al. (2018)

Table 3: Summary of the benefits of design systems.

3.3.1 Benefits of a design system for organizations

The main benefit of the design system for organizations is that it reduces the amount of work needed for development. [Churchill \(2019\)](#) discusses that the reason is that a design system reduces the amount of overlapping work in the organizations because developer and designers can use reusable components instead of developing new

components every time. [Gale \(1996\)](#) mentions in his article that the usage of style guides makes it possible that the designers do not have to re-invent the wheel over and over again in their work. This also reduces the overall development time and leaves more time to work providing more value for the organization, such as idea generation and research ([Gale, 1996](#); [Vesselov and Davis, 2019](#)).

Reusable design and development also reduces the need for maintenance of the applications, according to [Suarez et al. \(2018\)](#). They state that the reason is that the changes done in a design system will be further repeated in all the applications where the system is used, instead of needing to repeat these changes manually. [Gale \(1996\)](#) also mentions that reusability of code makes the applications easier to maintain and so decreases the time needed for development in the organizations. In addition to maintenance, [Suarez et al. \(2018\)](#) mention that a design system also eliminates the need for starting to develop a new application from scratch in the most cases.

Reusable design and code can be beneficial in prototyping products and services as well. [Suarez et al. \(2018\)](#) argues that a design system makes it possible for development teams to prototype and iterate their ideas faster using reusable components. [Vesselov and Davis \(2019\)](#) continues that a design system gives the designers possibility to see what will be actually in production through prototyping instead of using only design tools. They state that a design system overall brings designers closer to the final product earlier in the development process in order to test possible solutions. [Edelberg and Kilrain \(2020\)](#) also agrees by stating that a design system is a single source of reference for development teams to ideate and iterate.

Having design consistency is one of the main reasons for organizations to build design systems, according to [Yew et al. \(2020\)](#). [Gale \(1996\)](#) discusses in his article that the rise of organizations having different applications running on different platforms has increased the need for having design consistency. The reason behind this is that organizations want to present their brand as the same although the application or platform is different. [Gale \(1996\)](#) state this is especially important when the company wants to differentiate its image or product and service quality from the competitor's.

[Suarez et al. \(2018\)](#) state that having consistency in products and services also helps organization to lower its technical and design debt. The reason is that using a design system prevents the team from building short-term solutions and as a result providing non-reusable and inconsistent code or design. On the contrary, when reusable components of a design system are used, there is no need for fixing short-term solutions in parts where the system has been used.

[Churchill \(2019\)](#) states that design systems increase the amount of cross-functional collaboration in organizations. In practise, this means that design systems have potential to reduce disagreements between people because the design system aims to facilitate teamwork and create a common purpose. [Suarez et al. \(2018\)](#) agrees with this by stating that having design principles decreases the amount of time used in debating solutions. Design systems also aim to work as a bridge between design and development and as such prevent handoffs in organizations ([Suarez et al., 2018](#); [Vesselov and Davis, 2019](#)). As a result of increased collaboration, employees of the organization can be even more satisfied with their jobs and have less stress ([Churchill,](#)

2019).

According to [Suarez et al. \(2018\)](#), a design system helps the employees to work more consistently and prevent errors. [Gale \(1996\)](#) states that preventing errors by using style guides as a standardization will let the employees to be less frustrated while working. He continues that style guides have a possibility to increase the employee's confidence in the system and improve their productivity. [Vesselov and Davis \(2019\)](#) state the consistency helps people to work more autonomously and as a result the organization moves faster as a whole. [Suarez et al. \(2018\)](#) even argues that a design system site can be the best, most accessible source of truth for the development teams.

[Churchill \(2019\)](#) argues that design systems are easing the learning process in organizations. The reason is that junior designers and developers can use the expertise of the design system for learning from the decisions and reasoning of the system, and even propose something new based on the process. [Moore et al. \(2020\)](#) highlight that a design system helps learning by providing a conversation space for designers and developers of the organization. [Vesselov and Davis \(2019\)](#) take a different approach to learning by stating that a design system can be used for onboarding in the whole organization because it defines common terminology, concepts and patterns for the product.

3.3.2 Benefits of a design system for end users

[Vesselov and Davis \(2019\)](#) state that the reduced time spent in overlapping development has value for the end users in addition to the organization. They state that by using a design system, the development team have more time to work on user experience of the applications and as a result, improve it. Another benefit mentioned by them is that the development cycle time can be reduced and so more feedback can be gathered from the users. This feedback can further be used when improving the product to better reflect the user needs. [Novák et al. \(2019\)](#) discuss in their article that a design system can help the applications to have better user experience in fields where user experience has yet not been widely addressed, such as agriculture. The reason is that the usage of a design system does not require as much design work and instead, the developers can build the usable applications by using it.

Design consistency has also value for the users. [Suarez et al. \(2018\)](#) states that design systems make applications more predictable and easier to understand for the users. They continue that pages having countless number of interface elements can actually raise the cognitive load of the users and design systems help to deal with this issue. [Moore et al. \(2020\)](#) agree by stating that reusable components frees the user from learning new interaction methods all over again and makes the navigation of graphical interface easier. [Gale \(1996\)](#) continues by saying that the usage of style guides can increase the usability of the systems and customer satisfaction. [Suarez et al. \(2018\)](#) are also arguing that a common visual language, appealing to for example colors and icons, helps the organization to have more consistent user experience.

The awareness for the need for accessible applications has been rising lately but the developers of applications are still not good at implementing accessible applications

(Crabb et al., 2019). It is also a common misunderstanding that accessibility affects only a small minority of people needing assistive technology but actually it is a concern for 15% of all people (Suarez et al., 2018). Regarding this topic, Suarez et al. (2018) argue that design systems should value accessibility. They argue that making a site accessible for users with disabilities makes the user experience better for all users because then sites are easier to use and has less cognitive upload. Organizations should also pay attention to accessibility because nowadays there are laws which require the organizations to have accessible applications at least at some level (Suarez et al., 2018). Therefore, accessibility should be one of the focus areas when building a design system.

3.4 Challenges of design systems

Some common challenges of developing designs systems were brought up in the literature review and they are gone through in this section. The challenges are summarized in Table 4.

Challenge	Description	Resources
Documentation	Keeping documentation up-to-date can be difficult and documentation should not be too long or difficult to read.	Gale (1996) Suarez et al. (2018)
Breaking changes	If there are a lot of breaking changes and they are not versioned well enough, users may not know which version to use.	Suarez et al. (2018)
Performance degradation	A design system may face issues in loading times, especially for mobile users.	Suarez et al. (2018)
Presenting a new design system	Presenting a design system is often not thought from the perspective of successful adoption.	Gale (1996) Vesselov and Davis (2019)
Culture of an organization	The easiness of adoption depends on an organizational culture in perceiving standards, and communicating them.	Edelberg and Kilrain (2020) Gale (1996)
Starting the development process	Development teams tend to start the development too quickly or aim for perfection.	Vesselov and Davis (2019)
Measurement of success	Measuring the success of a design system may be difficult in quantifiable terms.	Vesselov and Davis (2019) Yew et al. (2020)

Table 4: The potential challenges of design systems.

Suarez et al. (2018) argue there are three common challenges of design systems which they have seen occurring in multiple organizations: keeping documentation up-to-date, handling breaking changes and avoiding performance degradation. When it comes to keeping documentation up-to-date, they state that it is common that the documentation is written separately from the other development processes or the documenting process is not automated enough. These will result the documentation being out-dated. Gale (1996) agrees that updating documentation is a common problem of organizations. He also mentions that documentation should not be too long or otherwise difficult to read in order to be usable for the users.

The second common challenge mentioned by [Suarez et al. \(2018\)](#) is dealing with breaking changes. A breaking change in a design system context is referring to a situation where the usage of an existing component is being changed ([Suarez et al., 2018](#)). According to [Suarez et al. \(2018\)](#), this can lead to difficulties because tracking the changes can be difficult for the design system development team and as a result the users may not know which version of the system they are using or should be using.

[Suarez et al. \(2018\)](#) mentions performance issues as a third common challenge of design systems. They state that performance issues are usual when a design system has grown to include a lot of components. If performance is not taken into account in the early development phase, the system will have issues regarding loading times, especially for mobile users.

[Gale \(1996\)](#) presents in his article the presenting of a new system as an usual challenge of style guides. He states that organizations often do not think how the system should be presented to the users in order to get the users to know about the system and to accept it. [Vesselov and Davis \(2019\)](#) agrees with this by stating that design systems often fail due to the lack of initial support from the organization.

[Edelberg and Kilrain \(2020\)](#) argue that the adoption of a design system can be difficult due to for example internal structure, communication and culture of the organization. [Gale \(1996\)](#) gives examples that the culture of perceiving standards to be boring and out-of-date, and different development teams using widely different development methods and tools can affect the success of a style guide.

[Vesselov and Davis \(2019\)](#) mention in their article that the process of starting the development of the design system can be difficult for many organizations. Basically, it means that organizations and development teams tend to start the development process too quickly or aim for perfectionism. [Vesselov and Davis \(2019\)](#) argue that design systems often fail if the needs and challenges of the organization are not understood before starting the development process or the organization tries to develop a perfect system during the first iteration already.

[Yew et al. \(2020\)](#) mention in their article that the measurement of success and metrics are a common problem of design systems. [Vesselov and Davis \(2019\)](#) agree with this by stating that it is a challenge to describe the benefits of a design system in quantifiable terms. Overall, they state that it is rather easy to measure performance of a system but when it comes to for example user satisfaction, finding accurate measurements is more difficult.

3.5 Guidelines for building a successful design system

The literature review gave some guidelines for building successful design systems and these can also be viewed as potential solutions to possible challenges. In this section, these guidelines are further divided to subsections [3.5.1](#) for building a design system team, [3.5.2](#) about recommended development practices for a design system and [3.5.3](#) about adoption of a design system. The guidelines are summarized in Table 5 and mapped with challenges they could help solving.

Challenge	Possible solutions	Resources
Documentation	Documented code standards and best practices Iterative development Up-to-date documentation	Edelberg and Kilrain (2020) Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Breaking changes	Documented code standards and best practices Versioning of codebase	Gale (1996) Suarez et al. (2018)
Performance degradation	Mobile-first development	Suarez et al. (2018)
Presenting a new design system	Choose a suitable team composition Choosing tools both bottom-up and top-down Discussion with teams Design system team promoting Documented code standards and best practices Prototyping Understanding environment and organization Up-to-date documentation Versioning of codebase	Edelberg and Kilrain (2020) Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Culture of an organization	Choose a suitable team composition Discussion with teams Documented code standards and best practices Iterative development Prototyping Tracking adoption process Understanding environment and organization Up-to-date documentation	Edelberg and Kilrain (2020) Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Starting the development process	Choose a suitable team composition Choosing tools bottom-up and top-down Discussion with teams Iterative development Understanding environment and organization Variation in skillsets of team members	Edelberg and Kilrain (2020) Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Measurement of success	Quantitative and qualitative methods Tracking adoption process	Suarez et al. (2018) Vesselov and Davis (2019)

Table 5: The common challenges of design systems linked with possible solutions to them.

3.5.1 Building a design system team

[Suarez et al. \(2018\)](#) discuss in their article the possible structure of a design system development team and their suggestions are presented in Figure 4. First, they argue that one option is to have a single team responsible for developing a design system. The advantage of having a single team is that the team keeps the system well maintained and the development process is fast ([Suarez et al., 2018](#)). This approach goes well along with the needs of speed and cost-effectiveness of Agile development. The disadvantage of the approach is that the development team may have problems in connecting the different user needs because they may not have enough resources for doing user research ([Suarez et al., 2018](#)).

Other form discussed by [Suarez et al. \(2018\)](#) is to have a core development team which connects members from multiple other teams of the organization. This

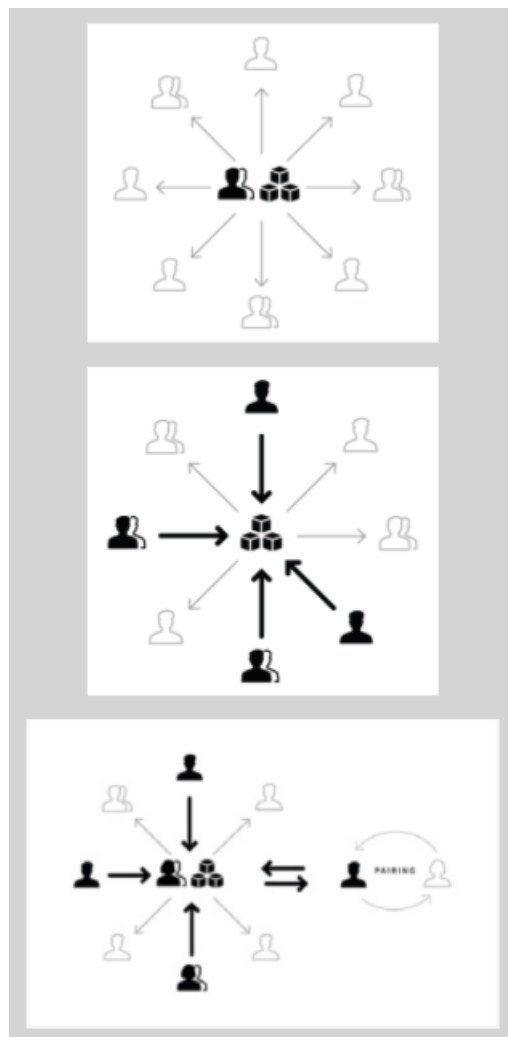


Figure 4: Different design system development team compositions presented by [Suarez et al. \(2018\)](#). The first picture is illustrating the situation where there is one team responsible over a design system. In the second picture, a design system team is formed from people working in various other teams. In the third picture, there is a core design system team that are in close collaboration with team members of other development teams.

approach has the advantage of providing different opinions to the development but it will also make the development process slower. [Suarez et al. \(2018\)](#) discusses also the possibility to form a design system team from people working across the organization in different development teams. This form tackles the issue of understanding the user needs but the team members may be too busy to be part of multiple teams at the same time.

[Edelberg and Kilrain \(2020\)](#) are also addressing the composition of the design system team in their article. They state that collaboration is the most important practice that will affect the outcome of the design system and recommend that multiple development teams work together in the development of the design system.

They think that many teams working together can provide better and coherent user experience than a small group working on a design system. This practise will also decrease the number of technical debt resulting from the lack of discussion with the end users (Edelberg and Kilrain, 2020). However, although Suarez et al. (2018) and Edelberg and Kilrain (2020) are giving some recommendations on the team composition, the organization wanting to start the development of the design system should choose the approach best suitable for their needs in order to have a successful design system.

