

# **Design system: A tool for scaling product design in large technology companies**

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<b>Degree programme</b> Degree program in Business Information Technology (BITe)	
<b>Thesis title</b> Design system: A tool for scaling product design in large technology companies	<b>Number of pages and appendix pages</b> 50 + 3
<p>Recently, the values of design have been increasingly recognized by large tech companies. In the fast-growing digital world, tech companies have faced challenges of scaling such as inconsistencies in digital products and less efficiency. A phenomenon called “design system” has emerged as a potential solution to these issues. This thesis concentrates on the role of design system in scaling product design in large tech companies. It aims to investigate potential challenges and explore in which aspects design system can support the design scaling. Another goal is to figure out how design system can be integrated into the whole companies.</p> <p>The theoretical background firstly studies the overview of design in technology companies. Secondly, the thesis investigates the factors that should be considered in scaling product design. Then, design systems in the context of product design scaling are studied deeper. This study is based on qualitative research method, consisting of 6 semi-structured interviews with designers who have been building design systems in 4 different large tech companies operating in Helsinki, Finland. The empirical research facilitates to understand the reasons for initiating a design system, the values a design system brings about and the approaches to integrating design systems into enterprises.</p> <p>The findings indicate that design system plays an important role in scaling product design in large tech companies. Design system can solve the main potential challenges of design scaling by introducing design toolkits and common design language, which helps build design-driven culture. Besides, by providing design foundations, solutions to basic problems and promoting the user-centered design approach, the design system helps drive innovations and business value, therefore, enabling sustainable design scaling. Design system can be possibly integrated in companies on a large scale by bottom-up approach and good practices of communicating and promoting the values of design system in companies.</p> <p>The thesis can contribute specific knowledge to the design system community, which can be beneficial to interested actors in large tech companies such as designers, developers, product owners. This research opens future researchable topics that are related to community-based design method, design system maturity level and the connection between design system and UX maturity.</p>	
<b>Keywords</b> Design system, Design scaling tool, Design at scale, Product design	

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## Terms and Abbreviations

CSS	Cascading Style Sheets, a style sheet language used for describing the presentation of HTML document
Design system	A collection of modular patterns, components and shared guidelines and practices for teams to design and develop digital products more efficiently and consistently.
Component library	A library including a company's user interface elements in front-end programming languages
DesOps	Design Operations, which plans, defines, manages all design operations including tools, infrastructure, workflow, people and governance
HTML	Hypertext Markup Language, a standard markup language for creating web pages and web applications
Pattern	A repeatable design solution to a problem
Pattern library	A library including organization's user interface elements in the form of design, not being coded yet
Product design	A process of defining problem, designing a proper solution and validating it with real users. An interchangeable term with software design
Product team	A dedicated team working on designing and developing a software product
Style guide	A set of standards for the writing and design
UI	User interface, designed things of an information device with which human interact
UX	User experience, the overall experience of a person using a product or a service

# 1 Introduction

Recently, design has been highly appreciated by the values it brings about to the software companies (Maeda 15 March 2015). In the fast-changing digital world when technologies have advanced, design plays a key role in innovating and differentiating the company from other competitors (Heikkinen & Määttä 2013). Besides, the competitive software business environment has enabled an increase in the number of new products. This has raised new challenges for companies in scaling and managing their product portfolios (Valdellon 15 July 2015).

It is widely known that consistency is one of the most important factors contributing to the great usability and user experience (Nielsen 1994a; Smith 30 March 2010; Soegaard 23 January 2018). Large tech companies, who have multiple digital products and different product teams, are facing a big challenge to unify and harmonize the design of all products. According to Enterprise UX industry report 2017 – 2018 conducted worldwide by Treder, Cao & Ho (2017, 12), 59% among respondents found improving consistency as their companies' top UX challenges (appendix 1). Another challenge is collaborating between teams reported by 44% of respondents (Treder & al. 2017, 12). The collaboration between designers and developer can be the most typical example. The misunderstanding in communication when people use different terms to talk about the same thing or the differences between the UI design deliverables and the final implementation results can affect teams' work efficiency and outcome quality.

In the scene of scaling product design, a concept called "design system" has been proposed as a useful tool for design scaling process (Armstrong 19 February 2018; Kholmatova 2017; Saarinen 14 March 2018). Design system has brought about values such as time-saving on product development while maintaining the high quality of design, improving internal communication, promoting the consistency in products and enhancing user experiences, etc. (Kholmatova 2017; Pernice 31 August 2018). In recent years, many technology corporations have been building their own design system to support the internal design process, for instance, Materials Design by Google, Carbon Design System by IBM, Lightning Design System by Salesforce, Fluent Design System by Microsoft, etc.

It is the author's experience of working on design system in two different corporations that has driven this research. She has been aware of design system since the first design system conference held on 15<sup>th</sup> March 2018 in Helsinki, Finland and become more interested in design system when working closely with it. From her work experience, she somehow

understands the role of the design system; however, it is better to investigate various situations of different design systems in different companies.

## **1.1 Research objectives and research questions**

The main objective of this study is to figure out the role of the design system in scaling product design in large technology companies that operate in Finland. The thesis aims to investigate the main potential challenges in scaling product design and explore in which aspects the design system can support. Another goal is to understand how the design system can be integrated into the whole large technology companies.

### **The main research questions:**

How can design system be a tool for scaling product design in large technology companies?

In order to answer the main research questions, following research sub-questions were formulated by the author:

1. What are the main potential challenges in scaling product design?
2. How can a design system solve those challenges and support in scaling product design in large technology companies?
3. How can a design system be integrated into large technology companies?

Researching those questions will formulate a good foundation to understand the importance of design system in product design scaling in large technology companies. The thesis can contribute specific knowledge to the design system community, which will be beneficial to interested actors, especially those who are involved in a product team in large technology companies such as designers, developers, product owners, etc.... Technology companies can use the thesis to learn and find the most suitable way to solve their problems in scaling digital product design.

## **1.2 Scope of the thesis**

The thesis focuses on the role of the design system in scaling product design in large technology companies which operates in Finland. Product design comprises all disciplines in design, from user interface design to user experience design because it is the final presence of user experience research and design decisions. Product development mentioned in this thesis more likely refers to the front-end development. This thesis does not go deep into how to build a design system, but it will give an overview of design system as

well as report findings of how the design system is used to support product design process and the impacts of these practices.

When it comes to scaling digital product design, it is worth mentioning the concept of Design Operations (DesOps), which means all operations, including tools, infrastructure, workflow, people, governance, that “support high-quality crafts, methods, and processes” (Malouf 2018). DesOps is a broader concept with different lenses focusing on different questions in design operations such as “How can I make my team more successful at getting work done?”, “How can I support the practice of design to help elevate it?”, “How can I support my designers to work with the enterprise better?”, “How do we scale design quality through the enterprise?” (Malouf 5 March 2018). Design system only focuses on how to scale design quality through the enterprise, other lenses of DesOps and DesOps itself will not be discussed in this thesis scope.

In terms of the type of companies, this research is conducted with large technology companies who have many different digital products and product teams and operate in Finland. Those companies who do not operate in Finland and those who have only one digital product or multiple physical products are excluded.

### 1.3 Structure of the thesis

The following table 1 describes the structure of the thesis and the main points in each chapter.

Table 1. The structure of the thesis.

Chapter	Name	Main content/ goals
Chapter 1	Introduction	<ul style="list-style-type: none"> <li>• Introducing the background of the research topic</li> <li>• Describing the research objectives and research questions, together with the scope and the structure of the thesis.</li> </ul>
Chapter 2	Theoretical background	<ul style="list-style-type: none"> <li>• Providing theoretical framework for the study</li> </ul>
Chapter 3	Methodology	<ul style="list-style-type: none"> <li>• Discussing methods for this study and reasons why to choose them</li> </ul>
Chapter 4	Results	<ul style="list-style-type: none"> <li>• Presenting all research results</li> </ul>

Chapter 5	Discussion	<ul style="list-style-type: none"> <li>• Analyzing data collected and comparing with the theoretical framework.</li> <li>• Discussing the recommendations</li> <li>• Concluding &amp; answering the research questions</li> <li>• Validating the research &amp; proposing future research</li> </ul>
Chapter 6	Summary	<ul style="list-style-type: none"> <li>• Summarizing research objectives, main results, research contributions &amp; limitations</li> <li>• Evaluating the project and personal learnings</li> </ul>
	References	<ul style="list-style-type: none"> <li>• Listing all sources used in this research</li> </ul>
	Appendices	<ul style="list-style-type: none"> <li>• Including information, charts, statistics supporting the main content</li> <li>• Containing semi-interview structure and interview details</li> </ul>

## **2 Theoretical framework**

This chapter lays out the theoretical background for the research project. Starting with a brief overview of design in technology companies with changes in recent years, subchapter 2.1 helps readers understand how design can be a part of the business scale. Subchapter 2.2 investigates the factors related to scaling product design, including systems thinking, process and methodology, people and products. The final sub-chapter 2.3 focuses on the key theme “design system in scaling product design”. This subchapter proceeds with the details of the design system, the benefits of the design system and looks at industry leaders’ cases to see how they have applied design system in scaling design.

### **2.1 Design in technology companies**

It is undeniable that the values of design have been increasingly recognized by enterprises, especially technology companies (Maeda 15 March 2015). In 1990s, user-centered design appeared in form of and usability study which has been utilized in software business (Nielsen 1994b). Then, design thinking has started becoming an important factor contributing to the innovation and success in business (Martin 2009). The case study of how IBM have transformed the whole organization - comprising of approximate 377 000 staff all over the world - to be more design-centered enterprise since 2012 is a strong evidence for the increasing awareness of the role of design in software business (Quito 11 September 2016). In the same vein, several recent studies by The Design Management Institute (2016) and Sheppard, Sarrazin, Kouyoumjian & Dore (2018) indicate that companies with stronger design performance gain better financial outcomes (appendix 2 & 3).

In an article published in Wall Street Journal, Andreessen (2011) states that “software is eating the world” and then design probably will eat the world (Satell 10 September 2014). Reported in Design in tech report 2015 that since 2010, 14 design agencies and 27 companies co-founded by designers have been acquired by large tech companies such as Google, Facebook, Accenture and Adobe (Maeda 15 March 2015). It seems that once technology company grows, more digital products are developed, so more designs are needed. As growing from 2012 to 2017, IBM hired around 1000 designers in 5 years. Similarly, the designer to developer ratio was dramatically increased in other well-known technology companies within 5-7 years (figure 1). These pieces of evidence presented in this paragraph suggest that software product design is also a part of the business scale. However, scaling software product design in not just recruiting more designers or acquiring design agencies, there are more aspects and factors that need to be taken into account. The following chapter will discuss these areas greater details.



Figure 1. The stats on six companies' designer to developer ratios 2010-2017 (Field 2017).

## 2.2 Factors in scaling product design

It is necessary here to clarify what is meant by “product design” and “scaling product design”. The term “product design” can be generally defined as a process of defining real problems, coming up with possible solutions, testing them and iterating on feedback to create the most usable products with better user experience (Lascar 31 August 2017). In the scope of this thesis, “product” refers to digital products, so it can be used interchangeably with “software”. Accordingly, “scaling product design” (scaling design in short form) can be understood as scaling the process aforementioned. It is said scaling design involves in “providing reusable solutions that meet multiple needs, access to proficient user research competencies and proof design” as well as “making designing within enterprise software context so exciting” (Bhowmick 27 March 2018). This chapter is divided into four main sections, each of which presents a factor relating to scaling product design within large technology organizations.

### 2.2.1 Systems thinking

A system is known as a set of interconnected parts that interact, affect each other, forming a larger whole for a specific purpose. A complete system can be a part of a bigger system. (Kim 1999, 2.) To illustrate the theory by the case of software business, the whole business is the biggest system that includes all different departments. More specifically, a soft-

ware product is a system that is made up of design and code. The design itself is a system that includes user experience design, user interface design, emotional design, motion design brand design, etc.; whereas the code is a separate system comprising of codes in different programming languages with different functionalities.

“Systems thinking is a way of understanding reality that emphasizes the relationship among various components in a process, rather than the independent constituents of the process” (Gregory & Miller 2011, 259). It seems that in order to enable the design scaling process effectively, organizations or responsible people first need to understand the relationships between design and other related aspects, for instance, development process, teams, business vision, business goals, organizational cultures and company policies, etc.