The other topic related to the team composition is the skills of the team members. Edelberg and Kilrain (2020) are discussing in their article how a design system team should be formed in order to have as little difficulties as possible. First, they state that a design system team should include both junior and senior individuals working with design and/or development. Junior individuals provide different perspectives which can boost the creativity of the team. On the other hand, senior individuals are responsible for having the skills and knowing the processes needed for building the product. Secondly, Edelberg and Kilrain (2020) argue that a design system team should have a skill combination of software and hardware skills and that they should have knowledge on the modern software industry. In addition, they mention that it is important that the design system team works in real-time collaborative environment.

3.5.2 Recommended development practices for a design system

Gale (1996) argues that in order to have a successful product, the development team should understand the development environment and culture of the organization. Vesselov and Davis (2019) agrees with this by stating that it is vital to understand the company needs and challenges before starting to develop the design system. They continue that the process of starting to develop the design system may require a lot of time in the beginning and therefore the development team should accept that the development is not always as fast as they want it to be.

Vesselov and Davis (2019) states that the teams should always keep the process of developing the design system iterative and should not worry over every detail of the system. Suarez et al. (2018) agrees with this and continues that a design system requires ongoing maintenance and improvement when there are new needs rising from the teams using the system. Gale (1996) states that the system should be changed when the organization learns more about its environment. In addition, Edelberg and Kilrain (2020) argue that the design system team should have flexible processes and protocols in order to respond to the constantly changing environment. Therefore, the system does not need to be perfect at the first iteration but it can be adjusted based on the feedback from the teams. However, it is very important to stay in constant contact with the users and other stakeholders (Suarez et al., 2018; Edelberg and Kilrain, 2020).

Suarez et al. (2018) suggest to interview the teams who are going to use the design system under development. They argue that interviews make it possible to forecast problems, define principles which will make the users to use the system in a desired way and prioritize the most important aspects of the design system first.

Suarez et al. (2018) state also that discussions with the management are important because they have a power to decide about the funding of the design system. Vesselov and Davis (2019) agrees by stating that it is important to discuss with people from all the levels of the organization before starting to implement the system. As a result, everyone in the organization should understand the benefits of the design system (Vesselov and Davis, 2019).

There are also new technological innovations coming fast and within a few years a design system might be out-dated if technical changes are not done regularly (Suarez et al., 2018). Suarez et al. (2018) mention also that the developers of the design system should use versioning of the codebase when executing an iterative process in order to keep the teams up-to-date about the current status of the system and let them know if the version they are using is out-dated. Versioning can be done either for the whole system or for individual modules such as components (Suarez et al., 2018).

Suarez et al. (2018) suggests to build the design system taking the mobile users into account first so that the performance of the system will stay appropriate. The performance issues can be tackled by deciding the core components of the system and ensuring the modularity of the components so that there are no cross-dependencies. As a result, an application using the design system does not need to download the whole system for the user which makes the loading times more bearable.

Edelberg and Kilrain (2020) state the process of choosing the tools being used by the design system team should work both bottom-up and top-down. Bottom-up process means that designers are themselves exploring suitable tools and then these tools will be adopted up the organizational ladder. Top-down means that design and product leaders "align the organization around practise and platform standards". In an organization wanting to have a successful design system, both of these methods should be applied.

3.5.3 Adoption of a design system

Suarez et al. (2018) argue that prototyping is an important method for presenting the design system because by using the system themselves, the potential users perceive the value of the system more concretely. They recommend tutorials or other teaching methods in order to get the users faster to understand the system. Gale (1996) argue that the release of a style guide should include some training showing how the system should be used in practise and support material in order to have an easier adoption process.

Gale (1996) state that the team developing the style guide should raise awareness and promote the system around the users. The goal is that the users understand why the system is developed and why it should be used. Suarez et al. (2018) agrees with this by stating that the core development team of the design system can do presentations for the potential users where they explain the design principles of the system more deeply. One option for raising the awareness is to involve the users tightly into the development phase which will also decrease the number of resistance in the teams (Gale, 1996).

[Suarez et al. \(2018\)](#) discusses that the adoption process should be tracked by the team responsible over the design system. The tracking can be for example checking which components are used by the users and how much. They argue that the results can be used for further development of the design system because they can show which parts of the system may be underperforming or have some bugs. [Vesselov and Davis \(2019\)](#) are giving an example where they measure how long the development of one component took and then compare that to the time used in the application development.

[Vesselov and Davis \(2019\)](#) argue that it is important to measure the positive effects of the design system using both quantitative and qualitative methods. As a result, the development team will have some measures to show for the management about the effectiveness of the design system. [Vesselov and Davis \(2019\)](#) state that the overall goal of measuring the aspects of the design system is to show that the employees are more productive and satisfied with their job and users are more productive and happier with the product they are using.

[Suarez et al. \(2018\)](#) are addressing that clearly documented code standards and best practises are important in order to have successful design system. When the documentation is well made, designers and developers of the organization can easily use the design system and also contribute to the system. [Gale \(1996\)](#) agrees with this by stating that documenting a style guide ensures that the commitment and understanding of the users is reached. The easiness of contribution is not only important for the development of the system but also because the users contributing to the system are also more likely to promote the design system to others ([Suarez et al., 2018](#)).

The documentation being up-to-date is also important in the adoption process. The reason is that by having updated documentation, the team involved in the development process of the design system can promote the new practices replacing the old ones easier ([Suarez et al., 2018](#)). [Suarez et al. \(2018\)](#) argue that using automation for generating documentation, and storing documentation and codebase to the same place helps keeping the documentation up-to-date. They state that it also reduces the need for writing new code and makes the implementation easier for the new users. The worst situation with having out-dated documentation is that the new users start to use the system in a wrong way, and as a result they get frustrated and have to redo their work ([Suarez et al., 2018](#)).

3.6 Summary

This section summarizes the main results of the literature review. It aims to identify the most important answers to the research questions of the thesis based on the used publications. The section consists of three subsections which of [3.6.1](#) is dedicated to benefits, [3.6.2](#) to challenges and [3.6.3](#) to solutions of the challenges.

3.6.1 Benefits of a design system

In the literature review, it was found out that constructing a design system has benefits for both organizations and end users. It depends on the organization which benefits are the most valued, but based on the number of mentions on the literature, the main benefits of design systems are the reduced amount of needed development work, design consistency and better user experience. Increase in cross-functional collaboration, easier prototyping and maintenance, and the support for accessibility were also valued. The results are summarized in Table 6.

Benefit	Description	Main resources
Reduced amount of needed development and design work	The usage of reusable components reduces the amount of overlapping work in an organization.	Churchill (2019) Vesselov and Davis (2019)
Design consistency	Organization is able to present its brand similarly regardless of the application or platform.	Gale (1996) Suarez et al. (2018)
Better user experience	The development teams have more time to work on user experience and gather feedback from users.	Novák et al. (2019) Vesselov and Davis (2019)
Increase in cross-functional collaboration	A design system has potential to reduce disagreements between people because it aims for a common purpose and to prevent handoffs.	Churchill (2019) Vesselov and Davis (2019)
Easier prototyping and maintenance	Development teams can prototype and iterate ideas faster with reusable components. Maintenance is easier because changes done in a design system are repeated in all the applications.	Edelberg and Kilrain (2020) Gale (1996) Suarez et al. (2018) Vesselov and Davis (2019)
Support for accessibility	Adding accessibility aspect to a design system makes the user experience better for all the users.	Crabb et al. (2019) Suarez et al. (2018)

Table 6: The main benefits of a design system.

Most important for the organizations is that having a design system reduces the needed development work for applications in the organization. A design system allows using reusable components and other material instead of constructing it repeatedly ([Churchill, 2019](#)). Reusable components also leave more time to work with other tasks providing more value to the organization ([Vesselov and Davis, 2019](#)).

Design consistency has benefits for both organizations and end users. The goal of the organizations is to present their brand consistently across the applications and platforms and that is possible by using components ([Gale, 1996](#)). When it comes to end users, design consistency provided by a design system makes applications more predictable and easier to understand ([Suarez et al., 2018](#)). This helps to decrease the amount of cognitive load for the users and happens both inside one application and across multiple applications of an organization ([Suarez et al., 2018](#)).

For the end user, the main benefit is the better user experience of applications. In addition to the value to the organization, using reusable components provide for the designers and developers more time to work on the user experience of applications

and so provide more benefit for the end users (Vesselov and Davis, 2019). In addition, it is possible to reduce the length of the development cycle by using components and as a result, a development team can gather more feedback from the users in the different development phases (Vesselov and Davis, 2019). This is also beneficial in the fields where there is not much earlier experience on similar application usage and quickly constructed prototypes can be used (Novák et al., 2019).

Constructing a design system can help an organization to increase the amount of cross-functional collaboration (Churchill, 2019). A design system aims to encourage teamwork between developers and designers, and to create a common purpose across applications which has a potential to reduce disagreements in the organization (Churchill, 2019). Because a design system works as a bridge between design and development, the amount of working in silos and having handoffs should decrease in an organization (Vesselov and Davis, 2019).

Reusable components can be used for easier and faster prototyping of product and services for both design and development needs (Suarez, 2018). It also allows better communication between designers and developers while constructing a user interface (Vesselov and Davis, 2019). Overall, a design system can work as a single source of reference when generating new ideas and iterating older ones (Edelberg and Kilrain, 2020). In addition to prototyping, a design system should make maintenance of applications easier. This is because the changes done in a design system are repeated further down to applications when a new release is made (Suarez et al., 2018). As a result, the time needed for maintenance is decreased (Gale, 1996).

Accessibility was not one of the main topics of the literature review but the awareness of the need for accessible applications has been constantly rising (Crabb et al., 2019). Moreover, it has been pointed out that developers themselves struggle to pay attention to accessibility (Crabb et al., 2019). A design system should value accessibility when components and other material is constructed although it does not solve all the accessibility issues of applications (Suarez et al., 2018). In addition to gaining a larger end user pool, it can make the applications more usable for all the users and help an organization to avoid a lawsuit (Suarez et al., 2018).

3.6.2 Challenges of a design system

Challenges of design systems were not the main topics of the literature review. The reason is that the potential challenges were not that much discussed in the publications and most of them did not mention challenges at all. Overall, the challenges presented in the literature were common to all kinds of new software projects. The most relevant challenges in the field of this topic were writing documentation, technical challenges, adoption and development of a new design system and measurement of success. The results are summarized in Table 7.

The main challenge in the context of this thesis is development of a new design system. Development teams tend to start the development of a design system too fast and aim for perfection right at the beginning (Vesselov and Davis, 2019). A new design system can even fail if needs and challenges of an organization are not investigated enough when starting the development process (Vesselov and Davis, 2019). It can be

Challenge	Description	Main resources
Development	Development teams tend to start the development too fast and aim for perfection. Largely different development methods and tools inside organization can also affect.	Gale (1996) Vesselov and Davis (2019)
Adoption	Lack of initial support from an organization is an issue. There is often not enough thought on how users will familiarize themselves with a system and start using it.	Edelberg and Kilrain (2020) Gale (1996) Vesselov and Davis (2019)
Documentation	Keeping documentation up-to-date is difficult if documentation is written separately from other activities or not automated enough. Should not be too long or difficult to read.	Gale (1996) Suarez et al. (2018)
Technical challenges	If design system developers have difficulty managing breaking changes, users do not know which version they should use. Performance issues are an issue of larger design systems.	Suarez et al. (2018)
Measuring the success	Measuring the success of a design system is difficult in quantifiable terms.	Vesselov and Davis (2019) Yew et al. (2020)

Table 7: The main challenges of a design system.

also difficult to construct a common system when different development teams use largely different development methods and tools ([Gale, 1996](#)).

Adoption of a new design system across an organization can also be challenging. Generally speaking, the usual reason for a design system to fail is the lack of initial support from organizations ([Vesselov and Davis, 2019](#)). Organizations have a tendency to not have enough thought on how users should get familiar with a new system and to start using it ([Gale, 1996](#)). In addition, organizational structure or poor communication can affect the adoption of a design system ([Edelberg and Kilrain, 2020](#)).

Documentation is often a challenge for design systems. It is common in the organizations that writing documentation is separated from other development practices ([Suarez et al., 2018](#)). It is also possible that the process of producing documentation is not automated enough, which raises the needed time for having relevant documentation ([Suarez et al., 2018](#)). This easily results in the documentation to be out-of-date. In addition, documentation should not be too long or otherwise difficult to read so that the users are willing to familiarize themselves with the documentation of a system ([Gale, 1996](#)).

Design systems are often large and therefore they are vulnerable to technical challenges. This applies to breaking changes which are changes where the usage of an existing component is being changed. In the context of design systems, tracking breaking changes can be difficult for a team managing a design system and as a result, users may be unsure which version of a design system should be used ([Suarez et al., 2018](#)). Performance issues are also common for large design systems ([Suarez et al., 2018](#)). If performance is not taken into account early in the development, especially mobile users will face long loading times.

Measuring the success and developing measurement metrics for a design system are a common challenge as well ([Yew et al., 2020](#)). Overall, it is difficult to describe

the benefits of a design system in quantifiable metrics (Vesselov and Davis, 2019). It is easy to measure the performance of a system but developing metrics to for example user satisfaction and usability can be challenging.

3.6.3 Solutions for the challenges of a design system

The literature review provided a lot of guidelines and suggestions for having a successful design system. These guidelines were always not straightly pointed to which challenges they could solve, but this thesis aims to do some kind of linking between challenges and possible solutions. These solutions and possible challenges they could solve are summarized in Table 8.

Challenge	Possible solutions	Main resources
Development	Choose a suitable team composition	Edelberg and Kilrain (2020)
	Iterative development	Gale (1996)
	Promoting a design system	Suarez et al. (2018)
	Understanding context and requirements	Vesselov and Davis (2019)
Adoption	Choose a suitable team composition	Edelberg and Kilrain (2020)
	Iterative development	Gale (1996)
	Promoting a design system	Suarez et al. (2018)
	Understanding context and requirements	Vesselov and Davis (2019)
Documentation	Iterative development	Edelberg and Kilrain (2020)
	Up-to-date and clear documentation	Gale (1996)
		Suarez et al. (2018)
Technical challenges		Vesselov and Davis (2019)
	Technical improvements	Gale (1996)
	Understanding context and requirements	Edelberg and Kilrain (2020)
Measuring the success		Vesselov and Davis (2019)
	Measuring the adoption	Suarez et al. (2018)

Table 8: The main solutions to challenges of a design system.

The solution getting the most mentions was choosing a suitable team composition and it is also important in the context of this thesis. A suitable team composition means how a design system team is constructed or if an alternative development method should be used. It is possible to have a single dedicated team responsible over a design system and its advantages are good maintenance and a fast development process (Suarez et al., 2018). A design system team can also be constructed by connecting team members from different teams and that ensures getting different opinions on the needs of a design system (Suarez et al., 2018). Design system developers can also work in different development teams of an organization and they work collaboratively towards a common solution (Edelberg and Kilrain, 2020). This approach makes it possible to have different opinions and better meet the user needs too, but it requires careful thinking in time allocation so that the developers have enough time to work with both a design system and their other projects (Suarez et al., 2018).