Systems thinking offers a model of decision-making that helps ones to learn and adapt to changes (Kim 1999, 5-11). Today, software business environment has constantly been changing, which requires new and innovative product features rapidly released to meet customers’ needs. This calls for the fast adaptability of design. People who are behind the design scaling might need to learn how to deal with not only new trends in design but also changes in other related aspects. Additionally, they should be careful of how design changes can affect other disciplines as well.

### **2.2.2 Process, methods and tools**

User-centered design has not been strange in the context of software product design since the 1990s (Nielsen 1994b). When it comes to user-centered design, people refer to methods and design processes that focus on the user context and user need. At a small scale, it seems easy to adopt user-centered design approach in design. When a company grows, and teams expand, it is not that easy to make sure that the design approach happen consistently or the ways of applying user-centered design are consistent in companies. (Devanney, Nishiyama, & Pastrovich 2017, 41-42.)

Freedom and flexibility in selecting the design process and methodology is good for designers to deliver the best work, but at the same time, it may result in design debts in the organizations. Different levels of knowledge and experience can lead to different ways of understanding theory. There is a likelihood that product will be more connected with individual designers and stakeholders’ personalities and preferences rather than designs that look more reliable and consistent with the whole business. (Devanney & al. 2017, 42.) Regarding design tools, enterprises need to provide design teams with standard and comprehensive guidelines to support their design processes. Because it is possible that these

tools might not be taken into usage if they are hard to use or do not support designers' work, it is recommended the tools should be continually maintained, updated and kept relevant. (Devanney & al. 2017, 57-59.) At large design scale, it is necessary to keep in mind how to align all designs themselves, as well as design processes, methods, tools with the business.

### **2.2.3 People**

In recent years, the number of designers in demand has significantly increased, a typical example is that IBM hired more than 1300 design staff in 3 years (Quito 11 September 2016). The increasing number of designers can be seen as a positive sign that companies have recognized of the role of design in business; however, this also causes problems in management, for instance, the new levels of uncertainty. As companies grow, teams are likely to be allocated in multiple products and in different locations, which also requires management activities to ensure the work capacity and enable impacts. (Devanney & al. 2017, 16.)

Devanney (2017, in Hanson 2017) points out that learning and knowledge management is also a challenge organization will face in delivering design at scale. In fast-changing digital environments, companies need to beware that it is not easy to find a lot of highly qualified designers; instead, offering designers chances to learn and grow individually is beneficial to themselves and companies as well. While personal development and career growth is a big motivator for each individual, it can exert great impacts on the company if they can build a culture of continuous learning and sharing within the organization. (Hanson 2017.) In addition, providing opportunities to learn and grow can make designers feel they fit the company, which helps retain the designers (Devanney & al. 2017, 17).

Once a company grows, teams expand, the sharing of knowledge and applying it throughout the company turns into much more difficult, and teams becomes less efficient. Designers with full skill sets and technology knowledge seem a bit fewer than seasoned designers, so it becomes necessary to increase the collaboration, communication and knowledge-sharing within design teams as well as between the design team and other teams such as development, business teams. The collaboration between design teams with the rest of the company not only equips designer with business and technology knowledge needed for their work but it also allows them to communicate and spread their works or new ideas with others. (Devanney & al. 2017, 81-84.) As stated by Diana Mounter (14 April 2016), the design manager at GitHub: "True collaboration isn't throwing

designs over the wall. It's designers, engineers, and the rest of the team sharing the responsibility to build a quality product. Reduce the barriers, support and empower them, and designers who code will become the norm.”

#### **2.2.4 Products**

Scaling product design can affect the product quality in several ways. For example, it can be a challenge or an unexpected outcome if different features in one product designed by different designers conflict or if different products under the same brand name may look and work incoherently. Nevertheless, how much these issues affect the product quality is not so clearly known in several companies. Similarly, the values of design work, for example, new user interfaces, new services, are difficult to measure in an organization. That is why design is not often measured. (Devanney & al. 2017, 123-124.) In the context of scaling, at a certain point, there will a need for understanding and measuring the contribution of the design to the product success. Therefore, mutual measurement methods should be defined and shared between designers, product teams and related stakeholders with relevant metrics. Metric examples can be product download conversion rate, user satisfaction, adherence to product goals, etc. (Devanney & al. 2017, 124-125; Armstrong 19 February 2018.)

Growing products will ultimately add more complexity to individual product and suite of product. Saarinen (14 March 2018) shares that Airbnb has faced a few challenges related to its products when scaling, for example, apps are not consistent and coherent cross platforms, devices and it is increasingly challenging to add new features or modify existing ones. Moreover, technical and design debts are unavoidable when a company grows and scales products (Suarez 20 September 2016). These debts will slow down the team progress as well as affect the product roadmap and its releasing schedule.

### **2.3 Design system in scaling product design**

This section aims to review the literature on design system in the context of technology companies. It begins by defining the design system from multiple perspectives. Then it investigates benefits or values that design system can bring to a company. Finally, two popular case studies of design system are presented in 2.3.1.

### 2.3.1 Design system

It is necessary to clarify what is meant by “design system”. Design system is known as “the single source of truth” (Hacq 22 May 2018) which is a collection of modular patterns, components and shared guidelines that allow teams to design and develop digital products more efficiently and consistently (Kholmatova 2017, 18; Curtis 10 October 2017; Fanguy 1 December 2017). There are still varied conceptions when it comes to defining design system. It can easily be misunderstood that the design system is a style guide or a pattern library if ones do not go deep enough to the field knowledge. However, several industry sources argue that style guides and pattern libraries are related parts in the set of deliverables called “design system” (Kholmatova 2017; Hacq 22 May 2018; Pernice 31 August 2018).

Popular industry sources (Kholmatova 2017; Anne 17 August 2017; Pernice 31 August 2018) points out the design system’s most common and important assets which include:

- Principles
- Style guide, also known as perceptual patterns
- Pattern and component libraries, also known as functional patterns

Principles are known as the base for the whole design system. Principles are the shared philosophy for the teams to work together, an actionable tool to make the design and development decisions. (Kholmatova 2017, 46-48.) For instance, at Salesforce, people use principles which are “Clarity, Efficiency, Consistency, and Beauty” to make design decisions and have realized how principles help them to remove decision debt (Anne 17 August 2017). Style guides are different perceptual patterns that represent the “ethos of products” (Kholmatova 2017, 20). According to Pernice (31 August 2018), the most popular style guide type pertains to brand design with indispensable elements like color, typography, icon fonts and trademark. Besides that, she indicates different types of style guides such as UX style guide providing instructions on visual and interaction design, content style guide telling about language, tone of voice. While the style guides (or perceptual patterns) are more focused on product’s personalities and aesthetic, pattern and component libraries (functional patterns) are related to the product behaviors and functionalities (Kholmatova 2017, xi). Pattern libraries include concrete building blocks of the interface like buttons, forms and information of what they are and when to use them. Backing down to 1970s, Christopher Alexander (1977) states that: “Each pattern describes a problem that occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice.” Then, pattern-driven design in the context of

software engineering emerged with the book “Design patterns: Elements of Reusable Object-oriented Software” by Gamma, Helm, Johnson & Vlissides (1995) and the latter 2000s witnessed the significant rise of patterns in digital design with a bunch of design pattern books (figure 2). Until now, Alexander’s great work has been establishing the content model for each pattern that people are using these days. (Curtis 28 January 2017.) While pattern libraries are more designer-oriented, the component libraries are more relevant to developers. Component libraries move UI pattern libraries to the next level with front-end programming. UI pattern library can be released as a Sketch library - a tool for designers, and component library can be released as a HTML & CSS framework or JavaScript repository for developers. Hence, neither designers nor developers need to repeat the work their colleagues have finished before. (Kholmatova 2017, 27; Pernice 31 August 2018; Curtis 10 October 2017.)



Figure 2. Design pattern books from the latter 2000s (Curtis 28 January 2017)

“Repetition and reusability make scale possible” (Suarez, Anne, Saylor-Miller, Mounter & Stanfield 2017). Reusability is one of the main principles of a design system. In order to promote the reusability and scalability of a design system, the company should take the modular approach in both design and code architecture. Parts in design system need to be composable and interchangeable, which means patterns are flexible and generic enough to be combined in different ways to solve various use cases in products. It is worth keeping in mind Atomic design methodology by Frost (2016) to understand modular design. Design system should also follow a best practice in software development called “Don’t repeat Yourself” (DRY) because the primary purpose of a design system is to help the company reduce work duplication and be more agile and adaptable in their operations. (Suarez & al. 2017; Kholmatova 2017, 146-147.)

Design system brings all assets and practices to one place, formulating a systematic framework for organizations to achieve their digital products' purposes. Frost (8 May 2018) agreed with Keith (7 May 2018) that design system is about telling the story of how a company designs and develops digital products. Therefore, a design system does not only provide tangible elements such as style guides, pattern libraries, components but it also offers intangible elements such as principles, shared work processes, standards, shared practices (Frost 8 May 2018; Kholmatova 2017, 18). Figure 3 illustrates elements that should be included in a design system.

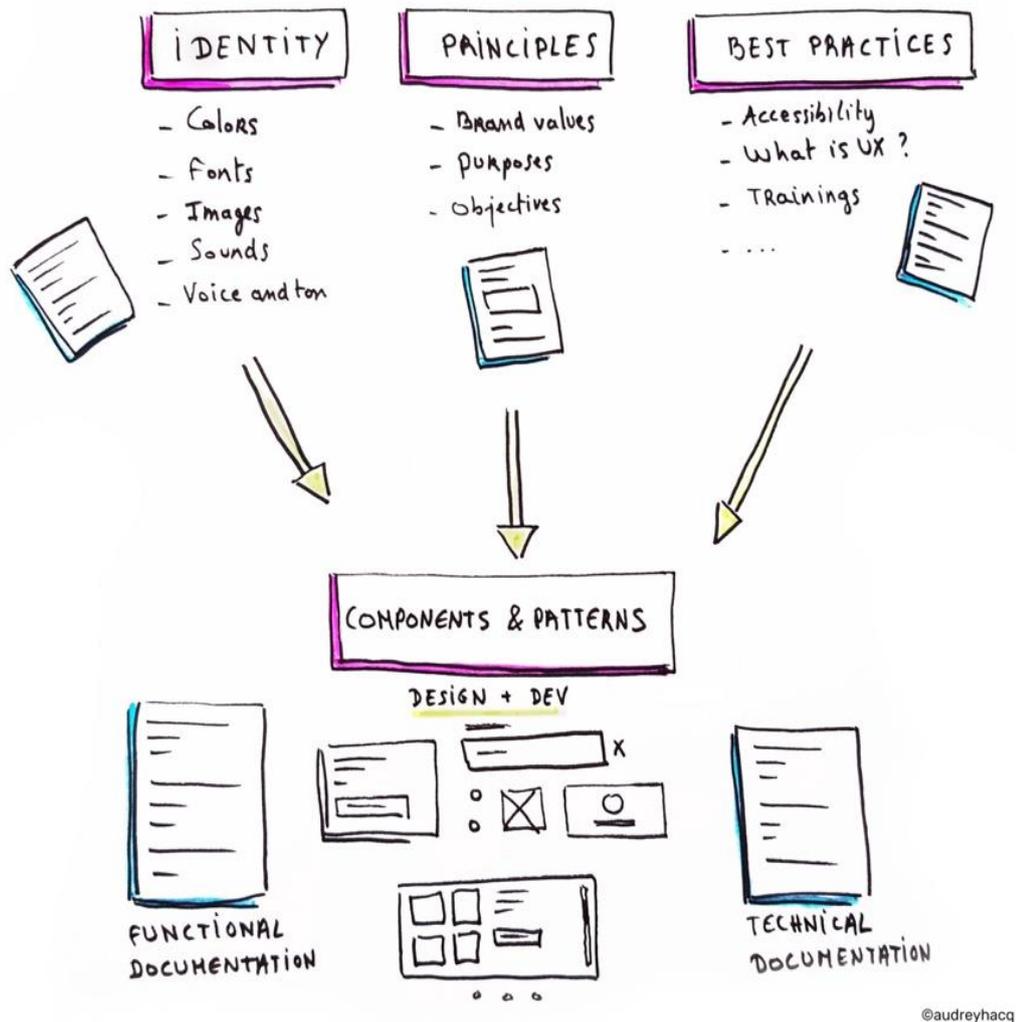


Figure 3. Design system's elements (Hacq 22 May 2018)

There is a myth pointed out by Suarez & al. (2017): "Once the design system is designed and built, the work is complete". Nevertheless, in the early days of design system field, Nathan Curtis (26 February 2016), a design system specialist, realized that: "A design system isn't a project. It's a project serving." Agreeing with Curtis (26 February 2016), Niko Laitinen (14 March 2018), in a conference, emphasizes on how to keep the design system alive and adaptable to serve other products when it comes to design system's

long-term life cycle. Apparently, a normal product serves certain customers, so it needs to be marketed to the right potential users. Additionally, the success of a product is always measured based on certain key performance indicators. Hence, working on design system is not simply product design and development, it is also about marketing, communication and management (Curtis 26 February 2016).