Before starting the development of a design system, the context and the requirements of a design system should be well understood. In the publications, it was stated

that it is important to have knowledge on for example the development environment, culture of an organization, company needs and possible challenges (Suarez et al., 2018; Vesselov and Davis, 2019). As a result of these requirements, starting the development of a design system may require some time and the development team and users of a design system should keep that in mind (Vesselov and Davis, 2019). A good practice is also to interview the future users in the beginning of the development phase because it enables forecasting issues and making an appropriate prioritization of components and other material (Suarez et al., 2018).

Iterative development is crucial in the process of building a design system. When starting a development of a design system, the developers should not worry over every detail of a system (Vesselov and Davis, 2019). Instead, improvements should be made to a design system when there are new needs required by the users (Suarez et al., 2018). This requires having flexible development processes and protocols so that a design system can meet the needs of a constantly changing environment (Edelberg and Kilrain, 2020). A constant interaction with users and other stakeholders of an organization are also important so that a design system can be adjusted based on feedback (Suarez et al., 2018; Gale, 1996).

A design system should be promoted inside an organization and prototyping is one of the methods that could be used. A recommendation is that a design system development team is responsible for promotion because they understand the system and its benefits the best (Suarez et al., 2018; Gale, 1996). When prototyping is used in promoting, potential users perceive the value of a design system more concretely (Suarez et al., 2018). However, a design system team should participate in prototyping by giving tutorials or use other teaching methods so that users get familiar with a design system faster (Suarez et al., 2018). It is also possible to raise awareness by closely involving users in the development and that can also decrease the resistance towards the system (Gale, 1996).

Paying enough attention to documentation is important so that it is easy enough for users to start to use a design system or even contribute to its development. Good documentation can help with ensuring that users understand a system well and can commit to using it (Gale, 1996). In addition to documenting how components should be used, code standards and best practices should be documented in order to ensure the desired usage of a design system (Suarez et al., 2018). Documentation should be kept up-to-date all the time so that both a team developing a design system and users of it know the most recent practices (Suarez et al., 2018). Automation should be exploited for generating documentation and documentation should be stored in the same place with codebase to make it easier to keep documentation up-to-date (Suarez et al., 2018).

The adoption process of a design system should be measured in order to have better communication for users and management. For example, it could be measured which components of a design system are used and how much because it can help identify bugs and other issues (Suarez et al., 2018). The positive effect of a design system can be measured by calculating how much time the development of a component took and then comparing that to time saved in application development (Vesselov and Davis, 2019). The overall goal of measuring is to find metrics that indicate the

increase in productivity for employees and the increase in satisfaction for the users of an application (Vesselov and Davis, 2019). These results should then be shown for management to prove the positive effect of having a design system (Vesselov and Davis, 2019).

There were also some technical improvements that were suggested in the literature. Technical changes should be done regularly for a design system in order to prevent it from getting out-dated (Suarez et al., 2018). Versioning of a codebase should be done to a whole project or independent components so that users of a design system are up-to-date on the current status (Suarez et al., 2018). One way to tackle performance issues is to build a design system in a mobile-first manner or by ensuring modularity in which a whole design system does not need to be loaded when only some of the components are used (Suarez et al., 2018). When it comes to the tools being used in a design system development, the design system development team should be able to choose some of the tools being used but the tools should be aligned well enough with the organizations and its standards (Edelberg and Kilrain, 2020).

4 Results of the empirical study

4.1 Interviews

In this section, the results of the interview research will be gone through. Section 4.1.1 presents the current status of the global design system mainly based on the interviews, but the figures and their explanations are based on the observations of the system itself. Section 4.1.2 goes through what the interviewees thought about the goals of the system. Section 4.1.3 discusses how the interviewees perceive the success of the system and what kind of benefits they think have been already reached. Section 4.1.4 presents the challenges of the global design system, both currently existing and already solved ones. The final section 4.1.5 goes through what was discussed with the interviewees about the future of the system. This section includes possible solutions to the current challenges, what benefits are expected to be reached and what kind of challenges there might be in the future.

4.1.1 Status of the global design system

The status of the global design system was mainly discussed with one of the interviewees. They explained that the global design system project started with couple of pilot teams from two countries. Those teams were chosen because they had the most knowledge on the most matured localized design systems of the company at that time. As a result, the adoption of the system was limited at first. The pilot teams also chose the technical stack to be used in the development of the new system to be aligned with their own stack. The global design system components were chosen to be developed by using Stencil.js because the framework allows building web components to be used in both React and Vue.js applications.

They stated that the focus of the design system has recently been on growing the design system and including more web components into it. One of the interviewees described that the global design system project started "like a start-up initially" meaning that the team was focused on doing their own development and trying to get people involved. However, they said that quite quickly people started to reach out and wanted to collaborate with the design system team. For these cases, the design system team is keeping up a Slack channel where people can send their bug reports and questions regarding the global design system.

Based on the interview with an interviewee, the developers of the design system implemented the web components to the global design system and the designers designed them across all countries but that is currently about to change due to the desire to increase the amount of contribution and collaboration. Until this moment, the global design system has been built without utilizing any public design system such as Material Design by Google. However, one of the interviewees highlighted that the localized design systems of the company has been used as a reference in the development process of the global system.

Based on the interviews, there is currently not a single application built by using only the global design system. One of the interviewees described the usage of the system "erratic" and said that it is a work in progress at initial stage. According to

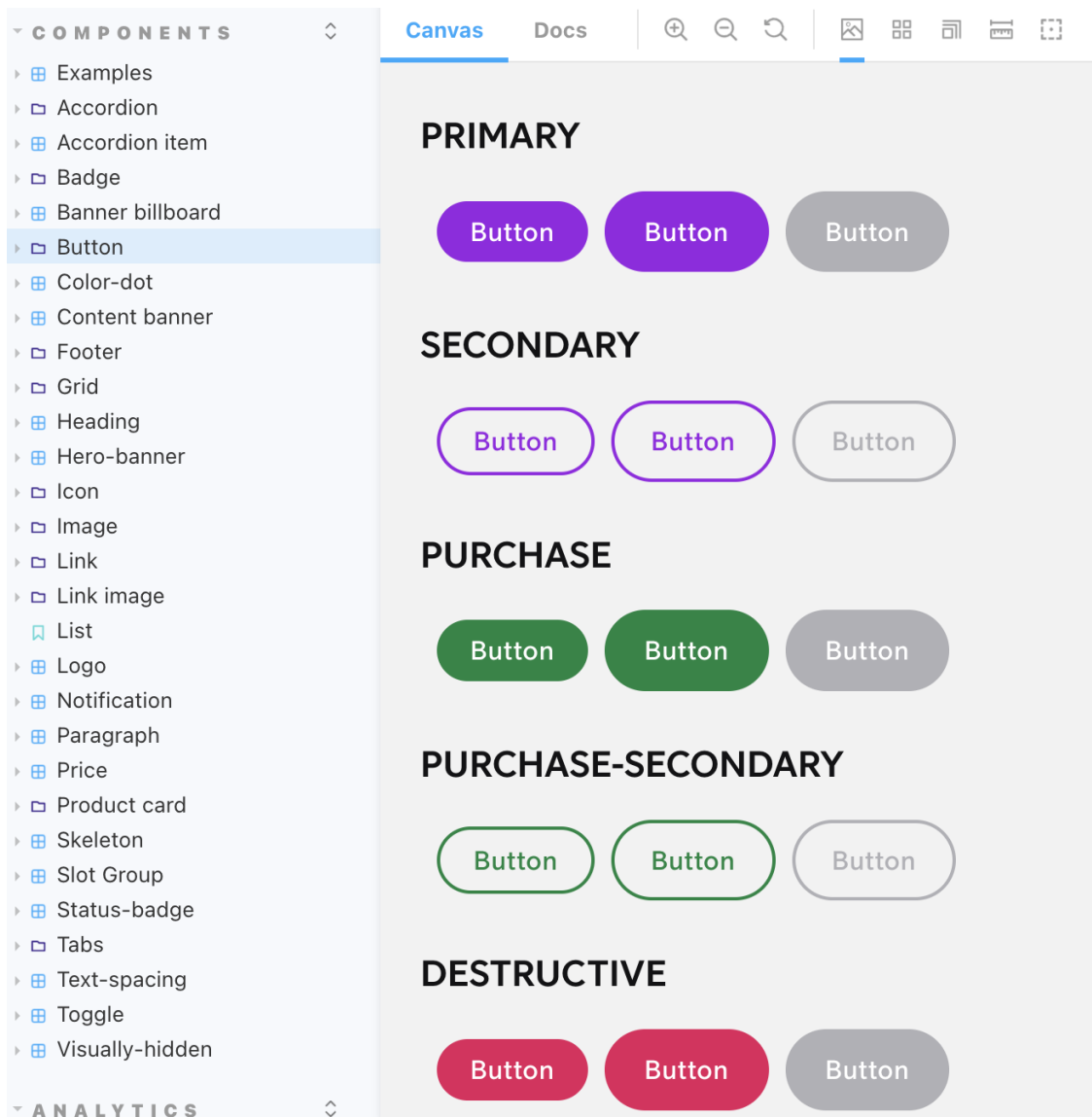


Figure 5: The current web components of the global design system under research and a button web component as an example.

another interviewee, the development teams of the company using the global design system are still using the old localized design systems along with the new one. There is even one country that is currently not involved at all and they are using only a localized design system.

Figure 5 represents the current web components included in the global design system and an example of the button web component in Storybook. In Figure 6, the web components linked to form actions are presented and an example of radio button group is shown. In addition as seen in Figure 6, the global design system includes also foundations and documentation. Storybook documentation includes information more relevant to developers whereas Figma has documentation for designers such as design guidelines and principles.

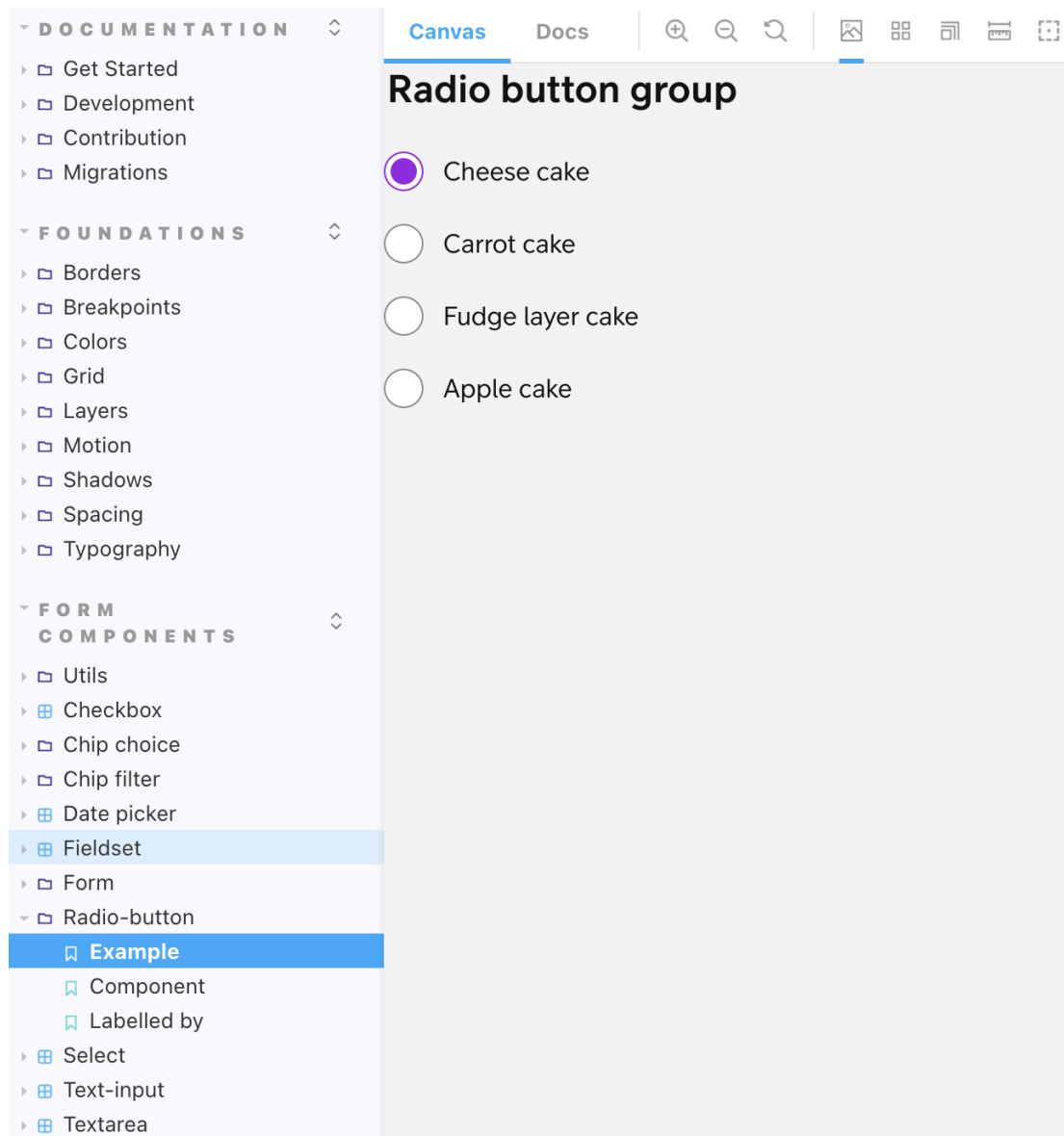


Figure 6: The current form web components, foundations and documentation for developers.

4.1.2 Goals of the global design system

The overall goals of the global design system were discussed in the interviews in order to get a view of what kind of benefits the company expects to gain in the future. This illustrated a larger image of the product because its development is still at the beginning. The goals mentioned by the interviewees are presented and categorized into goals and sub-goals in Table 9.

The goal of the global design system that was mentioned the most times and also by all the interviewees was customer centricity. According to two of them, the main objective of the user centricity is to ensure consistency between applications of

Goal	Sub-goals
Customer centricity	Ensure consistency between applications Consistency between market countries High quality in user experience Accessibility Clean brand representation
Save costs and reduce waste	Fewer developers and designers Reduce redoing things Reduce development time Reduce time to market Improve efficiency
Unify development tools and design	Modernize technical stack Unify stack across countries Build unified web components Unify and simplify design Common design principles across countries
Growth in collaboration	Global assets Contribution to the global design system
Reaching wider adoption	Alignment of the global design system More assets and guidelines Apps and tv global assets

Table 9: The goals of the global design system discussed with the interviewees.

each country. In practice, it means that the user experience and flow should be the same for example in the website and in the mobile application of the country. In addition, the consistency should apply between countries so that for example the flow of Finnish website should be similar with the Swedish one. The goal of high quality of the applications when it comes to user experience was also mentioned.

Other goals tightly linked to the user centricity were accessibility and clean brand representation. Two of the interviewees discussed the goal of accessibility by stating the goals of having accessible user journeys and meeting the global standards set for the accessibility. Accessibility standards have been set in different countries and also at European Union level so the company should meet them in order to avoid sanctions. The goal of having a clean brand representative was also quickly mentioned which is a positive approach for both business and users.

The goal mentioned the second most times was "save costs and reduce waste". One of the interviewees explained that it is the ultimate goal for business and it means basically reducing full-time equivalents (FTE). Having fewer developers and designers is possible when the company is able to reduce doing the same thing over

and over again. Another interviewee further explained the goal by stating that the company aims to build for example dropdown once instead of developing it separately in each country. It should also apply between different platforms. They stated that in addition to reducing FTEs, it would reduce development time and the time product gets into market, and improve efficiency in the company.

"It's kind of two-fold goal because on one hand you want save costs and you'll have less need for developers and designers but at the same time it would translate into user centricity, it would translate into unified design, brand and coded practices."

Linked to the development process of the global design system is the goal of unifying development tools and design. According to the interviewees, this goal includes modernizing the technical stack of the company and unifying it across the countries. It also encompasses the goal of reusing more and building shared web components. One of the interviewees added to the topic that design should be unified and simplified. They stated that currently there are many unnecessary differences between countries because all the applications have been built locally and even the brand has been interpreted differently in different countries. As a result, the designers should join forces and set proper basic principles in order to avoid pointless variations.

Unifying design and development is not possible without collaboration. It was mentioned that one of the goals of the design system is to help collaboration by being the single source of truth and providing web components that everyone can use. One of the interviewees stated that for the user it should be invisible that there are different teams working on different applications and this can be advanced by having global assets. Another interviewee discussed that the collaboration should also apply to the global design system itself by encouraging the teams to contribute and as a result they could have the sense of ownership for the product. However, it was also pointed out that although the global design system is part of the growth of collaboration in the company, it cannot solve everything. Therefore, the change in the way of working is the goal of the whole company as well.

Reaching wider adoption and the means to achieve it were goals that all the interviewees mentioned one way or another. One of the interviewees focused on the alignment. They stated that it is important to align the product so that it could serve everyone and the choices should not stop countries later joining to use the product. Another interviewee mentioned that the product needs clearly more adoption, more contribution and more web components. It was continued that there should be more assets and guidelines in the global design system so that it would be clear for all how to use the system and contribute to it. They also mentioned the goal of spreading the design system to apps and tv.

4.1.3 Benefits and success of the global design system

The company had not stated a definition of success for the global design system so I asked the interviewees how they would define it. One of the interviewees stated

that having a certain number of web components and variants would mean success at the initial stage of the product. The other discussed how they perceive the overall success of the global design system. They state that the system would be successful when it is the natural part of the workflow in the company. They also mention benefits such as speeding up the product development, enabling innovation and quality assurance. For the the third interviewee, the success meant better experience for both the developers and the end users, and efficiency of the development.

Below, there is a discussion of how the interviewees thought the global design system has already been beneficial for the organization. Some of the mentioned things are rather not benefits on their own but they are expected to lead to further benefits. The benefits are summarized in Table 10.

Benefit	Description
Global assets	Save design and development work Better usability, up-to-date and on brand More time to focus on user journeys and new services
Growth in usage and prepared to scale up	Analytics function, continuous deployment and visual testing Usage of the global design system grows exponentially
Growth in number of contacts	People face the issues the global design system tries to solve Awareness of existence of the global design system grows
Increase in collaboration	Designers form closer relationships with each other Global collaboration
Expose issues and risks	Find out issues that make the global initiatives more difficult
Miscellaneous	Better accessibility Modernize technical stack Take all countries into account

Table 10: The benefits of the global design system discussed with the interviewees.

An already reached benefit mentioned by all the interviewees was having the global assets. One of the interviewees had done a research about the effectiveness of having global web components and the result was that the amount of design and development work being saved was remarkable in the project under research. The other interviewee had heard good feedback about the usability of the assets and that they are well built, up-to-date and on brand. It was also perceived as a good thing that the teams do not have to redo the components and instead they can focus more on user journeys and inventing new services. The third interviewee also mentioned that the system has been successful when it comes to the number of users and web components. They state that the goal of being more efficient has been partly reached because when the global web components are used, the need for redoing and time to market decrease.

The usage of the global design system has been growing fast in the organization and the project is also prepared to scale up. One of the interviewees stated that

the design system team has successfully started setting up an analytics function, continuous deployment and visual testing in order to serve more teams seamlessly. Some other interviewee described the increasing usage by stating that the insertions of the web components and the number of teams using the design system has grown exponentially in the past few months. The third interviewee discussed the growth by saying that the company has made some "good strides" towards the wider usage but there is still a very long way to go in order to have a mature global design system.

In addition to the growing usage, the design system team has been reached out more recently. Two interviewees mentioned that they have been contacted more due to people facing issues that the global design system is trying to address. One of them listed such issues, for example lack of alignment, user experience guidelines and what is the brand of the company like. One also stated that they find the act of people reaching out more as a good indication of that the design system team is in the right place. The other of them added that it is also indicating that the awareness of the existence of the global design system is increasing in the company.

"We've also noticed that we are getting more and more people reaching out to us because they are facing the same issues that we are trying to address with the design system."

Increased collaboration was perceived as one of the benefits of the global design system although it is also connected to the wider transformation of the company. One of the interviewees mentioned that from the initiative of the design system team, the designers of different countries have started to form closer relationships in order to collaborate more. Another interviewee discussed that the global design system, as the first global initiative of the company, has shown to the employees of the company that it is fine to collaborate globally. They also mention that the global design system Slack channel has helped with getting people get into touch without meeting physically.

A benefit discussed a lot by one of the interviewees, but not that much mentioned by the other was exposing issues and risks, and informing them to the management. They explained that because the global design system is the first major global initiative of the company, during the project a lot of issues have been found that are making the global approaches more difficult in the company. One of such issues is the lack of alignment when it comes to development and design tools and practices. As a result of finding these issues and risks, the management is now able to do decisions easing the company transformation and further global initiatives.

There were also some miscellaneous benefits that were linked to the development of the global design system. First, in two interviews it was discussed that the design system has been an example in the company of how accessibility of products should be addressed. In the end, that will be a benefit for the end user. It was also mentioned that the global design system approach has been part of modernizing the technical stack used in the company and aligning it between countries successfully. Another thing was that the interviewees think that design system team has succeeded in globality while reaching out to all the countries where the company is operating in the development process.

4.1.4 Challenges of the global design system

Challenges was the topic discussed the most with the interviewees. Below is a list of the challenges that were discussed during the interviews. After that, the challenges and their reasons are gone through more deeply. All the challenges are summarized in Table 11.

Challenge	Decription
No alignment in development choices	No alignment in design tools Development, contribution and adoption are difficult
Resistance in product teams	Mature localized design systems No deadlines from management Lack of knowledge on technologies
The GDS not understood or known	Building global web components take time Goals and future existence of the GDS not known Marketing of the GDS is difficult in a large organization
Issues in the global design system team	Losing team members Lack of support for product teams Slow spreading of adoption in the organization Dependent on localized resources and initiatives
Lack of resources	Lack of specialized employees Product teams reluctant to collaborate Localized country budgets
Time issues	Development and adoption require time Tight deadlines of projects lead to lack of time for contribution Short-term mindset in the organization
Lack of collaboration culture	People not collaborating across country borders Poor collaboration between design and development
No unified design or design maturity	Different design between applications Design coming too late into the development process Design practices poorly documented
First global initiative	Getting initial buy-in for global initiatives Poor visibility of progress to the management Lack of global communication channels
Miscellaneous	Lack of knowledge on accessibility Guidelines lacking behind

Table 11: The challenges of the global design system discussed with the interviewees. Abbreviation GDS is used for the global design system.

The challenge which got the most mentions and was also mentioned by all the interviewees, was that there is no alignment in development choices in the company. In practise, it means that all the countries have had a chance to choose their own development tools, practices and frameworks. One of the interviewees mentioned that this also applies in the design side because everyone are not using the same design tools but the problem is not as big as in the development side. As a result, it has made the development of the global design system very complex and the system harder to contribute to, adopt and maintain because it needs to take the choices of different countries into account. They argued that the goal to serve all has become

almost impossible and that the management should mitigate the issue by choosing some of the best practices to be recommended in the company.

"We are meant to serve all, yet the stacks are varying, the technological choices that have been made in various parts of the organization are varied and it's hard to adjust and set up a product like a design system to serve all."

The challenge which got the second most mentions was resistance in product teams. The interviewees explained that there are some countries having relatively mature localized design systems and as a result, the product teams are reluctant to start using the global design system. One of the interviewees stated that in order to get them to switch, the global design system has to offer something that is not included in the localized design systems, and that is yet not the case. They also mentioned that because the management has not made any deadlines to start using the global design system, the product teams do not want to make the effort. It was also pointed out that the lack of knowledge on the technologies that are used in the global design system causes resistance, especially in the contribution.

Other challenge connected to the product teams is that the global design system is sometimes not understood or even not known at all in the organization. When it comes to the understanding, it was stated that the product teams do not always understand that building a global web component takes time. If a team has a need for some web component, they often expect the design system team to prioritize and build it immediately instead of waiting or contributing themselves. One of the interviewees also mentioned that there is uncertainty among the product teams on the goals and the future existence of the global design system because the project is still in the very beginning. They continued that some of the teams do not know the design system exists at all because the organization is very large and marketing the system is very difficult.

The challenge getting the third most mentions was the issues in the global design system team. According to the interviews, the team has been losing team members steadily which has slowed down the development. It has also affected how much the team is able to support the product teams requiring help with starting to use the design system or wanting to contribute to it. As a result, the product has not spread across the organization as fast as the company would have wanted. One of the interviewees even described that the team has been a bottleneck of the development of the system. Other interviewee criticized the way the design system team was formed initially because it consisted of people coming from different parts of the organization and the budget for the project came from those parts as well. Consequently, the design system team was very dependent on localized resources and initiatives instead of being an independent project.

The global design system project has been also overall lacking resources. The interviewees explained that there are for example no senior product designers or user experience researchers in the company to be consulted in the development process. It was also mentioned that it has been even difficult to get the right talent to the

design system team, for example team members having skills in accessibility. They argued that part of the lack of resources have been that people in the product teams are reluctant to collaborate or contribute so the shortage in the design system team cannot be countered that way. Another mentioned reason for the lack of contribution was that the country budgets are separate, and as a result the product teams do not have excessive time or budget to develop a global asset instead of doing it only for their use.

"Designers are still free to just not collaborate or not contribute, or they might start contributing and then just abandon midway because they decided not to."

The company is also facing time issues in the development of the global design system. The system is large and it will change the organizational environment a lot, so the development and adoption of it are taking time. According to one of the interviewees, the implementation of the design system or getting it up to speed are not easy, and there is a lot of hard work still to be done. The product teams are also having tight deadlines and a lot of stress so there is a lack of time when it comes to the contribution as well. It was also stated that the overall short-term mindset in the organization is affecting the development of the global design system.

The lack of collaboration culture in the organization was also discussed a lot in the interviews. It was explained that there is not much difference in the product and services provided in different countries but still people are not looking for possibilities to collaborate across country borders. It was even mentioned that the collaboration between design and development is sometimes at a poor level in the organization. However, the interviewees addressed that the global design system can help with the issue for some amount, but the rest will be left for the management and product teams.

Problems of the design side of the design system project are that there is no unified design or design maturity in the organization. "No unified design" means that the design and user experience are currently different between applications even inside the countries. In addition, the design is usually coming too late into the development, when the user interface is being developed, instead of being along the whole process. The global design system can help with these challenges but it is definitely not a silver bullet. When it comes to the design maturity, it was explained that the design practices are poorly or not at all documented and therefore they are not unified at all as well. These aspects make the development of unified design in the global design system more difficult.

The interviewees discussed that there is also some problems related to being a part of the first global initiative. Because of that, one of the interviewees described that getting an initial buy-in from the management was difficult. However, the challenge is nowadays more about getting the higher management to further invest into globality and otherwise supporting that kind of projects. They also mentioned that the visibility to the management is not in the place it should be because they are not getting a very concrete image of how the global design system benefits the

organization. Other challenge connected to the first global initiative is the lack of global channels. Other interviewee described that there are currently no global channels existing where they could see what is happening in different countries developmentwise. As a result, prioritizing the initiatives of the global design system can be difficult because the team may not have the knowledge on what is actually the most valuable thing for the business at the moment.

"I want to contribute but I don't know who to contact and I don't know how to do it so I'll just do my own thing like I've always done and then you miss an opportunity."

The last challenges mentioned were related to the development and contribution of the global design system. First, it was discussed that the knowledge on accessibility is in a low level in the company, and therefore the applications have not been earlier accessible enough. It was also mentioned that hiring people with more knowledge on accessibility has been rather difficult. The other thing mentioned was the guidelines lacking behind. One of the interviewees stated that the lack of guidelines has been one of the reasons why the status of the contribution is not in the level it should be. The main reason why the guidelines are lacking is that the usage of the system started to increase rapidly so the design system team could not keep up.

4.1.5 Future of the global design system

The discussions about the future of the global design system consisted of the possible solutions to the current challenges, and expected future benefits and challenges. The topics will be gone through in that order. Possible solutions are also summarized and linked to the challenges they could possibly solve in Table 12.

The main solution to the current challenges discussed by the interviewees was changing the model of working in the design system project. The aim is to change the role of the design system team to mainly govern the system and to review the contributions from the product teams. The web components would be built by the product teams because they have more resources and are building them for their own usage any way. So instead of building the web components for the usage of the product team only, they are going to build global web components that will be reviewed and adjusted by the design system team, and then added to the global design system. As a result, the global design system will grow faster and the growth will not be limited to the resources of the design system team.

Other solutions connected to the employees are having the management more involved and having a more stable team. One of the interviewees explained that due to the challenges there has been in the technology alignment, the design system team is currently more focused on the teams aligned with the technologies used in the global design system, and at the same time management is figuring out the alignment with other product teams. The management should be also responsible for prioritizing what should be built according the highest business value. In addition, it was discussed that the design system team should have enough people and be more

Challenge	Possible solutions
No alignment in development choices	More involved management
Resistance in product teams	Better guidelines and more assets Changing the model of working More involved management More stable team Sharing the goals of the design system
The global design system not understood or known in the organization	Design system team taking more role in promoting Sharing the goals of the global design system
Issues in the global design system team	Changing the model of working More stable team
Lack of resources	Better guidelines and more assets Changing the model of working Design system team taking more role in promoting More involved management
Time issues	Changing the model of working More stable team
Lack of collaboration culture	Changing the model of working Design system team taking more role in promoting
No unified design or design maturity	Design system team taking more role in promoting
First global initiative	Fully working analytics function More involved management Sharing the goals of the design system

Table 12: Summary of the challenges and possible solutions to them based on the interviews.

stable. This has started to be solved by hiring more people and aiming to rely less on the outsourced contractors.