So far, this subchapter has focused on the definition of design system from varied perspectives. The following section will discuss the main benefits of design systems in greater details.

### 2.3.2 Benefits of design system

An industry study conducted by Treder & al. (2017, 18) has shown that most companies around the world are utilizing or actively building pattern libraries or design system (figure 4). This implies that enterprises have been realized the values design system would bring to them. According to several authors (Kholmatova 2017, 167-173; Pernice 31 August 2018), the main benefits of creating design systems are followings:

- Time savings
- Higher consistency in design, code and brand
- Happier customer thanks to better UX design & code quality
- Higher efficiency because of increased team communication & collaboration

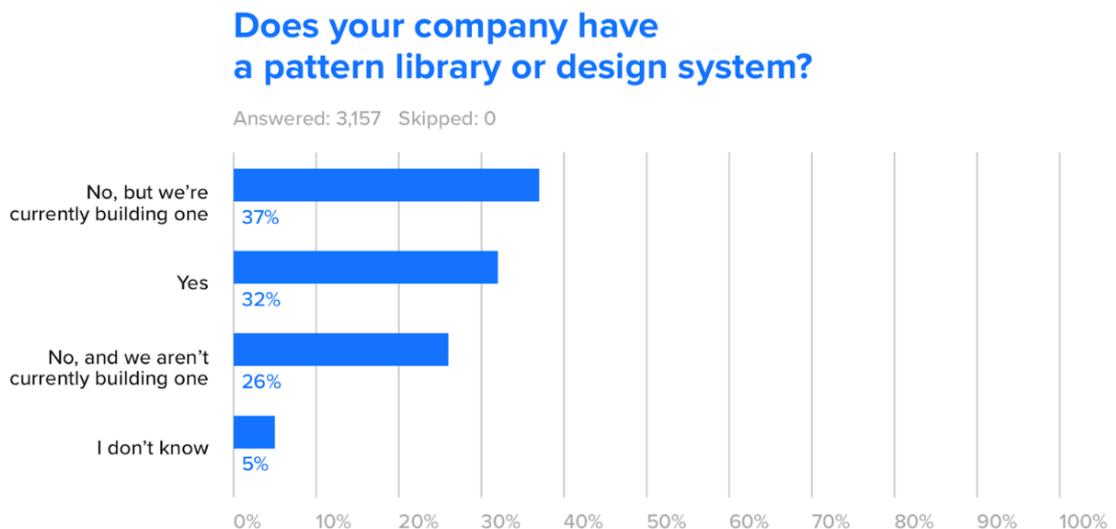


Figure 4. Stats on pattern libraries/design systems using and building (Treder & al. 2017, 18)

An enormous decrease in time and cost can be reflected in time spent on designing and building UI patterns, making product-wide changes and faster product launch. Time waste and inefficiency are head aching cost among technology companies. Curtis (26 July 2017) describes an example of how costly the work duplication is, and the conclusion is company will pay for \$1 000 000 to have good buttons if a company has 25 teams and each of them makes buttons separately. In addition, the design system also helps to reduce technical and design debt dramatically compared to traditional ways of working. Because of reusing patterns, changing a pattern will automatically update the same pattern throughout the products. (Kholmatova 2017, 169-170.) Adopting design system, specifically, pattern and component libraries can enable faster development cycles, because teams can quickly make a prototype and test the new features, for instance, Smartly.io can probably release a new feature in one week (Musatkin 14 March 2018). Tobias Ritterbach (in Kholmatova 2017, 171), an experience owner at Sigmoid says that they build pages 10-20 times faster when having a pattern library compared to not using any libraries. Hence, the design system helps mitigate costs of inefficiencies and wasted time of product teams.

Higher consistency in design, code and brand is considered as a value the design system brings to organizations. Apparently, inconsistencies in design and code are unavoidable when companies grow fast with multiple products. It is not rare to see different products that belong to one brand look totally different from one another just because of small tweaks in visual design. A survey by Treder & al. (2017, 13) indicates that when a company grows and has more than 25 employees, improving design consistency becomes a considerable challenge. Design systems offering style guide and clear standards help harmonize and unify all products under the same brand. Moreover, the consistent design makes user interface familiar, predictable to users and helps them learn the product easier and faster. (Kholmatova 2017, 171-172.) Consistent code styles and naming conventions can save a lot of time and efforts among development teams, because consistency in code makes it easier to understand, merge changes and fix bugs (Ziemoński 2 February 2017). Hence, development teams have more time for solving more challenging product problems rather than fixing small issues.

Design system provides reusable patterns, components and clear best practices to ensure the better UX design and code quality throughout a product and across multiple products. Each pattern in design system is designed and iterated based on usability testing before being added into the library (Pernice 31 August 2018) so that other designers do not need to think about the minor usability issues and have more time to rapidly prototype and test bigger modules or new features. Additionally, consistency also helps to miti-

gate user confusion and deliver coherent user experience. Regarding the code quality inter/intra product, Suarez & al. (2017) argue that design system provides holistic component libraries, which helps reduce time spent on quality assurance while ensuring the product quality and better user experience. Besides, other advantages of the design system can be reducing technical debt, eliminating code duplication and ensuring the implementation outcomes are the same as the UI design (Pernice 31 August 2018). In a nutshell, design system enables companies to deliver better product quality with better user experience in a faster way, which makes customers much happier.

Several authors have recently attempted to explain how company operations can benefit from design systems in terms of increased team communication & collaboration. It is argued by Jinna Anne (14 March 2018) that design system changes how design is being talked about in the organizations, which means there are more connections, more mutual learning and more shared understanding regarding communication about design. “Design systems are for people” because it lets people be heard, encourages them to contribute to the better design and makes them feel part of the design system. (Anne 14 March 2018.) Similarly, Design Language System Lead at Airbnb, Saarinen (14 March 2018) also shares the same opinion with Anne’s. According to him, design system not only breaks the communication silos, but it also improves the team collaboration, especially cooperation between designers and developers, which makes it easier for the scale of digital process and teams. (Saarinen 14 March 2018.) Vella (1 August 2018) emphasizes how design system can eliminate knowledge gaps within specific teams and organizations. A typical example can be how fast a new designer can catch up with the rest of the team, how fast companies can “get the most out of every new hire”. In the view of all that has been mentioned so far, one may suppose that the more communication, collaboration and sharing practices, the higher efficiency.

The evidence presented above suggests that companies can benefit a lot from investing in design system. In short, “it reduces design debt, accelerates the design process, and builds bridges between teams working in concert to bring products to life” (Suarez & al. 2017).

### **2.3.3 Design system used for design scaling by industry leaders**

In the context of design systems, it is worth mentioning how well-known technology companies scale design across large organizations, especially understanding their design system journeys. This chapter presents two popular case studies: Carbon Design System at IBM and Lightning Design System at Salesforce.

## IBM's Carbon Design System

While significantly raising the number of designers in IBM, Arin Bhowmick (27 March 2018) says “designing at scale is not just about having more people”. He points out that in order to enable design scaling throughout a huge organization, it is crucial for the entire IBM to adopt IBM Design Thinking approach and use the common design language and design tools. Previously, it was argued that scale is one of IBM's top challenges when making more than 2000 products coherently look and feel under the same brand. The fact was that only two-page style-guide was a single source of among over 50 designers and each service designed and owned the user interface themselves. Due to this growing pain - inconsistent user interface - IBM initiated a design system called “Carbon” (figure 5) with the aim of providing a tool for both designer and engineers and making it easily adoptable by product teams. (Sonefeld 30 March 2017.)

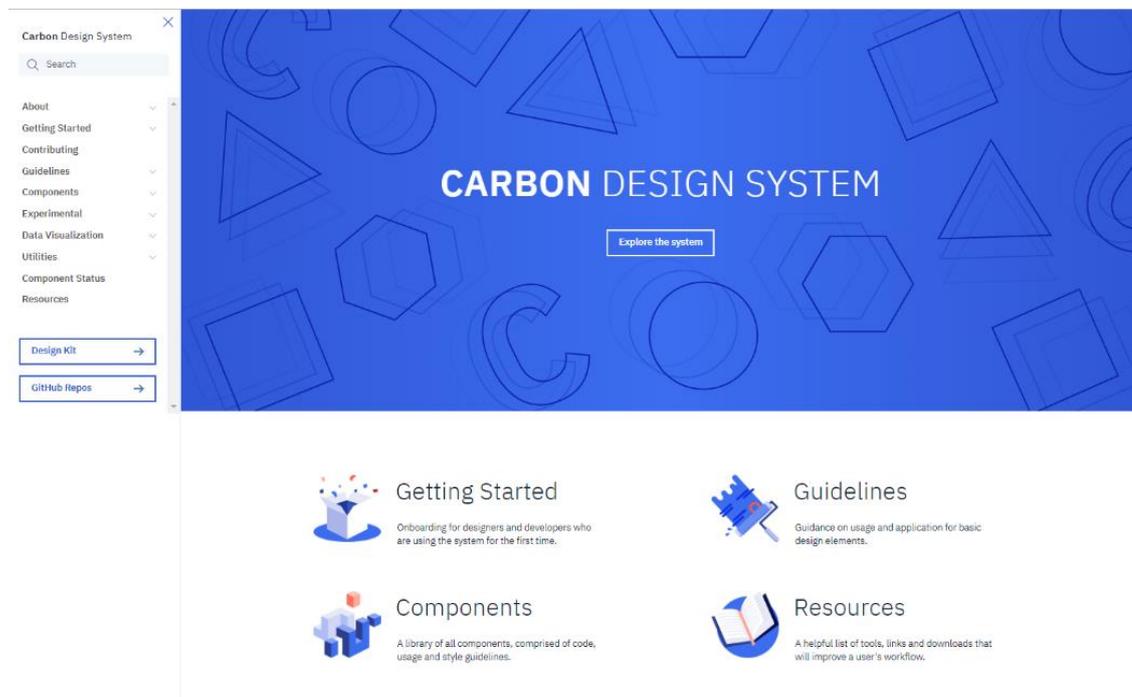


Figure 5. Carbon Design System (IBM 2018a)

According to Sonefeld (30 March 2017), the success of Carbon Design System is based on its users. In a Design System Conference, Hughes (14 March 2018) shares some findings from user research based on their framework to measure design system success (appendix 4) during the one-year period after the first release. It is reported that 80% of product teams in 15 business units have been applied the design language after a year of its release. Most of Carbon Design System's users found it was aligned with existing values: accessible, global, essential, expressive, and experimental. It was also considered

as easy to use and understand but still missing necessary elements and did not really support the development community. (Hughes 14 March 2018.) Carbon design team has been continuously improving the design system day by day because they did not build it to be “done” or “finished” (Sonefeld 30 March 2017). Commenting on design scaling at IBM, Esteban (in Bhowmick 27 March 2018) says “it certainly takes a whole mix of talent, vision, passion, and teamwork to successfully design at speed and scale...”

## Salesforce’s Lightning Design System

In the advent of technology and the fast growth of software companies in the latter 2000s, Salesforce has been aware of the importance of holistic UX in the organization scale. With the desire to scale the whole enterprise in an effective way, optimize all products teams and improve user experience, in 2015, Salesforce started building a living design system called “Lightning Design System” (figure 6). They have built the design system by framing the problem areas and goals, defining the principles, then communicating and collaborating to make decisions. (Villamor 29 April 2016.) Besides providing design principles, guidelines, patterns and component libraries, Lightning Design System needs to support multiple frameworks due to the horizontal scale of Salesforce, for instance, acquiring 22 companies in three years (Weibel 16 May 2018).