Creating better guidelines and more assets were also mentioned as solutions. The guidelines should be in place so that it would be easy for the users to use the assets of the global design system or contribute to the system. One of the interviewees described that the guidelines would also ease the challenge of not having enough resources because then the users do not need that much support and can also contribute themselves if they need something. Another interviewee stated that the guidelines can also help with the motivation to start using the system because then the users will know the end goals better and see the results of using the system. It was added that if there are enough web components to be used, more people will start using the system naturally.

There were also some solutions getting only a quick mention. One of the interviewees that it should be very clear in the company what are the goals of the

global design system and that they are supported by the company. That would make the employees more confident to start using the system. Related to that, it was mentioned that the design system team should take more role promoting the global design system in the future. Another interviewee mentioned that when the analytics function is fully functioning, meaning that it would be possible to gather more data about the usage of the web components, there would be more visibility about the benefits of the product for the organization. The last solution mentioned was patience. With patience it was meant that the global design system is worth waiting for because the project has already come a long way although it has taken some time.

"Given that resources are always going to be limited, we don't have an opportunity to have a huge design system team that can cater to everybody else, so hence we've had to be creative and come up with solutions like I mentioned."

The benefit expected to be reached in the future which got the most mentions was better collaboration in the organization. From the initiative of the design system team, the company is going to set up design and frontend communities for sharing information both within the community and with the management. The goal is to share what the teams are doing, what is happening in the future and identifying commonalities between countries. It is also hoped that these initiatives will help the collaboration between developers and designers as well as between the design system team and product teams. One of the interviewees stated that even if the design system team was massive and had a huge budget, it does not guarantee the success of the system. Instead, contribution and collaboration is required so that the product teams will feel the ownership on the system.

The benefit which got the second most mentions was more value for the end user. There has been no big difference for the end user yet, but that is expected to be reached when the global design system is more matured. Maturity of the system means in this case that there are more web components to be used in innovating and that more product teams are using the system. As a result, the applications are going to be more consistent and there should be no difference in user experience between different applications and countries. However, this requires mobile web components which will be developed in the future. It was also mentioned that the global design system is going to help the product teams to achieve better level of accessibility through accessible web components.

The third expected benefit was return of investment. One of the interviewees stated that the monetary benefits the organization is hoping for are probably going to happen in the future. It was further explained that the return of investment will be probably reached when the global design system includes the most common web components and the product teams have gone through the effort of replacing their assets. Learning Stencil and good accessibility practices can also play a role in the schedule of the return of investment. However, the management is aware that the return of investment will still take time but they are expecting that the value the global design system will bring is going to outweigh the wait.

All the interviewees are also thinking that on-boarding will be a reached benefit in the future. In this context, on-boarding means a training about the global design system when a new employee joins to do either design or front-end development. The training includes for example information about the standards, practices and tone of voice of the company. The training will apply to old employees as well who should learn the new way of development instead of sticking into old habits. According to one of the interviewees, there should be also some educational material about the global design system for the higher management in order for them to understand the system better.

"For people to change their mindset from working, sort of siloed to being more collaborative, I think is what we're trying to achieve with the global source system like this."

There were also some future benefits getting only a quick mention. A very important one was that the interviewees are expecting the global design system to expand in the organization and to get adopted more widely. One of the interviewees described that the global design system should apply to broader organization, serve more teams and save more money in the future. Another interviewee mentioned that in the future the global design system should be a part of the natural flow of development and it can be used for innovating new products and services. Another benefit getting mentions was that employees will be happier in the future. There is a shortage of employees in some fields in the organization and those employees will probably be happier when they have less work to do due to having a global design system. They will also be more satisfied with their jobs when they do not have to repeatedly build the same components but they can focus more on serving the customers better.

Expected future benefits of the global design system:

- Better collaboration
- More value for end user and better accessibility
- Return of investment
- On-boarding
- Expanding in organization and being adopted
- Happier employees

There were also some future challenges mentioned during the interviews although most of the interviewees stated that it is difficult to predict the future from that perspective. The one getting the most mentions was that problems with full adoption due to technological challenges are expected. There is currently no plans on having alignment in frontend technologies which can cause problems in adopting the global design system. In addition, if people are not able to develop web components, for

example because they do not have time to learn Stencil.js, they will not be fully involved users of the global design system.

Another challenge getting multiple mentions was that all the employees will not be happy with the changes brought with the global design system. The global design system will decrease the freedom of choice when it comes to technologies and all the employees will not be satisfied with that change. In addition, the way of working is currently changing in the design system team. All the team members will not be happy with writing more guidelines instead of focusing on development and that has already been seen in the team. Other aspect of unhappiness is that people tend to not like to change their way of working. The company has hired the employees for some purpose and if that purpose is changing, some people will be unsatisfied and even leave the company.

There were also some possible challenges related to the change in the model of working in the design system team. The development is going to be pushed more to the product teams but at the same time the number of web components is going to raise. As a result, the product teams should be more responsible for maintaining the global design system because the design system team will not have enough time to do bug fixes and such things. Therefore, it should be made sure that there is enough people and guidelines when it comes to the maintenance of the system. One of the interviewees was also a bit worried over the situation if there are many changes coming quickly and the design system team does not have time to review them. Who will be then responsible over the accessibility and being on brand if the design system team becomes a bottleneck again?

Expected future challenges of the global design system:

- Problems with full adoption due to technological challenges
- Unsatisfied employees
- The future of the governance of the system

4.2 Survey

In this section, the results of the survey study are be presented. Section 4.1.2 goes through the answers to the questions related to the success of the global design system. These questions were about the satisfaction, value of the system and changes in work. Section 4.2.2 discusses the challenges. The questions about challenges asked about the perceived problems and why people are not using the system much or contributing to it. Section 4.2.3 is about the solutions to the challenges. In this part of the survey, the respondents were asked to tell in their own words how the global design system could be improved in the future.

4.2.1 Benefits of the global design system and satisfaction

After the background questions, the first question of the survey was about the overall satisfaction of the global design system. The answers are shown in Figure 7. The average of the responses was 2.73 which describes that people are either not very satisfied or unsatisfied with the current global design system. However, the development of the system is still in the beginning so the score is not as bad as it could be.

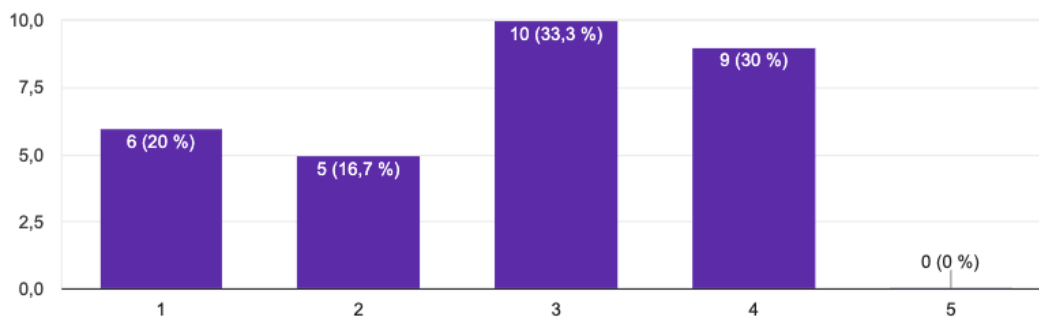


Figure 7: Summary of the answers to the question "How satisfied have you been with the global design system? 1 (not at all), 5 (very satisfied)."

The next question was about the value the global design system has provided. The answers can be seen in Figure 8. Approximately 67 % of the respondents thought that the global design system having global assets has provided them value. 50 % found that the system improving the accessibility of the applications is valuable. Other items getting a lot of mentions were being on brand, increasing collaboration between countries and helping to make more consistent applications.

There were no answer options with zero answers but modernizing technical stack, being updated regularly and increasing collaboration between development and design were found valuable the least. One respondent thought that the global design system does not provide value at all. Two respondents chose the option "other" but those answers were not further explained.

The third question was about the effects of using the global design system. The answers can be seen in Figure 9. Approximately 47 % of the respondents thought that the system has reduced the number of components being built in the product teams. 33 % found that they have learned new things and 23 % that they have had more time to work on other things while using the global design system.

None of the options got zero answers but prevented errors, prototyped new ideas and received more help at work were not very popular. Those are often the results of having a more matured design system so it is understandable that they were not yet achieved that much. 17 % of the respondents thought that their work has not changed and three respondents chose the option "other". However, the explanations of the answers were more about having challenges than positive changes in working.

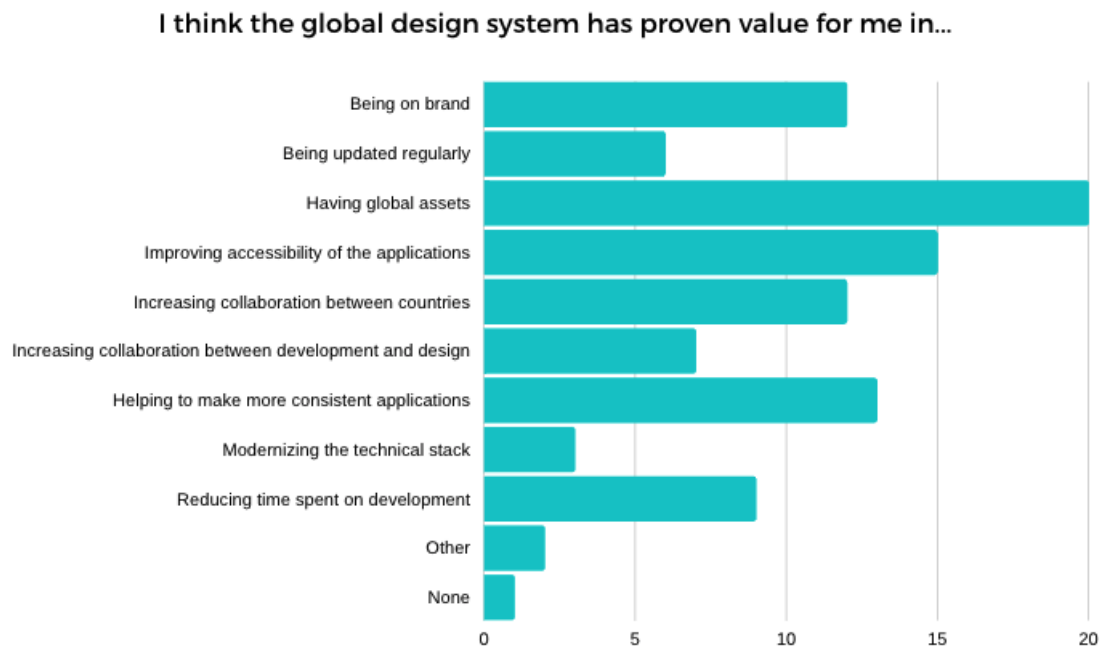


Figure 8: Answers to the question about the value of the global design system.

4.2.2 Challenges of the global design system

The first question about challenges asked the respondents about the problems they have perceived while using the global design system. The answers are presented in Figure 10. Almost all the respondents (87 %) had had problems with the lack of web components they need in the product teams. Other popular answer options were development of the global design system is slow (67 %) and documentation is not up-to-date (47 %).

Only one person thought that the documentation of the global design system is too long so it seems that the system is not having challenges with that aspect. Other answer options not getting many mentions were performance of the system is bad (20 %) and the visuals do not match the earlier ones (20 %). None of the respondent had not perceived any problems and 11 chose the answer option other.

The open-ended question after the checkbox question got 11 answers as well. Most of the challenges mentioned were related to the web components. Three people commented about the flexibility of the system. They argued that because the changes to the web components are limited, they cannot use the global design system in all of their use cases. Two people mentioned that Figma and Storybook documentation are not always synchronized. There were also two mentions about the maturity of the web components. Those people thought that the global design system is yet not ready for adoption because the web components are not sufficient enough.

There were also some other problems related to web components getting only one mention. One person argued that the examples of the usage of the web components presented in Storybook are not matching their needs and another mentioned that the variants of web components they need are missing. It was also argued that the

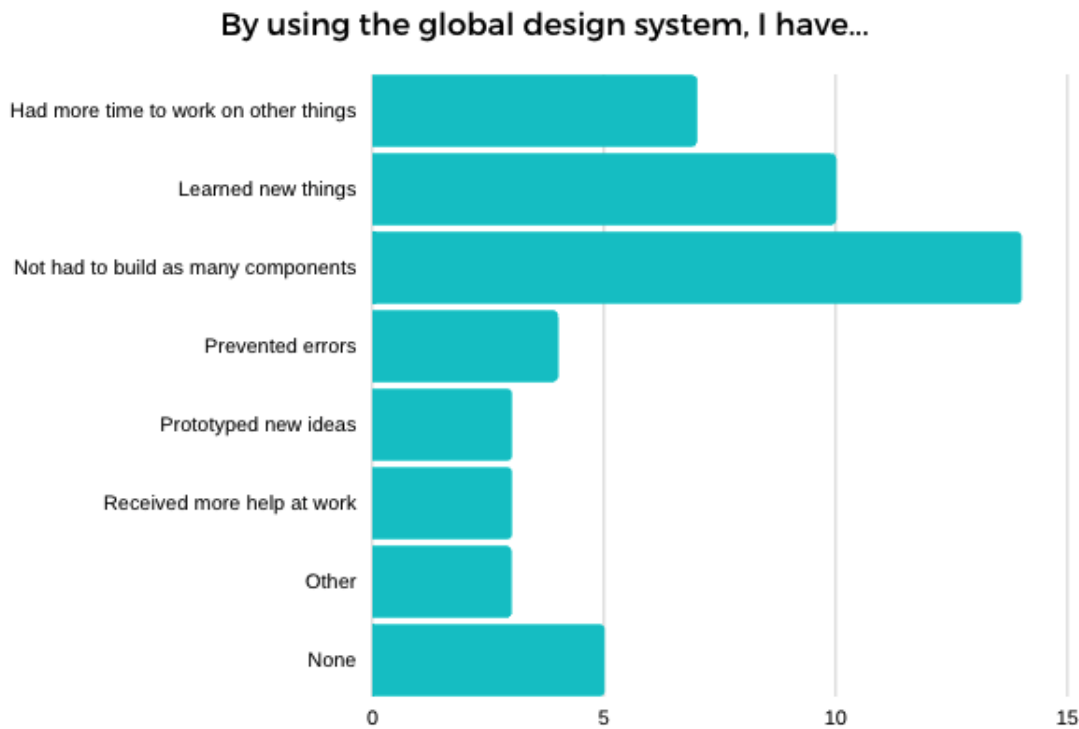


Figure 9: Answers to the question about the effects of using the global design system.

design of the web components is not up-to-date with company needs. One team had also faced an issue where one web component is breaking randomly. There were also mentions that all the web components are not stackable after each other and that the web components are not ready enough to be used in interactive prototyping. It was even argued if the web components are the best solution for the organization, and instead the organization should have libraries for different frameworks.