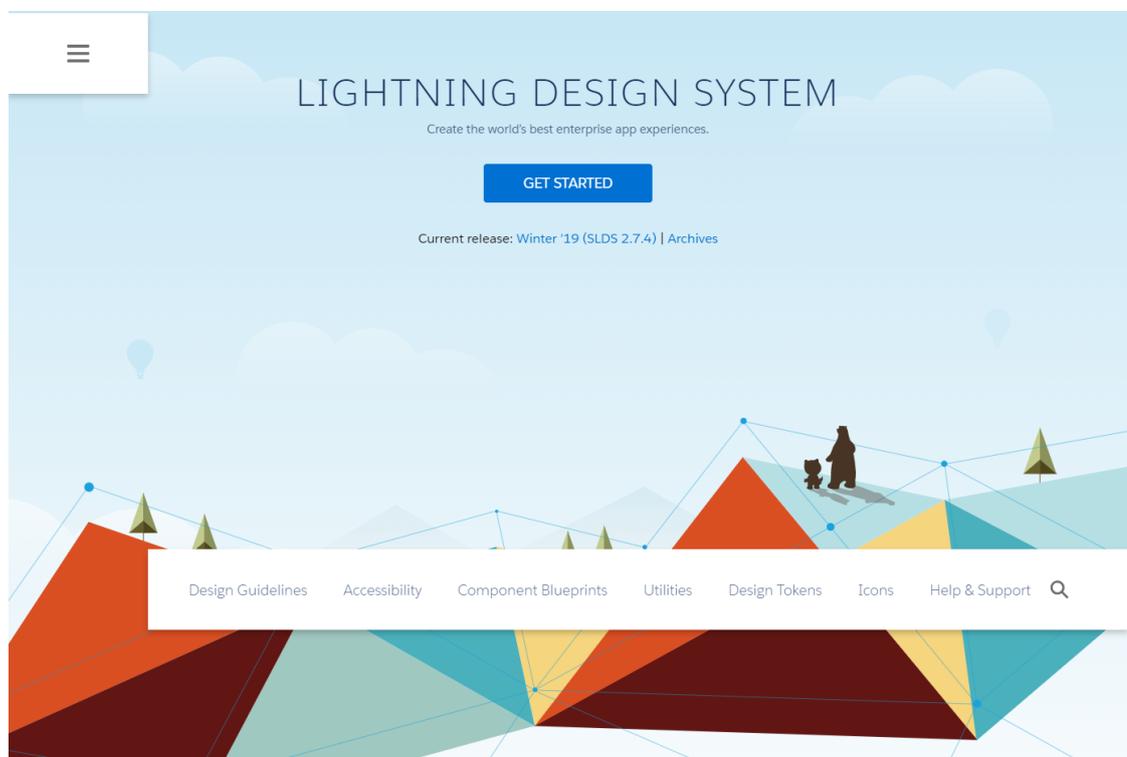


Figure 6. Lightning Design System (Salesforce 2018)

According to Kaelig Deloumeau-Prigent (25 April 2017), a Senior Designer in Salesforce Lightning Design Systems, metrics they use to measure the design system success are comprised of CSS code reduction and “how much of each main screen of the application is using the design system”. Based on his experience and evaluation, Salesforce Lightning Design System has brought the organization the following benefits: “spreading best practices”, higher quality of frontend at scale, making huge changes in a short time and reducing the CSS code redundancy. (Deloumeau-Prigent 25 April 2017.)

### **3 Research method**

This chapter describes empirical methods used in this research and give reasons why specific methods were adopted or omitted. The first section 3.1 discusses the data collecting methods and the second part 3.2 moves on to describe the data analyzing methods in greater details.

#### **3.1 Data collecting method**

The methodological approach taken in this study is qualitative research. Qualitative methods offer an effective way of investigating a new field of study and understanding an issue in a deep and extensive manner (Jamshed 2014, 87-88). Quantitative research methods such as questionnaires were not adopted in this study due to certain reasons. Firstly, design system was quite a new topic in most technology companies; there was little public announcement or news about companies who were building their design systems and little certainty in how properly they were doing. It seemed hard to get a sufficient number of target audiences for the questionnaires. Moreover, if the survey was completed by a non-representative sample, there would be a chance for the failure of the research project. Another reason was that quantitative methods offer fewer chances to explore and elaborate interesting topics that might pop up from respondents.

It is said that semi-structured interviewing is the most popular data collecting method in qualitative research (Dicicco-Bloom & Crabtree 2006, 315). According to Walliman (2011, 99), semi-structured interview contains structured sections with standardized questions and unstructured sections with open questions. Therefore, it allowed the author to keep the focus on the researched topic, identify and explore relevant topics. In this research, a defined interview structure was formulated and iterated while reviewing the literature and researching target companies (see appendix 5). Standardized questions helped the author get the qualitative insights into why they started building design systems and the ways design system had been integrated into the organization. Open questions were used to encourage participants to discuss more the topic more freely.

Six designers from four different large technology companies are recruited for this study. Criteria for selecting the participants are described in greater details in table 2, which helps to ensure the sample quality is aligned with the thesis scope. When it comes to the number of interviews for qualitative research, Morgan and colleagues (2002, in Namey 25 April 2017) as well as Francis & al. (2010) find out that most themes can be identified within 5-6 interviews. Similarity, a study by Guest, Bunce & Johnson (2006) reports that 6

interviews reach 70% saturation and 12 interviews reach 92% saturation. A small sample (6 instead of 12) was chosen because of the tight schedule and the light scope of the bachelor's degree thesis level.

Table 2. Criteria for selecting interviewees

Criteria aspects	Requirements
Company	<ul style="list-style-type: none"> <li>• be a large technology company operating in Helsinki, Finland</li> <li>• have more than 10 products in their product portfolios</li> <li>• have more than 1000 employees</li> </ul>
Designer	<ul style="list-style-type: none"> <li>• be involved in building design system for more than 6 months</li> <li>• have the key role in the design system team</li> <li>• be involved in making design decisions in the company</li> </ul>

Face-to-face interviews were conducted with each participant at a time. This helped avoid the bias and dishonesty in the answers, as well as helped get more different insights and ideas on the topic. In case there were problems in travelling or distance, video call interviews would be replaced for face-to-face ones in order to ensure the visual interactions or aids between interviewer and interviewees. All interviews were audio recorded and transcribed afterwards for later analysis. (Walliman 2011, 100.)

### 3.1 Data analyzing method

Thematic analysis, one of the most common methods used in qualitative research, was the main data analyzing method in this study. According to Braun & Clarke (2006), the thematic analysis is the process of identifying meaning patterns within qualitative interview data. Thematic analysis enables the researcher to discover the patterns and gain a deeper understanding from re-reading the data. Thematic analysis allows the researcher to “summarize key features, highlight similarities & differences across the data set”. (Braun & Clarke 2006.) King (2004, 268) claims that flexibility is an advantage of thematic analysis as it can be adjusted to any types of research. While agreeing with that statement, Braun & Clarke (2006) argue that flexibility can also be a drawback because it can make analyzing difficult and distract the researcher's focus on data.

In this research, all insights from six interview transcripts were thematized based on the six-phase thematic analysis framework provided by Braun & Clarke (2006). After getting

familiar with data set, the author started coding the interview transcripts and then organized the codes into themes that might be relevant to the main research questions or sub-questions. The next steps were to review, consolidate and finalize the themes, which then were laid out in chapter 4. (Braun & Clarke 2006.)

## 4 Results

This chapter presents the results of empirical research on how design system can be a design scaling tool in large technology companies. This chapter is divided into five sub-chapters, starting with interviewees and companies' backgrounds in 4.1 and their perspectives of design system in 4.2. Then, the three remaining subchapters focus on three key themes that include the initial reasons for starting a design system, the approaches and the challenges of integrating a design system into a large technology company and the values of the design system.

The following results are retrieved from semi-structured interview sessions that were conducted with 6 interviewees. Four out of six interview sessions occurred face-to-face while two of them were conducted online via Skype. When comparing two ways of conducting interviews, there were no significant influences on the results noticed. The details of all interviews can be seen at the appendix 6.

All interview sessions were audio recorded with all participants' permissions. They were also clearly informed that identity elements like interviewees' names, companies' names would not be presented, so all data are anonymous in the thesis. These results were sent back to interviewees for being proofread.

### 4.1 Backgrounds

There were six designers from four different large technology companies participating in the research. All of them have design background and have been involved in building the design systems in their own companies. In this study, there is at least one designer in each company who are the key decision maker for the design system or are directly involved in decision making process. The following table 3 briefly presents the interviewees' background in their companies as well as their experience and main responsibilities regarding design system work.

The four companies in this study vary in industries, employee population, number of digital products and design systems' states. Even though a few interviewed companies have physical products beside digital products, the design systems in their companies are built only for digital products. The general information of the studied companies is shown in table 4. These pieces of information are extracted from the interview sessions and partly from their websites and annual reports.

Table 3. Background of interviewees

Interviewee code	Gender	Company	Time in Design System	Main responsibilities in design system
1	Male	A	8 months	Content contributor and advocator
2	Male	A	8 months	Design system owner, key decision maker
3	Female	B	10 months	Design system owner, key decision maker
4	Male	B	10 months	Main content creator, e.g. interaction and usability parts
5	Male	C	nearly 2 years	Design system owner, key decision maker
6	Female	D	more than 2 years	Design system owner, key decision maker

Table 4. Backgrounds of studied companies

Company code	Number of employees	Number of products	Design system started	Dedicated team for design system	No. of products are using design system
A	>1 000	>10	2018	No	2
B	>100 000	>100	2018	Yes	N/A
C	>1 000	>10	2014	Yes	14
D	>10 000	>100	2016	Yes	N/A

#### 4.2 Interviewees' definitions of design system

As mentioned in chapter 2.3.1, design systems are more about how the companies tell the story of how they design and build their products; therefore, the question "What is a design system from your point of view?" was asked to get insights into the interviewees' perception of design system, which would help in later analysis. Table 5 presents the ideas of what design system is from interviewees' points of view.

Table 5. Interviewees' definitions of design system

Interviewees	Definition of Design system
Interviewee 1	<ul style="list-style-type: none"> <li>• Design system is officially a collection of components, patterns and other stuff that altogether creates a system, like a lego that you can build from.</li> <li>• It's a way people work together to solve the design issues. It's a kind of methodology, tool that assists the actual human system.</li> </ul>
Interviewee 2	<ul style="list-style-type: none"> <li>• Design system is a tool for our work, a way to scale the work and scale the design decisions.</li> <li>• It can be a tool for communication.</li> </ul>
Interviewee 3	<ul style="list-style-type: none"> <li>• Design system has content for principles, guidelines, toolkits, templates and reusable software components... essential part is that you create some of the content so that others can take it and reuse it.</li> <li>• It's a continuous work so it will never be finished</li> </ul>
Interviewee 4	<ul style="list-style-type: none"> <li>• Our design system provides design principles and systematic rules on how to approach to design...supplying as design assets in software assets for teams to use.</li> <li>• Design system is a more social aspect of the design, community-based design, user experience design</li> <li>• Design system is a more systematic approach in design</li> </ul>
Interviewee 5	<ul style="list-style-type: none"> <li>• Design system is more about patterns and shared practices ... a single source of truth for everything</li> <li>• Design system is just a tool in Design Operations... Design system tries to scale the design in organizations</li> </ul>
Interviewee 6	<ul style="list-style-type: none"> <li>• Design system is not just sort of visuals in the UX patterns that we have, it's also proven to be a way of working for us. It takes into account our communication, it was essentially building a language to be able to communicate with each other</li> <li>• Efficiency, glue/adherence, and community</li> <li>• It can be a tool or a guide/teaching tool. Even it can be a way of working.</li> </ul>

It is apparent from table 5 that all participants consider design system as a tool or methodology for their design work. Some think that design system is a way to scale design in companies. In terms of the social aspect of design, some define design system as a community-based design method, a communication tool, or a design teaching tool.

### 4.3 Reasons for starting design system in large technology companies

The reasons for initiating design systems in these companies are investigated in the interviews with the aim of seeing if these reasons are related to the product design scaling or not. The themes identified in these responses to this question are shown in the following table 6.

Table 6. Reasons for starting a design system

Main themes	Sub Themes	Codes
Consistency	Visual consistency	<ul style="list-style-type: none"> <li>• consistency like how it looks (A,1)</li> <li>• consistency throughout products (A,2)</li> <li>• make them look more similar (B,3)</li> <li>• consistency in the offerings (B,4)</li> <li>• have the same look (C, 5)</li> <li>• a lot of incoherencies (D,6)</li> </ul>
	UX consistency	<ul style="list-style-type: none"> <li>• unify the UX (A,1)</li> <li>• use in similar manner (B,4)</li> <li>• the same feel (C,5)</li> </ul>
	Consistency in branding	<ul style="list-style-type: none"> <li>• create brand consistency in all of products (A,2)</li> <li>• brand consistency (B,3)</li> <li>• the same branding (C,5)</li> </ul>
Working process	Maintenance	<ul style="list-style-type: none"> <li>• management of consistency (A,1)</li> <li>• lots of legacies (A,1)</li> <li>• Issues like legacies (A,2)</li> </ul>
	Sharing	<ul style="list-style-type: none"> <li>• reuse icon library (B,3)</li> <li>• share the same assets (B,3)</li> <li>• don't need to reinvent the wheel (A,2)</li> </ul>
		<ul style="list-style-type: none"> <li>• lots of the ways of working and the processes (D,6)</li> <li>• put all things together (D,6)</li> </ul>
		<ul style="list-style-type: none"> <li>• all the team have their own needs (C,5)</li> <li>• developers don't care much about visual design, (A,2)</li> </ul>
	Improving ways to work	<ul style="list-style-type: none"> <li>• Lean ideology (B,3)</li> <li>• make the processes smoother (D,6)</li> <li>• customer or user collaboration (B,3)</li> <li>• scale all design decisions (A,2)</li> <li>• general cultural change for human-centered design driven approach. (B, 4)</li> <li>• a tool for our team and product team to communicate (A, 2)</li> </ul>
	Communication issues	<ul style="list-style-type: none"> <li>• communication silos (A, 2)</li> <li>• not discuss with each other (A,2)</li> <li>• not talk about the same thing. (C,5)</li> </ul>
Business related objectives	Resources saving	<ul style="list-style-type: none"> <li>• more time for UX research and backend (A,1)</li> <li>• saving in time and cost (A,2)</li> <li>• save that time (B,3)</li> <li>• savings (B,4)</li> <li>• save a lot of time and money (C,5)</li> <li>• faster development process (D,6)</li> </ul>
	Business reasonings	<ul style="list-style-type: none"> <li>• unification (A, 1)</li> <li>• huge and trusted brand (A, 2)</li> <li>• product quality (B, 3)</li> <li>• trying to do good business (B, 3)</li> <li>• employer branding (C, 4)</li> <li>• happy customers (D, 6)</li> </ul>

Note: (A, 2) means Company A, Interviewee 2, which can be referenced to background section in Results chapter (Table 3 & 4)

When the interviewees were asked about the reasons why the design system was initiated, the majority of them commented that the consistency and resource savings were their reasons. The consistency was discussed in different aspects, for instance, visual design, UX design and branding. It seems that ensuring the consistencies throughout all products is one of the critical objectives of companies when they deliver design at scale by using the design system.

“When the company grows, there are a lot of products, when you acquire other companies and have to integrate them, it is easier if you have a kind of design system already. It makes the work more efficient, helps to keep the look, iterates the usability as a quality product.” (Company A, Interviewee 1)

“Company C didn’t have work guideline back then. We had to build one to make sure that services in the future have the same look, feel and branding.” (Company C, Interviewee 4)

Even though each company has different pain points and reasons, they all aim to improve their ways of working and do better business. Some of them mentioned communication issues while some emphasized the reusability of assets and sharing of knowledge to make processes smoother. One interviewee stated that: “It is like applying Lean ideology, reducing unnecessary wastes...” (Company B, Interviewee 3) and the other participant commented: “Another reason is a general cultural change for a human-centered design approach.” (Company B, Interviewee 4). Interestingly, scaling design decisions and work within the company is the aim of company A.

#### **4.4 Integrating design system into large technology companies**

This section firstly summarizes the approaches these researched companies have used or plan to use for integrating design system into their organizations, then challenges that the companies face during integration are looked into.

It is worth noticing that four researched companies’ design systems are in different maturity phases: company A and B’s design systems are in beta phase while those of company C and D are a little more mature, based on the age of the design systems (table 4). With respect to methods and challenges of design system integration, the size of the companies should be taken into account when interpreting the following results.

#### 4.4.1 How to integrate design system into companies

When asking the questions: “How has design system been taken into use in your company?” and “What is your plan to integrate design system into the company?”, a range of responses was elicited. The themes identified in these responses to these questions are shown in table 7.

Table 7. Ways of integrating design systems into companies

Main themes	Sub themes	Codes
General approach	Bottom-up approach	<ul style="list-style-type: none"> <li>it came from down to up. (A, 1)</li> <li>use a product to promote design system (A, 2)</li> <li>bottom-up approach (B, 4)</li> <li>started in 1 or few products, prove it bottom up (C,5)</li> <li>we tried it out first and we see if it scales to the rest of the company (D, 6)</li> </ul>
	Collaborating with other teams	<ul style="list-style-type: none"> <li>work with project managers and developers to integrate (A, 2)</li> <li>see how they work and see how we can help (A, 2)</li> <li>communicate with developers (A, 1)</li> <li>help in the planning, find UX designers (B, 4)</li> <li>working together with a larger portal so more and more components will be finished (A, 1)</li> <li>have sponsors in organization (C, 5)</li> <li>someone who have the budget and willingness to test it out (C, 5)</li> </ul>
	Continuously promoting	<ul style="list-style-type: none"> <li>making people start talking about it (A, 1)</li> <li>spread it in the air (A, 1)</li> <li>spread information, spread knowledge (D, 6)</li> <li>evangelize and show the values (A, 2)</li> <li>communicate that kind of values (B, 3)</li> <li>introduce why it is important (C, 5)</li> </ul>
	Raising awareness among target audience	<ul style="list-style-type: none"> <li>designers, R&amp;D managers, and developers (B, 4)</li> <li>raise awareness among top management (A, 1)</li> <li>key stakeholders are aware (designers, developers and product owners) (B, 3)</li> <li>top management level (B, 3)</li> <li>product teams (D,6)</li> </ul>
	Tracking the progress and improvements	<ul style="list-style-type: none"> <li>user testing to collect feedback (A,1)</li> <li>hackathon to test components (A,1)</li> <li>surveys (B,3)</li> <li>KPI for design system: How many teams are using it? How much money can it save (C, 5)</li> <li>surveys (D,6)</li> <li>the amount of time needed for creating a feature (D,6)</li> <li>more features to the customer (D, 6)</li> </ul>

Promoting channels and methods	Word-of-mouth	<ul style="list-style-type: none"> <li>designers will promote it within product teams (A,1)</li> <li>key person to spread DS (A, 2)</li> <li>have an ambassador from teams (D, 6)</li> <li>promoting themselves (B, 3)</li> <li>word-of-mouth (D, 6)</li> </ul>
	Building community	<ul style="list-style-type: none"> <li>it's a community base (D, 6)</li> <li>having designers' meetings (B, 4)</li> <li>create some kind of choices or ownership (B, 4)</li> <li>designer community (B, 4)</li> </ul>
	Communication via multiple channels	<ul style="list-style-type: none"> <li>demos (A, 1)</li> <li>digital communication channel (A, 2)</li> <li>Skype calls with the community (B, 3)</li> <li>Common mailbox, emails (B, 3)</li> <li>communication channels for questions (C, 5)</li> <li>own site on the internet (D, 6)</li> <li>main page for design system (C, 5)</li> </ul>
	Digital promoting channels	<ul style="list-style-type: none"> <li>promoting through the digital channels (B, 3)</li> <li>newsletters (B, 3)</li> <li>videos (B, 3)</li> <li>blog (B, 3)</li> <li>blog (C, 5)</li> <li>newsletters (D, 6)</li> </ul>
	Events	<ul style="list-style-type: none"> <li>offline event for launching (A, 1)</li> <li>visit offices in other locations &amp; talk about it (D, 6)</li> <li>organize events in a few key locations (B, 3)</li> </ul>
	Face-to-face meetings	<ul style="list-style-type: none"> <li>create meetings (A, 1)</li> <li>meet face-to-face (B, 3)</li> <li>have workshop (B, 3)</li> <li>good to do face-to-face consultation (D, 6)</li> <li>usually meet teams (C, 5)</li> </ul>

Note: (A, 2) means Company 1, Interviewee 2, which can be referenced to Background section in Results chapter (Table 3 & 4)

In general, table 7 indicates that all companies in research choose to use the bottom-up approach to integrate design systems, without any doubts. Starting with one or a few products, design system teams can easily test and complete a collection of components in a compatible manner with existing products while it does not require a huge investment. The bottom-up approach seems to be a common and proven way among many companies.

“If it comes from top to down, it means that the company's design maturity level is so high, and top management has an understanding of the benefits of building this kind of thing. But usually there are not many companies with that high design maturity level. So, you have to prove it bottom up. That is usually the way, which I've learnt when talking with different companies. (Company C, Interview 5)

Most of the responses to these two questions are about raising awareness among target stakeholders by continuously promoting design system in the companies. Among many different promoting channels and methods, the most noticeable ones are word-of-mouth and face-to-face meetings. Furthermore, building design community, organizing events and providing multiple digital communication and promotion channels were also brought up by interviewees.

#### 4.4.2 Challenges in design system integration

The question about challenges of design system integration in companies was asked in order to discover if there were any limitations in their integrating approaches. This question might also help to bring up challenging areas of integration that these companies' approaches has not covered yet. These challenges identified and categorized into external challenges and internal ones by the author are presented in table 8

Table 8. Challenges in integrating design systems into company

	Company A	Company B	Company C	Company D
External (not up to DS team)	Developers do not want to rework	People's hesitance to change		People's hesitance to change
	People located in many different places	Large scale: people located in different places		Large organization, different countries.
	Product priority is on functionality rather than fancy UI		Have more important things to do in the backlog	
	Shortage of resources: budget, time	Resources: budget, lack of competent designers & frontend developers	Budget matters	
	Rework does not add much values for clients	Cost for rework		
	Legacies	Slow movement because of long product life cycle	Not able to change everything at once	
Internal (Up to DS team)	Lack of some components		Create the best solutions for all team needs.	The capacity to cater everyone
	Lack of technical competence in team	Making others feel part of design system		

It can be seen from table 8 that common external challenges of design system integration into companies are people's hesitance to change, lack of resources and the large scale. The staff hesitance is seen rather a normal reaction; one commented that time would solve it.

“When it comes to initial reaction, people are generally very hesitant to change but once they started to see the benefits of the ways of working being changed and there has not been that much backlash.” (Company D, Interview 6)

Company A has a challenge that developers do not want to rework because they see the rework does not add many values to the existing products. An interviewee in company B somehow agreed with the cost of rework; however, he argued that:

“It is not really much work because our components' styles are so systematic that it is a lot easier to implement than before, rework would benefit in the long term.”  
(Company B, Interviewee 4)

In terms of internal challenges, the most noticeable one is the design system team's inability to support and cater to all teams' needs. One respondent mentioned that technical issues at the early stage, for example, unstable website was a big challenge for them to spread the design system throughout the company. Another interviewee expressed the concern about how to make others feel being a part of the design system. Overall, these internal challenges seem to be unavoidable consequences of the large scale of multinational corporations.

#### **4.5 Values of design system**

In order to see whether the design system has been able to help companies to mitigate pain points or achieve their objectives that were mentioned in chapter 4.3, all interviewees were asked: “What kinds of benefits has your company gained from design system so far?” or/and “What kinds of benefits would your company gain from design system?”. The first question aims to get insights into values happened while the latter one is more about the values expected to occur. It is worth mentioning again, two out of four companies in question have design systems in the beta phase and their design systems have not been widely used in companies.

From all responses to these questions, the main values were identified and grouped for certain subjects including designers, developers, product owners, customers and top

management & company. Table 9 illustrates the opinions of company representatives regarding the values of the design system for different subjects. Symbol “x” means at least one company representative mentioned that value in the interviews.

Table 9. Values of design system

Subjects	Values	A	B	C	D
For designers	designers are getting better: more time to learn new skills, be more efficient, faster ways to work	x	x	x	x
	Reduce time spent on basic, common problems, e.g. UI design with branding and fixing UI bugs	x	x	x	x
	Have more time on research and solve more complex UX problems		x	x	
	It's a way of onboarding new designers		x		x
	Keep design more maintainable		x		
	proven, tested, good design practices		x		x
For developers	have more time to focus on more complex problems	x	x	x	x
	saves time, more time to learn new skill	x		x	
	reduce time spent on basic problems, e.g. fix UI bugs	x	x		
	keep it easier to implement and maintain	x	x		
For product owners	Support communication thanks to common design language	x	x	x	x
	better product quality	x	x	x	x
	make the processes better between in teams	x			x
	giving the opportunities to fail fast and test more things	x			
For customers	make UI development quicker, save development costs		x		
	getting better experience, more values	x	x	x	x
	easy-to- use product thanks to similar looking and working throughout many products	x	x	x	x
For top management & company	better accessibility and usability		x		x
	saving basic resource: cost reduction and time savings	x	x	x	x
	more efficient, faster ways of work	x	x	x	x
	better quality of the products	x	x	x	x
	better brand, better business values	x	x	x	
	consistency	x	x	x	x
	common language between designers and developers	x	x	x	x
	easy to manage the product portfolio	x	x		
	speeding up the change, the digital transformation		x		
	promoting user-centered methodology		x		
happier customers				x	

Generally, data in table 9 indicates that the most common values are: (1) designers and developers are able to solve complex problems in more efficient ways, (2) product owners enhance the product quality and improve the working process with a common design language, (3) customers get better user experience, (4) company can save basic resources

while improving the branding. On the other hand, there are a few values that were mentioned by only one participant. Although others did not bring up some points in the interviews, it is not possible to assume that they do not agree with these values. The data, therefore, should be interpreted with caution.