Some other problems related to the global design system were also mentioned. One team had tested the performance of the global design system themselves because there is no data about it presented anywhere. Another team had an issue where the design made by their own product team designers is misaligned with the design presented in the global design system. Some also thought that it is an issue that everybody is not currently using the global design system and that there is no common understanding of who owns the system in the company.

Other problems the respondents had perceived:

- Changes to web components are too limited
- Design and development documentation not synchronized
- Web components not sufficient enough
- Examples of usage of web components not matching needs
- Needed variants of web components missing

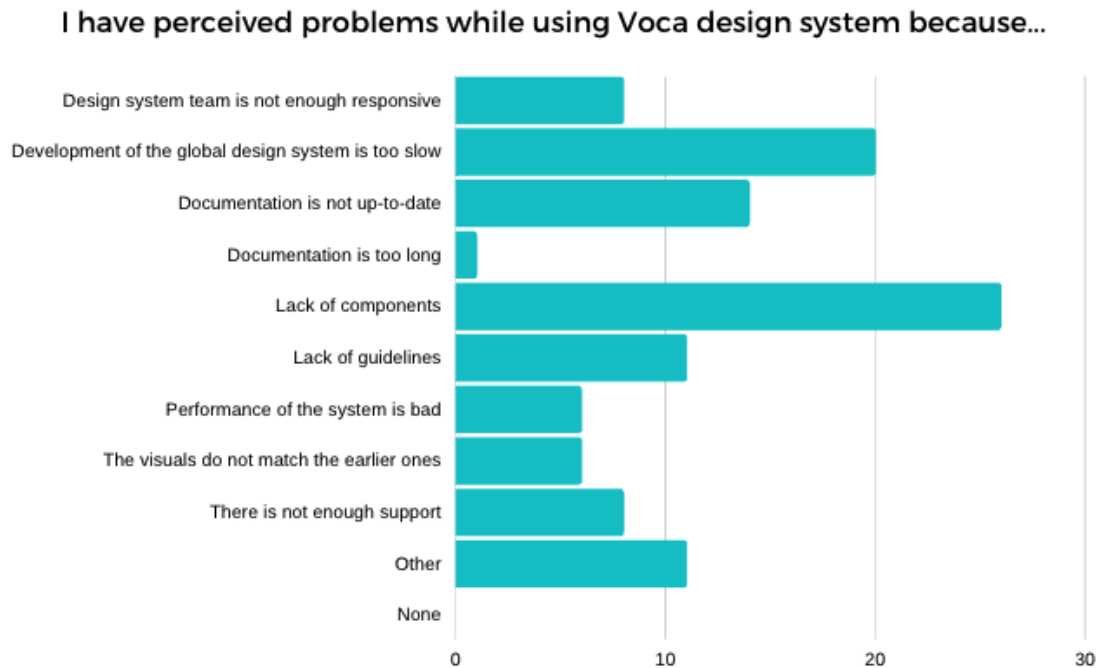


Figure 10: Summary of the answers to the first question about the challenges of the global design system.

- Design of web components not up-to-date
- Web components breaking
- Web components not stackable
- Web components not ready for interactive prototyping
- Usage of web components instead of having separate libraries for different frameworks
- No data about performance
- Design made by product team designers not matching global design system
- Everyone not using global design system
- No common understanding on ownership of the global design system

The second question about challenges asked the respondents about reasons why they are not using the global design system much or not contributing to it. The main reasons according to the answers were not knowing how to contribute (43 %) and not enough time due to deadlines (43 %). Effort is higher than benefit (30 %) and usage of some other design system (30 %) were popular answers as well.

Most of the respondents thought that not enough knowledge on accessibility (7 %) and unfamiliar technologies used in the development of the global design system are

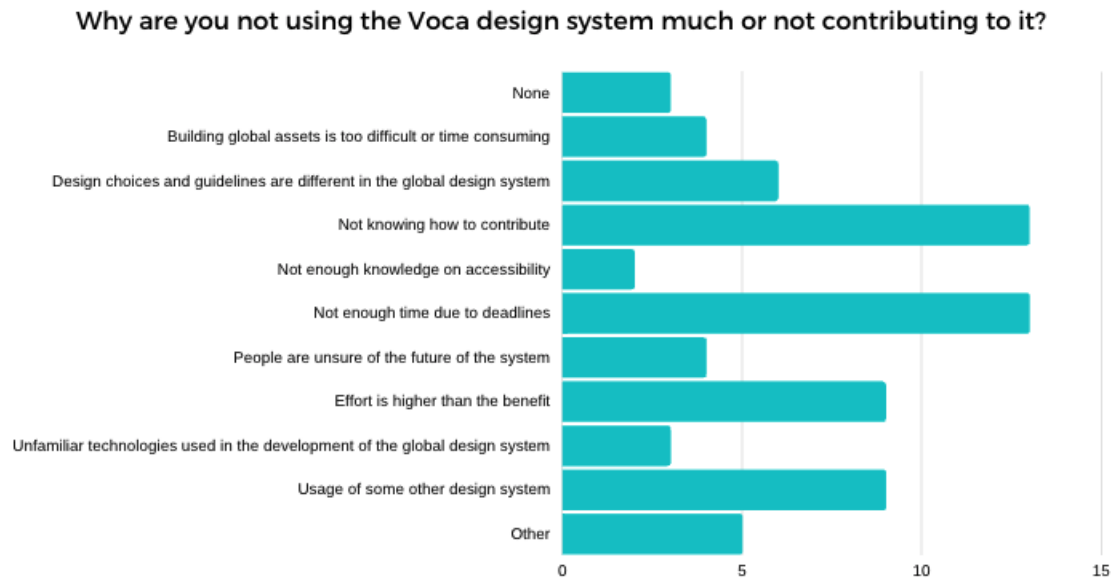


Figure 11: Summary of the answers to the second question about the challenges of the global design system.

not reasons for not fully adopting the system or contributing to it (10 %). Overall, it seemed that the skills of the employees cannot be blamed on the low number of use or contribution. Three respondents thought that there is no reason for not using or contributing and five respondents chose the option other.

The open-ended question after the second question got five answers. Most of them were related to contribution. Two of the respondents thought that collaboration with the global design system team is difficult and the team has not accepted the web components they have developed. One of the respondents thought that there is no need for contributing when there is a design system team responsible for the system. Other comments were about adoption. One pointed out that migrating from other design system to the global design system is a large effort. The last respondent had a lot of technical comments related to the usage of the system, for example arguing that breaking changes, technical limitations and lack of test coverage make the adoption difficult.

Other reasons why the respondents are not using the global design system much or not contributing to it:

- Collaboration with global design system is difficult
- Global design system team has not accepted provided web components
- No need for contribution when there is dedicated team
- Migrating from other design system is large effort
- Breaking changes

- Technical limitations
- Bad test coverage

4.2.3 Solutions to the challenges of the global design system

The open-ended question "How could the global design system be improved in the future?" was mandatory in the survey and as a result, it got lots of different kinds of answers. The solution getting the most mentions was developing more assets. Five of the respondents thought that the global design system should have more web components and two wanted to have more variants to existing web components and guidelines. One mentioned that the system should be updated more often.

Solutions to improve the global design system:

- More assets
- Increase amount of collaboration
- Listen more the user needs
- More consistent and faster work in the design system team
- Handle changes better
- Changing from web components to framework based
- Better documentation
- Patency
- Reusing the components of the existing applications
- Clean code and tests

Other solution getting a lot of mentions was increasing the amount of collaboration. Most of them were about collaborating more with the users and the desire for the design system team to work more closely with the product teams. Two suggested having mob sessions with developers. Two also mentioned that the decisions about the global design system should be more about collaboration and less about giving orders.

Connected to the collaboration was the suggested solution to listen to user needs more. The respondents wanted the design system team to consider the user experience the user experience more and be more flexible and supportive when it comes to feature requests. Two also mentioned that there should be more consideration about what should be included in the global design system and what should be localized. There were also some mixed mentions about contribution. Some thought that contribution is not needed at all but the design system team should fulfill the requests. Some other mentioned that contribution should be made easier for the product teams.

Multiple respondents gave feedback about the design system team. Especially, there were a desire for more consistent and faster work. Two respondents suggested growing the number of people in the design system team in order to meet those needs. There were also some mentions about the design. Two of the respondents thought that the design system team should align the design better. One of them suggested the design system team to have more control on design because the discussion with product teams in the Slack channel does not seem to lead anywhere.

According to the respondents, the design system team should also find a way to handle the changes to the global design system better. Some of the respondents stated that it is hard to stay up-to-date because almost every change is a breaking change. They argued that the changes should be made backwards compatible so that the applications do not require updates every time the global design system is updated. Other suggested solutions were to polish the web components more before release or to simplify the build process so that each web component is in a different bundle.

Four respondents suggested changing the technological choices of the global design system. They argued that using the web components is not usable for the product teams and instead the development should be framework based. The suggestions were either about targeting a certain framework or having multiple versions of the components for different frameworks. One respondent also recommended doing localized foundations and guidelines which would then be authorized globally.

There were also a few solutions mentioned only by a few respondents. Three respondents highlighted the need for having matching Figma designs and web components and that the documentation of them should be improved. One respondent recommended being patient with the growing usage of the system because it is difficult to fully rely on a system whose development is still largely in progress. Some other technological changes were also suggested. One respondent had an idea where more components could be extracted from the existing applications and another pointed out the importance of clean code and having more testing.

4.3 Summary

This section summarizes the main results of the empirical study. It discusses the main similarities and differences between the interviews and the survey. Most of the differences can be explained by the different perspectives. The interviews were involved in the development process of the global design system and as a result, answered the interview questions from that perspective. The survey was aimed to the users of the global design system and most of the respondents were developers. Therefore, the respondents of the survey were the experts of usability of the global design system and did not know that much about the development of it.

4.3.1 Benefits of the global design system

In the interviews, the interviewees were asked how successful they perceive the global design system. The benefits for the organization, end users, business, design and

management were also discussed. In addition, the possible future benefits of the system were discussed in the form of future benefits and goals. In the survey, the respondents were asked how satisfied they are with the system, how they think the global design system has provided value for them and which benefits they have gained by using the system. A summary of the current benefits is presented in Table 13.

Benefit	Description	Resources
Global assets	Saves design and development work Not as much need for rebuilding components Assets on brand	Interviews Survey
Increasing collaboration	Global collaboration increasing Increasing cross-functional collaboration	Interviews Survey
Better accessibility	Better accessibility of the company applications	Interviews Survey
Better technical stack	Unified and modernized technical stack	Interviews Survey (a few)
Growing usage	More people starting to use the global design system More people contacting the design system team	Interviews
Exposing new issues and risks	Helping future global initiatives	Interviews
More consistent applications	Applications are consistent across platforms and countries	Survey Interviews (a few)
Learning new things	Learning new technologies and new ways of working	Survey

Table 13: A summary of the benefits of the empirical study.

The benefit getting the most mentions in the empirical study was having global assets. Both in the interviews and in the survey, the respondents thought that the global assets are valuable in saving design and development work because there is not as much need for rebuilding the web components. Both also valued that the assets are on brand. The respondents disagreed on the global design system resulting into having more time to work on other things. The biggest reason for the disagreement is probably that the adoption process still takes a lot of time from the developers and designers.

The benefit getting the second most mentions was increasing collaboration in the organization. In the interviews, it was stated that collaboration globally has been increasing and the designers are forming closer relationships. In the survey, increasing collaboration between countries was highlighted. However, increase in collaboration between development and design or receiving more help at work were perceived only by a couple of respondents.

Other common benefits were related to accessibility and technical stack. In both the interviews and the survey, it was stated that the global design system leads to better accessibility of the applications. When it comes to modernizing the technical stack, it was mentioned as a benefit in the interviews but only a few respondents chose the option in the survey. However, the benefits of having the unified, modernized stack is probably not that much perceived by a regular developer working in the company.

There were some benefits mentioned only in the interviews which were mostly related to the development and adoption of the global design system. First, the growing usage and number of contacts to the design system team were perceived as a benefit. Overall, it means that the global design system has been so beneficial that the product teams are interested in adopting and developing it. Other thing mentioned in the interviews was that the project has been successful in exposing new issues and risks to the management. This can benefit the future global initiatives a lot in the organization.

In the survey, a lot of respondents perceived that the global design system is helping in building more consistent applications. This was not mentioned in the interviews, because the interviewees thought that consistency is a benefit which has not yet been reached. The respondents of the survey also thought that they have learned new things while using the system. These indicate that at least for some users the adoption has started out successfully.

4.3.2 Challenges of the global design system

In the interviews, the challenges were discussed from the viewpoints of planning, development, adoption and future. In addition, the interviewees were asked about the challenges from their perspective which were about business, design and management. In the survey questions, the perspective was more about what kind of challenges the users had perceived. They were also asked about why they do not use the global design system much or do not contribute to it. Summary of the challenges can be found in Table 13.

The challenge getting the most mentions in the empirical study was issues in the design system team. In the interviews, it was stated that the team is lacking resources and that the team has been losing team members steadily. As a result, the support for product teams has not been in a state the team would have wanted it to be. In the survey, there were a lot of responses about not knowing how to contribute to the global design system, the design system team not being responsive enough and not getting enough support. Overall, it seems that the survey responses are well aligned with the fact that the design system team has had problems with having enough resources.

Another challenge connected to the design system team is that the product teams are sometimes reluctant to collaborate with the design system team. In the interviews, it was discussed that the product teams do not want to contribute to the global design system or sometimes even not discuss about the desired features with the design system team. In the survey, many respondents stated the collaboration with the design system team is difficult. Some respondent even mentioned that there is simply no need for contribution when there is a dedicated team working on the global design system. Overall, it can be said that the design system team and the product teams disagree in many cases about the development of the system.

Other issue affecting the development and adoption of the global design system is that the system is not understood or sometimes not known at all in the organization. In the interviews, it was stated that the product teams do not always understand

Challenge	Description	Resource
Issues in the design system team	Lacking resources Losing team members Not enough support for product teams Teams not knowing how to contribute	Interviews Survey
Product teams reluctant to contribute	Teams do not want to contribute Teams do not want to discuss the features Collaboration with the GDS team is difficult Disagreements on the development	Interviews Survey
Global design system not understood or known	Not understood that building global assets take time Goals of the global design system not known Development of the global design system is slow Web components of product teams not accepted	Interviews Survey
Usage of localized design systems	Mature localized design systems Migrating the global design system is a large effort	Interviews Survey
Documentation and guidelines are lacking	Guidelines about how to use the GDS lacking Documentation not up-to-date Design and development documentation not synchronized Examples of usage not matching the needs	Interviews Survey
Design challenges	No unified design or design maturity in the organization Different design between applications Design practices badly documented Design choices different in the product teams	Interviews Survey
Time issues	Tight deadlines for the product teams Not enough time to contribute	Interviews Survey
Lack of collaboration culture	People not collaborating across country borders Bad collaboration between design and development	Interviews Survey
No alignment in development choices	Makes development and adoption more difficult	Interviews
Localized country budgets	Issues in funding and contribution	Interviews
Issues with management	No deadlines for adoption Getting initial buy-in Visibility of the development to the management	Interviews
Lack of web components and flexibility of them	Web components not sufficient enough Changes to web components limited Not enough variants	Survey
Technical issues	Web components breaking Bad test coverage Many large breaking changes Web components not ready for prototyping No data about performance	Survey

Table 14: A summary of the challenges addressed in the empirical study.

that building the global web components is time consuming. It was also mentioned that some people do not know the goals or are unsure about the future existence of the system and that is affecting their willingness to adopt the system. In the survey, many respondents thought that the development of the global design system is too slow. However, most of the respondents did not agree with the statement of being unsure about the future existence of the global design system. In addition, one survey

respondent argued that the design system team had not accepted the web components their team had delivered. This mention is well aligned with the discussion in the interviews about the product teams not understanding the development of the global web components well.

Another challenge getting a lot of mentions was the usage of some localized design system. In the interviews, it was stated that there is resistance on the global design system in product teams and one of the reasons for it is countries having mature localized design systems themselves. Another reason stated was a lack of knowledge on technologies used in the development of the global design system. In the survey, the respondents agreed that the usage of a localized design system is affecting their usage of the global system. It was added that migrating from another design system to the global design system is a large effort. One respondent had a comment that the effort of adopting the global design system is currently overall higher than the benefit of using it. However, only a few thought that unfamiliar technologies are a problem when it comes to usage and contribution.

The challenges related to documentation and guidelines of the global design system were mentioned both in the interviews and the survey. In the interviews, it was discussed that the guidelines of the system and how it should be used are lagging behind due to the high rise in adoption. This statement was agreed in the survey because a lot of respondents thought that the documentation of the system is not up-to-date and there is a lack of guidelines. In addition, some respondents mentioned that design and development documentation are not always synchronized and that the examples related to the usage of the system do not sometimes match the needs of the respondents.

Some challenges related to design also came up. The interviewees found that there is no unified design or design maturity in the organization which is a problem for the development of the global design system. In practice, it means that there is a different design between applications and that the used design practices are badly documented. The challenge of not having unified design was also perceived in the survey because many respondents thought that design choices and guidelines are different in the global design system than in the product teams. There were also some comments about the product teams perceiving that the design of the global design system is not modern or matching the one created by the product team designers.

The last challenge in which the interviewees and survey respondents fully agreed on was the time issues. In the interviews, it was discussed that the tight deadlines set by the organization lead to a situation where the product teams do not have enough time to contribute to the global design system. Most of the survey respondents also thought that there is not enough time for the adoption and contribution due to deadlines. However, only a few respondents thought that building global assets is overall too difficult or time consuming.

There were also a few challenges which were discussed in both the interviews and the survey but in which there was not a clear consensus. First, the interviewees mentioned that there is a lack of collaboration culture in the organization which means that people are not collaborating across country borders and that there is a bad collaboration between design and development. The challenge was not mentioned

in the survey but it was highly highlighted that the global design system is increasing the collaboration between countries. However, increase in the collaboration between development and design were not that much perceived. Other thing mentioned in the interviews was that there is a lack of knowledge on accessibility in the organization. Nonetheless, the respondents of the survey did not think that is a huge problem.

In addition, there were a lot of challenges perceived only by the interviewees. The most important one was that there is no alignment in development choices in the organization which makes the development and adoption of the global design system more difficult. The development of the global design system is also suffering from the localized country budgets which make the funding and contribution process harder. It has been a challenge with the management that they have not set deadlines for the adoption of the system. In addition because the global design system is the first global initiative of the organization, there has been problems with getting the initial buy-in and overall visibility of the development to the management.

The challenges perceived only by the survey respondents were very technical. First, they thought that there is a lack of web components and that they are yet not sufficient enough. It was also thought that there is not enough flexibility because changes to the web components are limited and there are not enough variants for the needs of the product teams. Many respondents had also perceived technical issues such as the web components breaking, bad test coverage and that there are too many large breaking changes. In addition, it was stated that the web components are yet not ready for interactive prototyping and there is no data about the performance of the system.

4.3.3 Solutions to the challenges of the global design system

When it comes to the suggested solutions, there were large differences in the answers between the interviews and the survey. The interviewees were asked how would they improve the global design system and how could the current or future challenges be solved. In the survey, the respondents were asked how could the global design system be improved in the future. Overall, the questions in both studies were very similar but in the interviewees the responses were more focused on helping the product teams while in the survey the answers were more about technical solutions. The possible solutions are linked with the challenges in Table 15. In some cases, it was not directly brought up that a challenge could be solved with a certain solution and then the conclusion was made based on the overall description of the solution.

There were only two solutions which were clearly suggested in both the interviews and the survey. The interviewees discussed that better guidelines and more assets would help the adoption of the global design system and could raise the interest for contribution. Many survey respondents also mentioned that the global design system should have more assets and that the documentation could be improved. Other common suggestion in the empirical study was patience. In the interviews, it was stated that the development and adoption of the global design system requires patience from all the stakeholders. This aspect was also mentioned in the survey where some respondents mentioned that the system will improve over time.

There were also two suggested solutions where some kind of connection between the interviews and the survey can be made. In the interviews, one of the solutions getting a lot of mentions was changing the model of working from the design system team centered to giving more responsibility to the product teams. In the survey, it was stated that the amount of collaboration in the development of the global design system should increase and that the user needs should be listened more. Both of these solutions are related to the act of changing the model of working. Another solution stated in the interviews was that there should be more stable design system team. In the survey, the respondents mentioned that work of the design system team should be more consistent and faster. These solutions are clearly connected to having more stable design system team.

Some solutions were only mentioned in the interviews. First, it was stated that the management should be more involved in the development of the global design system. As a result, they would have better visibility on the system and its issues. Another mentioned solution was that the design system team should take bigger role in promoting the system because they know it the best. In addition, the goals of the global design system should be shared in a more comprehensive manner so that the product teams and management would understand the need for the system in the organization better.

In the survey, there were some other suggested solutions which were mostly technical. Multiple respondents requested the global design system team to handle the changes in the global design system better. For example, it was suggested that breaking changes could be based on the web components instead of needing to update the whole global design system package. Another solution getting a lot of mentions was that instead of developing web components, the global design system could be based on frameworks. It means that there could be different web components for different frameworks and that could result into more usable and stable system. The respondents of the survey also recommended having more tests for the system in order to increase reliability and decrease the need for breaking changes.

Challenge	Possible solutions	Resource
Issues in the design system team	Change in model of working More stable team	Interviews Survey
Product teams reluctant to collaborate	Better guidelines and more assets Change in model of working Framework based system More involved management More stable team Patience	Interviews Survey
Global design system not understood or known	Design system team taking larger role in promotion More involved management Sharing goals of design system better	Interviews
Usage of localized design systems	Better guidelines and more assets Framework based system More involved management Patience	Interviews Survey
Documentation and guidelines lacking	Better guidelines and more assets Handle changes better More stable design system team	Interviews Survey
Design challenges	Better guidelines and more assets Change in model of working Design system team taking larger role in promotion	Interviews Survey
Time issues	More involved management Patience	Interviews Survey
Lack of collaboration culture	Change in model of working Design system team taking larger role in promotion More involved management	Interviews Survey
No alignment in development choices	Framework based system More involved management Sharing goals of the global design system better	Interviews Survey
Localized country budgets	Change in model of working More involved management	Interviews Survey
Issues with the management	Design system team taking larger role in promotion More involved management Sharing goals of the global design system better	Interviews Survey
Lack of web components and flexibility of them	Better guidelines and more assets Change in model of working Framework based system Handle changes better	Interviews Survey
Technical issues	Framework based system Handle changes better More testing	Survey

Table 15: The challenges linked with a possible solutions that came up in the empirical study.

5 Discussion

5.1 The benefits of the global design system

The global design system of the company under research was perceived to be moderately successful. It had a lot of benefits which had either already been achieved or which achievement had progressed well. However, when people were asked about the success of the system directly, they did not think the system has been that successful or did not give a very good grade to it. Based on the other research questions, the reason is that people are currently highlighting more the challenges of the development and usage of the system. As a result, the factors in which the system has been beneficial are less in mind.

The main feature where the global design system had been beneficial was having global assets. The global assets refer to all the parts of the global design system such as web components, foundations and guidelines which the development teams can utilize in their projects. In the company, people perceived that the global assets have saved design and development work, and reduced the need for rebuilding components although the amount of them is not yet as desired. The globality aspect was not presented in the literature but it was stated that the decrease in needed development and design work is the main value of a design system. The amount of needed work decreases due to the usage of reusable web components which reduces overlapping work in the organization (Churchill, 2019).

Increase in collaboration was perceived as a very important benefit of the global design system in the empirical study. People found especially that the global design system has eased the global collaboration between developers and designers of the company. In addition, it was noted that the system has helped with cross-functional collaboration. Cross-functional collaboration was mentioned as one of the benefits of a design system in the literature review as well, but the viewpoint was different. In two publications, it was stated that a design system can reduce disagreements and debates between people (Churchill, 2019; Suarez et al., 2018). This aspect was not found in the empirical study but Suarez et al. (2018) also mentioned that a design system can help with preventing handoffs, and that is better aligned with the results of the empirical study.

In the literature, design consistency was perceived as an important benefit of design systems for both the organization and end users (Gale, 1996; Yew et al., 2020). In the empirical study, design consistency was also found to be beneficial but unfortunately the project has not reached that goal yet. In the future, the organization aims to have design consistency across both software applications and countries, when the system grows and more people start using it. However, it was found out in the empirical study that people value the web components being currently on brand globally. This reduces the needed design and development work because people do not need to deal with brand updates themselves, and makes the brand more consistent across countries.

Another benefit where literature and the empirical study agreed on was accessibility. In the literature review, Suarez et al. (2018) argued that paying attention to

accessibility of a design system and as a result applications, makes the usability of them better for all the end users. In the case company, accessibility had not earlier been taken into account much but as the development of the global design system started, they wanted to change this practice. It was also found out in the empirical study that product teams find the increase in accessibility important and that they want to advance the improvement of it.

There were also several benefits that were found in the empirical study but which were not present in the literature. The probable reason for that is that these benefits are more connected to the organizational change than the design system itself. First, it was found important that the development of the global design system is exposing new issues and risks in the organization which can help with the development of systems in the future. Other thing discussed was that the design system improves the technical stack of the organization. It forces more people to use unified technical solutions which makes collaboration easier in the organization.

5.2 The challenges of the global design system

The challenges of design systems were not one of the main topics of the literature review. Most of the found publications related to design systems did not discuss the challenges at all or mentioned them very quickly. Instead, in the empirical research challenges were the most discussed topic. The reason why the challenges were a very important topic in the empirical research was probably because the design system project was one of the first global projects of the organization. The project was also in an early stage which probably also highlighted the challenges.

Having up-to-date documentation was highlighted as a common issue in literature by [Suarez et al. \(2018\)](#) and [Gale \(1996\)](#). In the empirical study, it was also one of the most mentioned challenges of the global design system. Product teams thought that the guidelines of how the global design system should be used were lacking and that the documentation is not always up-to-date. They also mentioned that the documentation for designers and developers were not often synchronized. These arguments were agreed by the design system team who mentioned that they have not had enough resources for writing a good enough documentation.

Presenting of a new design system is often difficult from the perspective of adoption and acceptance of the system ([Gale, 1996](#); [Vesselov and Davis, 2019](#)). The global design system has also faced this challenge. For example, the global design system team has not had enough resources to support the product teams in adoption and contribution. In addition, the product teams do not understand the system very well because the global design system representatives have not been very successful in presenting the goals and development process of the system. Instead, the product teams highlighted that the development of the global design system is too slow and that the web components built by them do not get accepted. This implies that the practices of global development are not well known across the organization.

According to [Edelberg and Kilrain \(2020\)](#) and [Gale \(1996\)](#), the easiness of adoption is dependent on the organizational culture. In the case company, it was perceived that the lack of collaboration culture is affecting the adoption of the global design

system negatively. The product teams do not have a culture of collaborating across country borders and between development and design. Another thing affecting the adoption is that there is no alignment in development choices between the countries. Earlier, each country or even each team has been free to choose their development methods and tools and now this practice is affecting the development of the global design system. In addition, some countries also have their own design systems which raises the resistance towards adopting the new system.

In addition to the development choices, there are also issues related to the design choices being made in the case company. Before, each country has been free to create their own design for applications and as a result, there is no unified design across the organization. The overall design maturity is also in a low level. For example, design is always not the same between applications even inside one country and the design practices might be badly documented. Different product teams inside one country also sometimes use different design tools and may have made some other design decisions affecting the process of unifying design. These issues with design make the development of the global design system slower and more difficult because the agreement between different product teams need to be found.

Related to the organizational culture is that there are disagreements about collaboration between the product teams and the global design system team in the organization. The design system team thinks that the product teams are reluctant to contribute and that they do not want to discuss the features to be included in the global design system. However, the product teams find the collaboration with the design system team difficult and that there are disagreements on the development choices. The issue of collaboration was not straightly discussed in the literature but [Suarez et al. \(2018\)](#) handled the different design system team compositions. They mentioned that certain team compositions of the design system development may make the development process slower. One reason for that could be the disagreements between stakeholders.

There are also some organizational and technical challenges in the company under research. First, the members of the design system team discussed that they are lacking resources because they cannot get all the skills they need to be involved in the team. In addition, the team has been losing team members steadily, and hiring new employees and on-boarding them takes time. Outside the design system team, the developers and designers have tight deadlines and that causes them to have not enough time to contribute to the global design system. As a result of other challenges, the product teams report technical issues and a lack of web components. They state that the web components are not always suitable for their needs, for example because there is not the variants they are needing or that the web components are breaking.