#### 4.6 Additional ideas

Finally, an open question was used to encourage the interviewees to discuss the topic more, especially in the context of product design scaling. Some additional ideas collected during the interviews are presented in table 10.

Table 10. Interviewees' addition ideas

Interviewee 1	<ul style="list-style-type: none"> <li>I think design and design system should be a part of company strategy. You need to have design culture in the company, and it starts from designers who create the culture. We are now creating it. It is kind of chicken and egg issues, we create the design system then we create the culture, then we have design culture, we can accelerate the design system...</li> </ul>
Interviewee 4	<ul style="list-style-type: none"> <li>It is a systematic approach to design. I would recommend even for startups.</li> </ul>
Interviewee 5	<ul style="list-style-type: none"> <li>In different companies, it means different things, you have to understand the organization needs before you actually start doing something</li> </ul>
Interviewee 6	<ul style="list-style-type: none"> <li>Scale can be in different manners. It can be scaled to all parts of the company, to omnichannel or whatever. It's the basis that everyone at least in our company will need to adhere to because it's been tested, it's been gone through iterations, it's been used.</li> </ul>

Together, these results presented in the chapter provide important insights into the design system understanding in different companies, challenges they want to solve by design system, approaches of integrating design system into company and values design system can bring about. The next chapter moves on to analyze and discuss these research results in greater details.

## 5 Discussion

This chapter of the thesis analyses the results of the interviews and discusses the findings in the research, focusing on three main themes in sub-chapter 5.1, 5.2 and 5.3. Then, concise answers to the research sub-questions and the main research question are presented in sub-chapter 5.4. Finally, sub-chapter 5.5 proposes topics for future research into this area.

### 5.1 Background of design system cases

In this research, four design system cases all satisfy the criteria mentioned in table 2; however, they have significantly varied backgrounds that can be seen from the company background and design system status (see table 4). Two out of four design systems are in the beta phase with less than 1 year old while the other two are more mature. It is essential to bear in mind that the design system maturity levels in this research are only based on the year of the design systems. Future studies with more focus on design system maturity levels are therefore suggested.

In term of design system team, surprisingly, only one design system case (company A), which is in beta phase, does not have a dedicated team for design system. Even though they well understand the need for a dedicated design system team, this is not the priority in that company. Being in the same beta phase, the other case (company C) has a dedicated team with people from multiple disciplines and tends to increase the number of team members. A possible explanation for this difference is that previously company C had a team working on and publishing a huge software UI style guide which has been widely used by many teams, so the company is somehow aware of the needs and values of design system. In contrast, company A only had a basic HTML & CSS for main elements that might not have been used. These findings will help in understanding better the possible differences in topics discussed in the following sections.

As mentioned in the theoretical background, chapter 2.3.1, design systems are more about how companies tell the story of how they design and build their products; therefore, the definition of design system probably varies among researched companies depending on what they sought to achieve with design system. The current study found that design system is considered as a tool or methodology for work in the company with principles, pattern library, components and shared practices, which confirms the definition of a great deal of the previous authors in this field. There are similarities between the thoughts expressed by two design system owners and Suarez & al. (2017) and Malouf (5 March

2018) when they think that design system is a way to scale design in companies. Interestingly, one-third of respondents mention design system as a community-based design method, which is hardly mentioned in other previous popular industry sources. This result may be explained by the thought that design system is a communication tool and teaching tool. However, further work is required to establish this.

## **5.2 Potential challenges of scaling product design**

The first sub-question in this research sought to determine what the main potential challenges in scaling product design are. In order to find the answers to this question, the results regarding initial reasons for starting design system are carefully investigated and reflected against theoretical framework; therefore, these results need to be interpreted with caution.

In this research, consistency was found to be one of the critical objectives of initiating design system in companies (see table 6). Consistency was mentioned quite many times by all respondents regarding different aspects like visual design/ user interface, user experience, and branding. Nevertheless, only one company representative explicitly stated that there are a lot of incoherencies in products while other implicitly expressed their desire to create consistency for present and future products. It can therefore be assumed that inconsistency is one of the issues when delivering product design at scale. This finding corroborates Treder & al.'s finding (2017, 12), which showed that improving UX consistency is one of the top UX challenges in enterprises (appendix 1). Prior studies that have noted the importance of consistency in products as it contributes to the great usability and user experience, which leads to product quality. In the context of scaling, for example, in an acquisition, inconsistencies in digital products can affect the business outcomes negatively.

In addition, the research results indicate that working process improvement is what companies sought to achieve by design systems, although the interviewed companies have different types of pain points in their ways of working. It can be seen from the results (table 6) that the main working process's issues lie in work maintenance, knowledge and practices sharing, communication and collaboration. These challenges were found in previous studies as considerable factors in scaling design. The work maintenance issue is illustrated by technical and design debts, which are unavoidable when a company grows and scales products (Suarez 20 September 2018). Devanney & al. (2017) point out that as companies grow, it is increasingly difficult to communicate, collaborate, share

knowledge & best practices, and apply them throughout the companies, and team become less efficient. Hence, it is possible that such connections exist between these working process issues and challenges of product design scaling process.

Resource saving is another reason for starting design systems. Most company representatives believed that design system can help save a lot of resources such as time and money. A possible explanation for this result may relate to the two reasons mentioned above. Firstly, inconsistencies in products need to be fixed for better business outcomes, which requires additional budget and time. Secondly, the inefficient working process can cause unnecessary wastes such as waiting, rework, defects, etc. that are against Lean philosophy; therefore, this leads to unnecessary cost and resource waste in companies.

This combination of findings may help us to understand potential challenges in scaling product design in large technology companies. The most important limitation lies in the fact that no interview questions directly asking about the challenges in the context of scaling product design. While this study did not confirm the reasons discussed above are the product design scaling challenges, it did partially substantiate the connection between them. This raises questions about how design system can support in scaling product design, which will be discussed in the next section.

### **5.3 Design system supporting in scaling product design**

The second sub-question in this research is “how can the design system solve those challenges and support in scaling product design in large technology companies”. As discussed above, four researched cases have slightly different perceptions of design systems and have different pain points and design stories; nevertheless, all of them chose the design system as a solution. This section discusses findings regarding this research sub-question, focusing on two themes: how design systems help in building a design-driven culture and how design system can help to enable sustainable scaling.

#### **5.3.1 Design system helping build design-driven culture**

This study found that design system can solve challenges in scaling product design by facilitating in building a design-driven culture in companies. First of all, design systems were found to provide a design tool which includes design foundation, a collection of solutions to basic common design problems and proven, tested design practices for all organization staff. Accordingly, the design system brings about consistency and enhances product quality with better user experience, evidenced in table 9. It is believed that design system

is a single source of truth that contains all shared design and UI code assets so that all teams can contribute and reuse without questioning. This enables Lean philosophy by significantly reducing unnecessary wastes in working processes, consequently, saving a lot of time and money. In addition, results indicate that design system' modular approach helps keep design and UI code easier to implement and maintain; in other words, it contributes to the decrease in technical and design debts. These findings are consistent with the previous studies that have examined the benefits of design systems, seen in theoretical background, chapter 2.3.2.

One unexpected finding is that a design system can also help promote the user-centered design methodology within companies. Although this result has not previously been described, it seems suitable. It is difficult to explain this result, but it might be related to the interviewee perception of the design system's functions and their primary objectives when starting a design system. From literature review on design system and interview results with respect to reasons for starting a design system, it is possible to hypothesize such connections exist between the design system' missions and the effort to fix a broken user experience (figure 7), especially in the context of scaling. This is an interesting topic for future research. If a design system is well designed and built to be equal to the fourth effort level "Unified experience strategy" (figure 7) upwards, then it is likely that most of inconsistency-related challenges in scaling product design are solved.



Figure 7. The hierarchy of effort to fix a broken user experience (Klocek 27 September 2012)

On top of that, a design system brings a common design language into teams' conversations (table 9). This finding corroborates the ideas of the previous study, which suggested that design system changes how design is being talked about in the companies, which means there are more connections, more mutual learning and more shared understanding regarding communication about design. As a result, the increased communication and collaborations make the working processes smoother and more efficient. This, hence, saves a lot of company resources.

Together these findings provide some support for the interpretation that a design system can solve challenges of product design scaling because they provide a toolkit and a common design language to enhance the consistency and efficiency in companies. At the same, a design system can facilitate in growing the design culture in large technology companies.

### **5.3.2 Design system enabling sustainable scaling**

Generally, table 9 indicates a wide range of values that the design system can bring to companies and specific stakeholders. Most of them are seen in previous studies, evidenced in subchapter 2.3.2. There were many values mentioned multiple time by interviewees, for example, (1) designers and developers are able to solve complex problems in more efficient ways, (2) product owners enhance the product quality and improve the working process with a common design language, (3) customers get better user experience, (4) company can save basic resources while improving the branding. However, some obvious values were discussed in the theoretical part but not brought up by all participants, for instance, happier customers. It seems possible that this result is due to the differences in perception of design system among company representatives and different pain points or challenges each company is currently facing. Another possible explanation for this result might be that some values are too obvious to be mentioned. Thus, it can possibly be assumed that interviewees would agree with these values. Hence, these results in table 9 cannot be generalized to the importance level of these values. Table 9 provides a list of business values that can be a good base for future research into topics like the ranking of design system' values. All in all, this study produced results which corroborate the declaration by Watson (1973, in IBM 2018b) that "good design is good business".

The current research found that design systems can support in scaling product design by providing a great foundation for scaling and encouraging innovations. As mentioned in the theoretical background, the design system's modular approach promotes the reusability

that makes scale possible (Suarez & al. 2017). This is supported by the finding that design systems were seen as a systematic approach in design in which (1) foundations, solutions to common basic design and development problems are provided as components for many designers and developers to develop product-specific features and maintain their work easily; and (2) people can contribute and reuse assets contributed by others in the design system. Moreover, in the context of acquisition or merger, a design system is a “single source of truth” that makes the branding integration into products more efficient. As expected, these findings provide further support for the hypothesis that such a connection exists between design systems and product design scaling. One participant commented:

“Scale can be in different manners. It can be scaled to all parts of the company, to omnichannel or whatever. It’s the basis that everyone at least in our company will need to adhere to because it’s been tested, it’s been gone through iterations, it’s been used.” (Company D, interviewee 6)

As discussed earlier, the design system was seen as a great tool to promote design-driven culture in corporations, especially user-centered design approach and design thinking method. Martin’s (2009) finding is that design thinking can contribute to the innovation and success in business. It is likely therefore that design systems can encourage the innovations thanks to spreading design thinking throughout the companies. On the other hand, design systems help save product teams a lot of time and effort spent on basic problems, so they can have more time to learn new things, research on more complex problems and come up with more innovative design ideas. In other words, design systems “give the opportunities to fail fast and test more things” (Company A, Interviewee 2).

Hence, the study has found that a design system can enable sustainable scaling in companies. Design system not only supports product design scaling by providing systematic foundations for design, but it also encourages the innovations among varied stakeholders; therefore, it supports the general operations which drives business values.

#### **5.4 Good practices of design system integration**

In reviewing the literature, little was found on the question of how to integrate a design system into large technology companies. This study set out with the third research sub-question aiming to find out good practices of design system integration.

The results of this research (table 7) show that bottom-up approach is a common way to incorporate design system into large tech companies, which means starting with one or a few products before steadily scaling to the rest of the company. There are several possible explanations for this result. Firstly, starting with one or a few products, design system team can easily test and complete a collection of components in a compatible manner with existing products while it does not require a huge investment. Second possible explanation for this may be that not many companies have high design maturity level and not many top management executives understand the values of design, specifically design system. A study conducted in March 2014 in Sweden indicates that almost half of respondents (42%) find that their companies are at the beginning of UX revolution (Berndtsson 28 April 2014). Additionally, it seems possible that the bottom-up approach may be caused by the fact that significant investments are not available as it is not so clear why to invest in the design system in the first place.

The bottom-up approach seems a reasonable choice; however, one issue that emerges from this finding is whether it can be generalized to those companies who have a top-down management strategy. This is an interesting topic for future research. Another possible issue of the bottom-up approach is the risk of not seeing the holistic picture of all products. In other words, if the design system team focuses on a few products of the same type or those of the same complexity level and develops the design system, there will be a risk that those elements may not be compatible with other types of product. Therefore, it is recommended to understand the company's situations and needs thoroughly before choosing bottom-up approach or top-down one.

In addition, the current study also found that collaborating with other teams, continuously promoting to raise awareness of the design system and tracking the progress and improvement are parts of the integration. This finding further supports Curtis's (26 February 2016) the idea, which suggests that working on design system is not simply product design and development, it is also about marketing, communication and management. There are similarities between the way to improve and measure the success of four researched companies in this study and those of IBM and Salesforce, seen in chapter 2.3.3. For example, they collect feedback from the design system users, do some surveys, and have certain key performance indicators for the design system.

Based on this study, figure 8 was drawn by the author to illustrate the ways of integrating a design system into large technology companies.

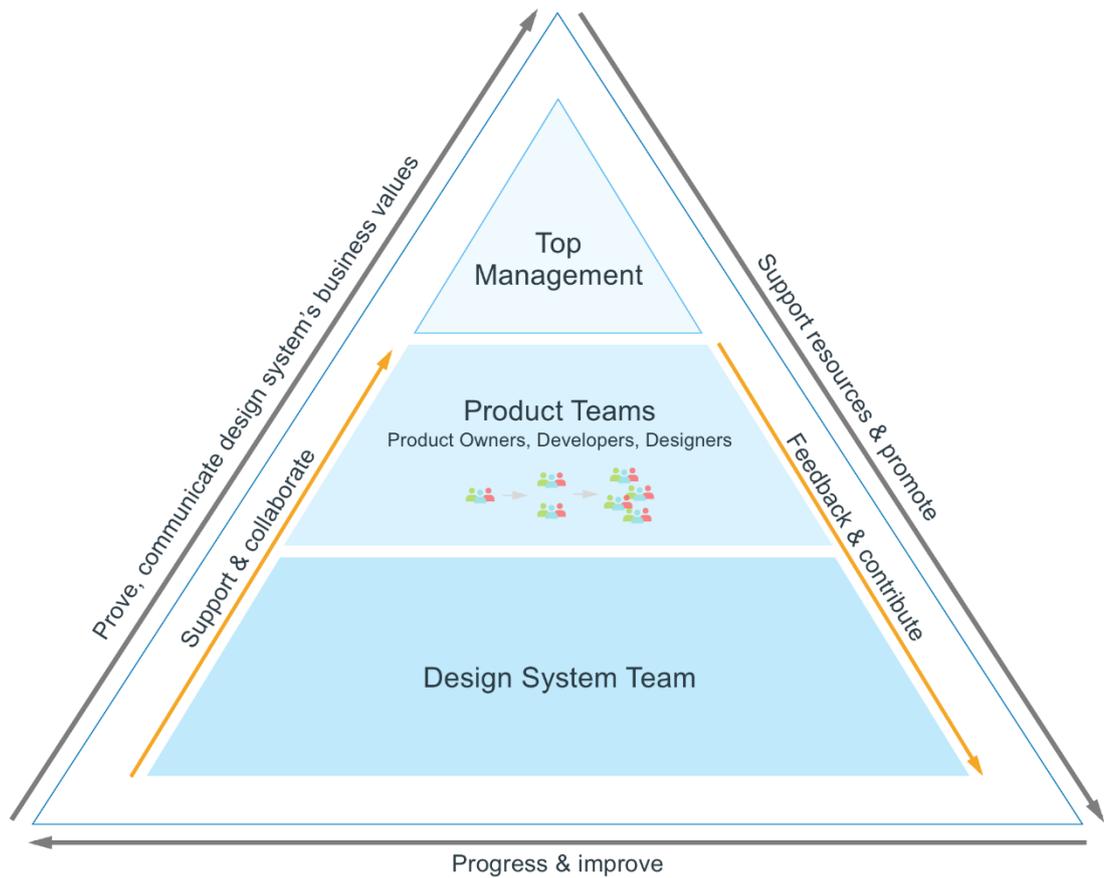


Figure 8. Approaches to design system integration (by the author)

On the question of challenges in incorporating a design system into companies, it is interesting to notice that there are quite a few internal challenges when compared to the number of external challenges (table 8) and these internal challenges seem to be expected consequences of some external challenges such as lack of resources and large scale of multiple-country corporations. It is difficult to explain this result, but it might be related to the limitation that no separate interview questions were asked about the external challenges and internal challenges in the interviews. Table 8 was made based on the author's interpretation, therefore a further study with more focus on this topic is suggested.

It seems that most of the challenges described in table 8 can partly be mitigated by the proper ways of collaboration and communication as well as a sufficient period of time. It is crucial to communicate the values of the design system to target stakeholders and continuously promote to the existence of the design systems in companies. When other people start seeing the benefits of the design system, they will adopt it; and commonly, they will promote it themselves. This helps a lot in solving these challenges. From the results, an omnichannel framework for promoting design system internally was come up with by author and is illustrated in figure 9.

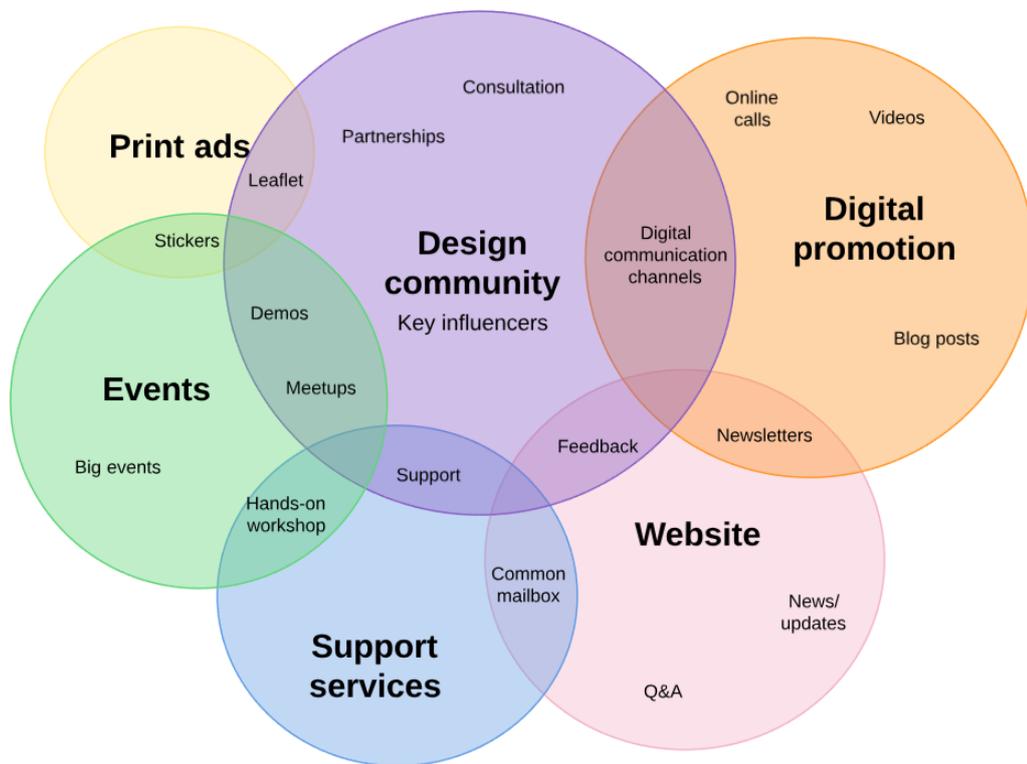


Figure 9. Omnichannel promoting framework for design system (by the author)

In the omnichannel promoting framework (figure 9), key influencers and design community are emphasized. In multinational companies, local influencers can help a lot raising people' awareness of the design system. With the power of word-of-mouth, the presence and values of design systems can be spread out to every corner of the company. Key influencers can be designers, developers or anyone who can see benefits from design system and want to advocate for it. Design community aims to help design-minded people to get started and be better on design as well as share and discuss design system. Design community is also a part of building design-driven culture in companies. It is interesting that the design community is suggested to promote design system while design system seems to be a hook to attract people to the community because it might be challenging to have people join the community. One company representative emphasized the role of designers in building design culture and commented that design culture & design system was like chicken & egg issue:

“I think design and design system should be a part of company strategy. You need to have design culture in the company, and it starts from designers who create the culture. We are now creating it. It is kind of chicken and eggs issues. We create the design system then we create the culture, then we have design culture, we can accelerate the design system...” (Company A, Interviewee 1)

All in all, in order to integrate design system into large technology companies, design system teams should communicate clearly and regularly the values of the design system to the rest of the company and collaborate closely with key local influences who can advocate the design system development and design culture. The framework suggested above is just a general idea of how to promote design systems within companies by omni channels. Depending on the resources and the situations of companies, the framework can be flexibly applied, as one commented that “in different companies it means different things, you have to understand the organization needs before you actually start doing something”.

## 5.5 Conclusion

Based on the analyzed data and discussion above, this chapter forms the answers to the research sub-questions and the main research questions.

**Research sub-question 1:** What are the main potential challenges in scaling product design?

Based on this study, the main potential challenges in scaling product design are inconsistencies and inefficiencies. Inconsistencies in product design include inconsistencies in visual design, user experience design and branding throughout a product or a suite of products. These inconsistencies cause technical and design debt for the company. When companies grow, it is getting difficult to communicate, collaborate and share knowledge within companies and teams become less efficient. This may lead to unnecessary resources wastes such as work duplication, waiting, which is costly.

**Research sub-question 2:** How can a design system solve those challenges and support in scaling product design in large technology companies?

Design system provides a collection of tested, proven patterns, components, guidelines and shared practices. This allows the reusability and sharing of design and software assets within company, which helps save time and resources while enhancing the consistency in products and keeping it more maintainable. Design system also helps improve product quality with better user experience because it promotes user-centered design methodology in the company. Besides, it provides a common design language which supports the communication, collaboration and makes the processes better between teams.

In addition to solving the main potential challenges in scaling design, design system also supports the scaling of product design. Design system provides design foundations and systematic approach to design which makes the branding integration into products more efficient, especially in case of merger and acquisition. By providing solutions to basic problems and promoting the user-centered design approach and design thinking, design system helps to move designers and related stakeholders to the next level. This drives innovation and business value in large technology companies.

**Research sub-question 3:** How can a design system be integrated into large technology companies?

This research suggests a way to incorporate design system into a large technology company is the bottom-up approach, which means starting with one or a few products before steadily scaling to the rest of the company. Moreover, collaborating with other teams, continuously promoting design system and tracking the progress and improvement are parts of the integration. One of the most important things in design system integration is to ensure that target stakeholders are aware of the presence and the values of the design system. Therefore, the communication and promotion should be emphasized. Among promoting channels, key influencers and design community seem practical and effective ways in the context of large technology companies.

**Main research question:** How can design system be a tool for scaling product design in large tech companies?

This study has shown that design system plays an important role in scaling product design in large tech companies. Design system can solve potential challenges of design scaling by introducing design toolkits and common design language, which helps build design-driven culture. Besides, by providing design foundations, solutions to basic problems and promoting the user-centered design approach, design system helps to drive innovations and business value. Therefore, design system can enable sustainable design scaling. Furthermore, design system can be possibly integrated in companies on a large scale by the bottom-up approach and good practices of communicating and promoting the values of design system widely in companies. However, it is essential to understand the company's situations and needs before determining which integration practices should be utilized.

## 5.6 Reliability, validity and future research

In theoretical framework, the secondary data were collected from different trustworthy and reliable sources such as design books and research paper from Google Scholar, ACM, IEEE database. While most of the design system sources are short articles in form of blog posts, article authors are design system specialists and the pioneers in the early days of design system. In the empirical research, the semi-structured interviews were conducted in the same way with six designers from four different large tech companies. Because of their positions in design system team and their experience in design system, all interviewees gave valuable insights into design system in their companies, which are what the research is supposed to find. Overall, the research questions have been answered adequately with the data gathered from the interviews.