5.3 Solutions to the challenges of the global design system

In the literature, the best practices of developing a design system were a common topic. These best practices were used for analyzing the solutions to possible challenges of design systems. In a few cases the writers themselves also proposed direct solutions to possible challenges they had investigated. In the empirical study, the respondents

were asked open ended questions about how they would improve the global design system. In the analysis, these answers were matched to challenges they would possibly solve. However, in both the literature review and empirical study, these solutions are only proposals, not silver bullets for solving the challenges.

Having up-to-date documentation and useful guidelines was a highlighted challenge in both the literature and empirical study. In literature, there were no straightforward solutions to this challenge but [Suarez et al. \(2018\)](#) argued that it is important to pay attention to documenting code standards and best practises in order to ensure smooth usage of the design system and contribution. They also stated that the team should not aim for perfection at the beginning but instead focus on ongoing improvements based on the new needs and feedback and that applies to documentation as well. The design system team argued that having more stable team and enough resources would help them on creating better documentation and guidelines. Increasing collaboration could be also one of the solutions because it could enable a shorter feedback loop or even get the product teams to help with the documentation when they spot an issue.

The global design system project also had challenges in spreading knowledge of the new system and not being able to provide enough support for the product teams. In the literature review, [Gale \(1996\)](#) and [Suarez et al. \(2018\)](#) argued that the design system team is the best at promoting a new system because they have the most knowledge on it. This solution was also quickly mentioned in the empirical study. [Suarez et al. \(2018\)](#) added that prototyping helps the product teams to perceive the value of the system better. In addition, [Gale \(1996\)](#) stated that involving the users tightly in the development process can raise awareness of the system. In the empirical study, it was pointed out that the management should pay more attention into spreading knowledge on the goals of the global design system in order to increase confidence in the new system.

Another big challenge of the global design system was the lack of collaboration culture. This had led to a situation where there is no alignment between development choices, design and the tools across the organization. It was acknowledged in both the literature review and the empirical study that developing the global design system collaboratively can ease this kind of situation. According to [Edelberg and Kilrain \(2020\)](#) and [Suarez et al. \(2018\)](#), collaboration between different teams in the development process results into a system meeting more user needs. In the empirical study, the need for more contribution towards the global design system was highlighted. One other way that may help with this situation is spreading the knowledge on the advantages of a design system and how it requires some level of alignment in the organization. In literature, it was stated that open discussions with the teams, and prototyping can help with the process ([Vesselov and Davis, 2019](#); [Suarez et al., 2018](#)). In the empirical study, the need for more involved management pushing the teams to familiarize themselves with the system was hoped for. The developers using the system had also an idea where the global design system could be framework-based instead of being consisted of web components and that could help dealing with the differences between the teams.

Connected to the collaboration culture of the organization is also the disagreements between the design system team and the product teams. The design system team

finds that the product teams are reluctant to contribute and on the contrary, the product teams think that collaboration between the design system team is difficult. In the literature review, it was found that one way to tackle with the contribution is having good enough documentation including best practices and code standards (Suarez et al., 2018). This was also stated in the empirical study, where it was mentioned that the contribution is difficult due to bad guidelines. The design system team also pointed out that the management could encourage the teams to contribute more. The challenge of collaboration with the design system team can be again dealt with collaborative development and discussions with the teams which can lessen the disagreements (Vesselov and Davis, 2019; Suarez et al., 2018). In addition, the design system team pointed out in the empirical study that a more stable team would provide more time to help the product teams.

There were also a lot of organizational challenges pointed out, such as measuring the success, lack of resources and the global design system being the first global initiative of the company. In the literature review, there were multiple solutions for measuring the success. Suarez et al. (2018) and Vesselov and Davis (2019) suggested collecting data of the usage of the web components which can also be used in the further development of the system. Vesselov and Davis (2019) also recommended doing a research in the organization using both quantitative and qualitative methods in order to show the management the positive results of a design system. When it comes to lack of resources, the aid would be having a more stable design system team and increasing the amount of collaboration with the product teams based on the empirical study. The management can also help with the lack of resources by allocating more time for the product teams to learn to use the global design system and to develop it better for their needs. The successful development of the first global initiative can be achieved by sharing the goals of the global design system constantly and consistently. Both the global design system team and the management should participate in this work.

The final main challenge found in the study was related to technical choices, such as breaking changes, performance degradation and lacking technical guidelines. First, Suarez et al. (2018) argued that breaking changes can be managed by good versioning of the codebase because then the product teams should be always up-to-date on the current status of the system. In the empirical study, it was found that the product teams think that there are too many breaking changes, and they suggested not to release those changes too often. For performance degradation, Suarez et al. (2018) suggested mobile-first development because the available resources are more limited for mobile users. When it comes to lacking technical guidelines, Suarez et al. (2018) highly recommended documenting also well the code standards and best practices. In the empirical study, it was argued that clean code and tests could also help with understanding the technicalities of the global design system better.

5.4 Limitations of the study

The main limitation of the empirical study is that the case and some of the participants were well known beforehand. This can result into accidentally adding some earlier own

knowledge into the result without realizing it. In addition, the earlier relationships with the interviewees can have an effect on the interview situation. For example, the interviewees can assume some earlier knowledge of the interviewer and therefore not discuss the case as precisely as it should have been. Unfortunately, it was not possible to avoid this while choosing the interviewees because there were not that many people working with the project under research.

There were also some limitations regarding the survey. The survey was shared for a large group of people but the number of respondents were at maximum 10 % of the reached people. There were also a large bias towards employees working in Sweden because they have been most actively participating in the development of the project. However, more responses from employees from other countries would have been very beneficial for this study.

The biggest limitation of the literature review is the lack of used resources. The term "design system" is very new and the origin of the practice lies in the industry. Therefore, there has yet not been much research on the topic in academia. In addition, this master's thesis avoided using grey literature as a resource and it further limits the number of used resources. [Vendramini et al. \(2021\)](#) conducted a literature mapping of design systems and all the white literature they used has been reviewed for this master's thesis. They also used a lot of grey literature as a resource which implies that the number of academic studies is very limited for conducting a mapping study.

Other limitation affecting the literature review is the usage of the term "design system" in the literature. The term in the same form as defined in this master's thesis has been established only a few years ago ([Frost, 2016](#)), and therefore it has yet not been used a lot in the academia. In addition, based on the keyword search, the same term has been used for example for describing electronic design automation which are software tools for designing electronic system. An example of this kind of article is [Chen et al. \(2011\)](#). These confusions between the terms make the finding of relevant articles more difficult and it is possible that all the sufficient resources have not been found in the literature search.

6 Conclusions

The research problem of the master thesis was to find out how the status of the global design system of the case company could be improved in the future. The thesis delved into benefits, challenges and possible solutions to challenges of the global design system using multiple resources and as a result, the current status and how to improve it can also be further elaborated. However, the aim was to investigate ways to improve the global design system from the perspective of the current status and therefore, similar research should be conducted again in the future in order to measure success in a long run.

In order to have a successful design system in the future, **the organization should focus on establishing a clear vision of the global design system.** At present, the product teams do not understand the goals of the global design system very well and it complicates the adoption process. Having a clear vision and spreading it would increase the confidence of the product teams on the future existence of the design system and on the benefits the usage provides. A clear vision also helps allocating the resources into the right targets. If the company wants to increase the number of web components created by the product teams, it should be also stated in the vision. The product teams cannot participate more in the development of the global design system if there is no more time allocated for that in the feature planning. In addition, the role of the global design system team should also be then more focused on evaluating the web components developed by the product teams so that they are globally usable.

The main goal of the global design system is to provide global assets to product teams and as a result, the number of global assets should be kept as the main priority. The global assets include for example the style guide, design guidelines and design token libraries in addition to web components. The global assets are the key for having design consistency across the applications of the organization which is clearly a business advantage. If there are enough assets and the quality of them is desirable, the global design system should also surpass the earlier localized design systems on its own. This would also fulfill the goal of accessibility when it comes to web components and accessibility guidelines in use. The aim of having more global assets can be most easily solved by increasing the contribution from the product teams because they have already developed a lot of components for their applications or localized design systems. However, these assets need to be further globalized but the process should utilize iterative development in order to meet the most user needs in a reasonable time.

In addition to contribution to the system, **the global design system requires innovations when it comes to global communication and collaboration.** The raise in communication within developers and designers was a highlighted advantage of the global design system but there are still issues when the communication should happen across country borders. The lack of global communication is slowing down the development of the design system because creating global web components is currently requiring much time from the global design system team. Having well functioning global communication channels would shorten the feedback loops and

make the new assets to better meet the user needs already at the beginning. In addition, it would help in pointing out the global misalignments in the development and design choices which could ease the job of the global design system team and the management to choose when actions are required in the sake of a well functioning global design system. The initiative of the design and development communities is a good start but it certainly requires some actions from the management to get it working well in all the countries and benefiting the global design system.

In addition to further research in the case company, the topic of design systems requires more investigation in the field of academia. The concept of a design system has its roots in the technology organizations and as a result, there is not much research on design systems across organizations. Academic research on design systems would have potential to define design systems better and to seek out the common pitfalls and solutions to them. That would also increase the accuracy of available information about design systems and help the organizations in the process of creating better design systems for their needs.

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A Interview structure for product owner

1. What is your role in the organization?
2. How is your work involved with the Global Design System?
3. What do you think are the main goals of the development of the Global Design System?
 - (a) Do you think it is possible to state what are the goals for business especially?
4. How has the Global Design System been used so far?
 - (a) What kind of experiences have already been gained with the usage of the system?
5. How successful has the Global Design System been so far?
 - (a) What have been the main benefits for the organization?
 - (b) What have been the main benefits for the end users?
 - (c) What are the main benefits for business?
 - (d) What benefits are expected to be reached in the future?
6. What kind of challenges have there been related to the Global Design System project?
 - (a) Has there been any challenges in the planning and development of the project?
 - (b) Has there been any challenges in the adoption of the system?
 - (c) What challenges are perceived as especially difficult from the perspective of business?
 - (d) Are there any challenges that are expected to rise in the future?
7. How would you improve the Global Design System?
 - (a) How could the current or future challenges be solved?
8. Is there anything else you would like to highlight about the Global Design System?

B Interview structure for design lead

1. What is your role in the organization?
2. How is your work involved with the Global Design System?
3. What do you think are the main goals of the development of the Global Design System?
 - (a) Do you think it is possible to state what are the goals for design especially?
4. How has the Global Design System been used so far?
 - (a) What kind of experiences and feedback have already been gained with the usage of the system?
5. How do you perceive the success of the Global Design System?
 - (a) How successful do you think the Global Design System has been so far?
 - (b) What have been the main benefits for the organization?
 - (c) What have been the main benefits for the end users?
 - (d) What are the main benefits for designers?
 - (e) What benefits are expected to be reached in the future?
6. What kind of challenges have there been related to the Global Design System project?
 - (a) Has there been any challenges in the planning and development of the project?
 - (b) Has there been any challenges in the adoption of the system?
 - (c) What challenges are perceived as especially difficult from the perspective of designers?
 - (d) Are there any challenges that are expected to rise in the future?
7. How would you improve the Global Design System?
 - (a) How could the current or future challenges be solved?
8. Is there anything else you would like to highlight about the Global Design System?

C Interview structure for head of product area customer experience platforms

1. What is your role in the organization?
2. How is your work involved with the Global Design System?
3. What do you think are the main goals of the development of the Global Design System?
 - (a) Do you think it is possible to state what are the goals for management especially?
4. How has the Global Design System been used so far?
 - (a) What kind of experiences and feedback have already been gained with the usage of the system?
5. How do you perceive the success of the Global Design System?
 - (a) How successful do you think the Global Design System has been so far?
 - (b) What have been the main benefits for the organization?
 - (c) What have been the main benefits for the end users?
 - (d) What are the main benefits for management?
 - (e) What benefits are expected to be reached in the future?
6. What kind of challenges have there been related to the Global Design System project?
 - (a) Has there been any challenges in the planning and development of the project?
 - (b) Has there been any challenges in the adoption of the system?
 - (c) What challenges are perceived as especially difficult from the perspective of management?
 - (d) Are there any challenges that are expected to rise in the future?
7. How would you improve the Global Design System?
 - (a) How could the current or future challenges be solved?
8. Is there anything else you would like to highlight about the Global Design System?

D Survey

A survey about the global design system

This survey is a part of the master's thesis in the field of software and service engineering at Aalto University. The goal of the survey is to find out what kind of value the global design system provides, what are the challenges of the system and how the system could be improved in the future. The feedback given in this survey will help with the development of a better design system.

Answering the survey takes approximately 5 minutes. The survey is aimed for people who have used the global design system or otherwise interacted with it. The survey is anonymous and the results will be only used in the master's thesis and for the development of the design system.

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* Required

I am working as a *

- Designer
- Developer
- Product Owner
- Scrum Master
- Manager
- Other, what?

If the answer to the previous question was "other", please describe your role.

Your answer

I'm working in *

- Denmark
- Estonia
- Finland
- Latvia
- Lithuania
- Norway
- Sweden

What have you used the global design system for? *

Your answer

How satisfied have you been with the global design system? 1 (not at all), 5 (very satisfied) *

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I think the global design system has provided value for me in... *

- Being on brand
- Being updated regularly
- Having global assets
- Improving accessibility of the applications
- Increasing collaboration between countries
- Increasing collaboration between development and design
- Helping to make more consistent applications
- Modernizing the technical stack
- Reducing time spent on development or design
- Other
- None

If you clicked "other" in the last question or want to elaborate, please explain how the global design system has provided value in your opinion.

Your answer

By using the global design system, I have... *

- Had more time to work on other things
- Learned new things
- Not had to build as many components
- Prevented errors
- Prototyped new ideas
- Received more help at work
- Other
- None

If you clicked "other" in the last question or want to elaborate, please explain what positive results the usage of the global design system has had for you. *

- Design system team is not enough responsive
- Development of the global design system is too slow
- Documentation is not up-to-date
- Documentation is too long
- Lack of components
- Lack of guidelines
- Performance of the system is bad
- The visuals do not match the earlier ones
- There is not enough support
- Other
- None

If you clicked "other" in the last question or want to elaborate, please explain what problems you have perceived.

Your answer _____

Why are you not using the global design system much or not contributing to it?

- None
- Building global assets is too difficult or time consuming
- Design choices and guidelines are different in the global design system
- Not knowing how to contribute
- Not enough knowledge on accessibility
- Not enough time due to deadlines
- People are unsure of the future of the system
- Effort is higher than the benefit
- Unfamiliar technologies used in the development of the global design system
- Usage of some other design system
- Other

If you clicked "other" in the last question or want to elaborate, please explain the reasons why you are not using the global design system or not contributing to it.

Your answer _____

How could the global design system be improved in the future? *

Your answer _____

Thank you for participating!