The thesis contributes to the existing knowledge of design system's values and functions, mainly in the context of large tech companies. Even though this study is based on a relatively small sample of participants, the findings provide understanding of the role of design system in the product design scaling in technology organizations. This thesis has thrown up many questions in need of further investigation. It would be interesting to research the impacts of design systems on the organizational shift to user-center corporations. More broadly, investigation is also needed to determine the design system maturity level and the relationship between design system maturity level and corporate design maturity level. With respect to the ways of incorporating design system into companies, practices and promoting framework should be used flexibly, depending on the situations of the companies and the status of design system. However, a further study needs to be undertaken to determine more specific design system integration approaches in different phases of design systems. Because of the status of the design system maturity phase and the thesis scope, an issue not addressed in this study was how design system supports the collaboration between designers and developers. However, this is an interesting research question that could be asked in one- or two-years' time.

## 6 Summary

The main objective of this thesis is to figure out how design system can be a tool for scaling product design in large tech companies by investigating challenges, exploring which aspects design system can support product design scaling and understanding how design system can be integrated into companies. The thesis is based on qualitative research, which has been designed and conducted using semi-structured interview method to find the answer to the main research question: “How can design system be a tool for scaling product design in large technology companies?”

This research has shown that design system plays an important role in scaling product design in large tech companies. Design system can solve main potential challenges and support design scaling by providing design foundations, toolkits, common design language, which mitigate inconsistency and inefficiency issues and encourages innovations. In general, therefore, it seems that design system can help in building the design-driven culture and enable sustainable design scaling while increasing the business values.

This work contributes to existing knowledge of design system by providing a different perspective of the design system’s function and suggesting good practices of communicating and promoting design system in the context of large technology companies. A limitation of this study is that the sample size is quite small. This is because of the short timeline and the difficulty of finding and inviting interview candidates that satisfy the eligibility criteria.

Regarding personal learning, this thesis project has been beneficial to the author. The author has gained a lot of new knowledge of design system and had a closer look at the picture of design in technology companies. In this project, various academic research methods were discovered, and those would help the author in future higher education. Additionally, conducting the research project within a very short timeline has helped the author develop time management skill. Thanks to this research, the author’s professional network has expanded towards other professional designers and design system advocators. Design system has recently been a requirement in many UX/UI designer job ads, so this will help the author a lot in the future professional career development.

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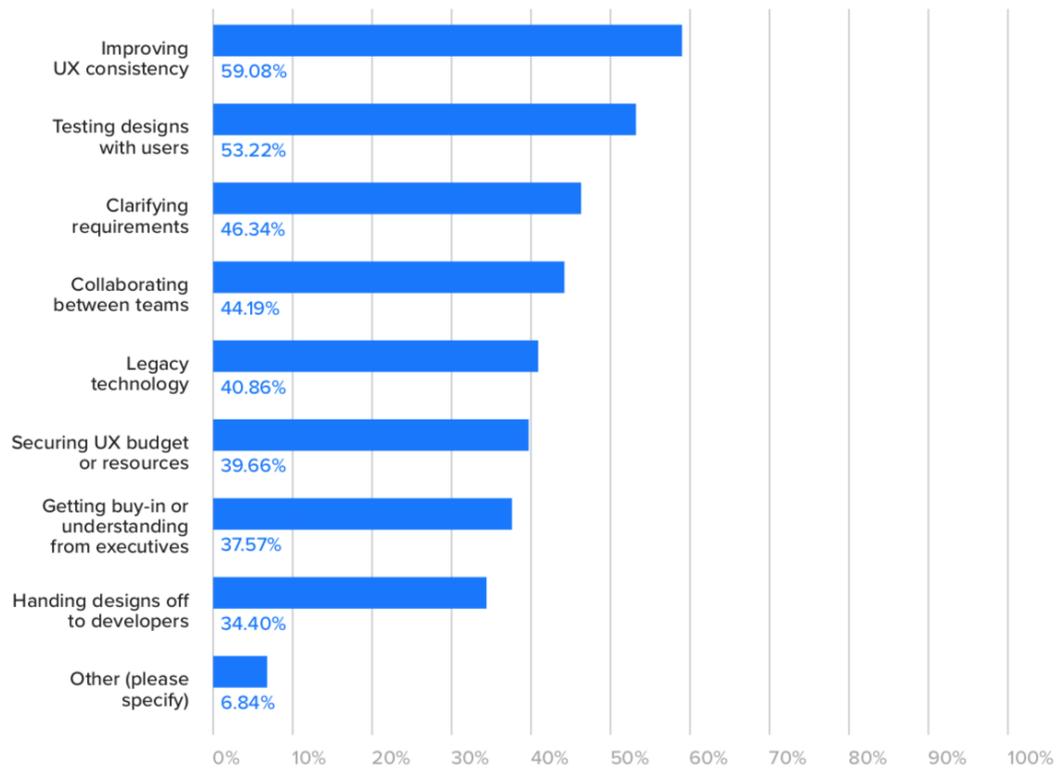
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## Appendices

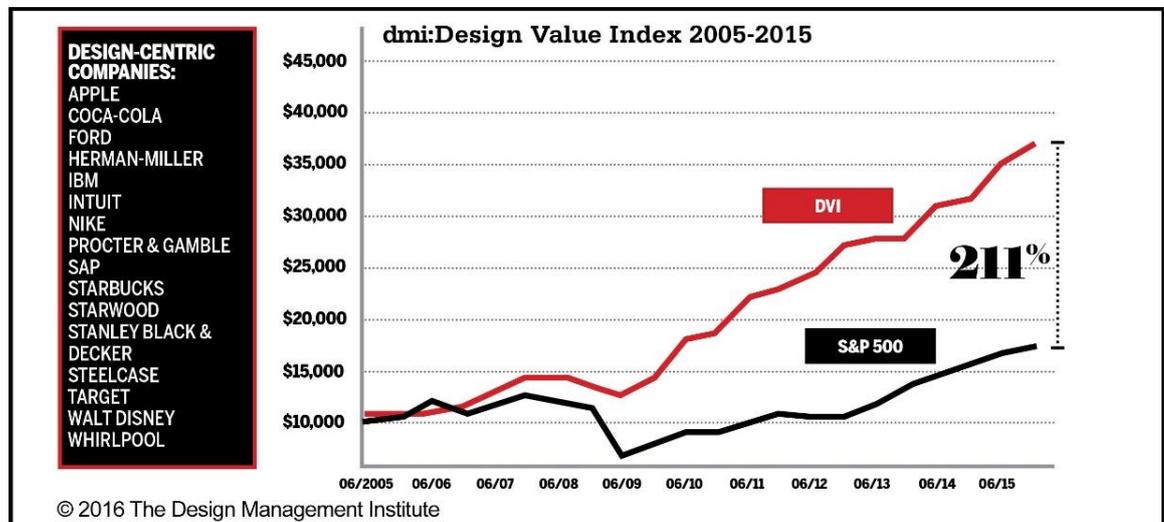
### Appendix 1. Statistics on Enterprise UX Challenges

#### What challenges do you currently face in your UX process?

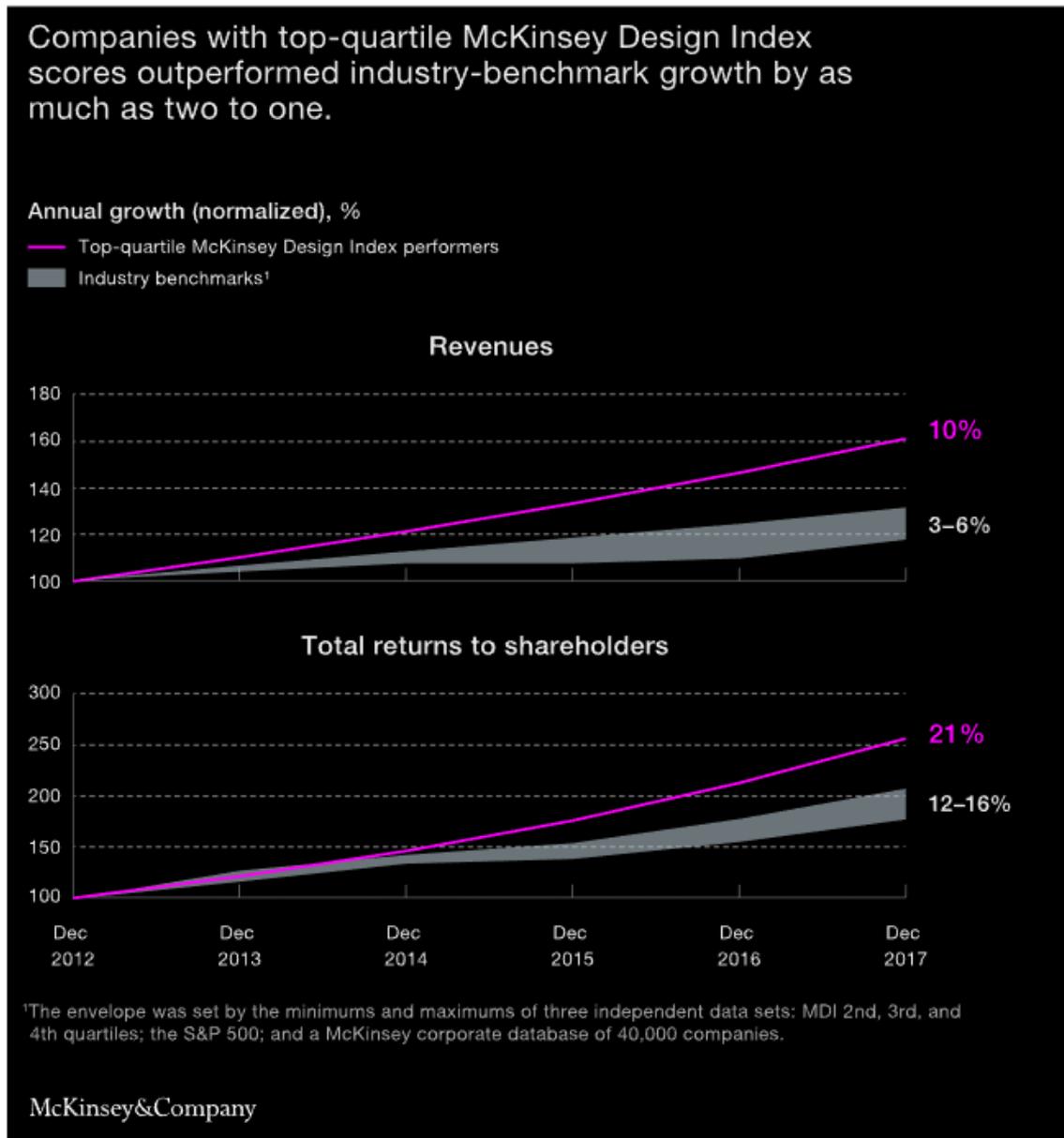
Answered: 3,157 Skipped: 0



### Appendix 2. dmi: Design Value Index 2005-2015



### Appendix 3. McKinsey Design Index score



### Appendix 4. IBM's Design Language Success Measuring framework

Framework for measuring Design Language Success at IBM (Hughes 14 March 2018):

- 1) Is it better than the current state?
- 2) Is it consistent with existing values?
- 3) Is it easy to use and understand?
- 4) Can you experiment with it?
- 5) Do you see people practice with success?

## Appendix 5. Semi-interview structure

### A) Background

- 1) Can you tell about your background in the company?
- 2) What are your main responsibilities in design system team?
- 3) How many products are there in your company? (roughly)

### B) Design System

- 1) What is design system from your point of view?
- 2) What are the reasons initiating the design system in your company? Are there any business-related objectives? If yes, what are they?
- 3) How many products are using design system right now?
- 4) How has design system been taken into use in your company? How long, in which way? Can you share any challenges since the start?
- 5) What is your plan for integrating Design system into the company?
- 6) What kinds of benefits has your company gained from design system so far? What kinds of benefits would your company gain from design system?
- 7) Do you have any ideas, questions, comments about design system in the context of scaling software product design?

## Appendix 6. Details of interviews

No.	Interviewee	Date of interview	Duration	Method of interview
1	Interviewee 1	2 Nov 2018	50 minutes	Face to face
2	Interviewee 2	2 Nov 2018	40 minutes	Face to face
3	Interviewee 3	5 Nov 2018	40 minutes	Face to face
4	Interviewee 4	5 Nov 2018	35 minutes	Online via Skype
5	Interviewee 5	8 Nov 2018	40 minutes	Online via Skype
6	Interviewee 6	8 Nov 2018	35 minutes	Face to face