BEYOND THE PDF

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Transforming Data-Driven Government Publications Through Participatory Information Design

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Basic Information

Abstract

As data becomes a commodity to today's society, government bodies that publish data have the unique opportunity to become reliable sources for data as well as for insight into this data. Lately, open government data has become widely available through database interfaces and dashboards. In contrast, the interpretation of data is often still published in PDF reports that are hard to access and inconvenient to use. At the same time, a growing number of data visualization and design tools would allow for more advanced formats that match the expectations of today's users.

The Master's thesis *Beyond the PDF* examines how a participatory information design approach can be applied to create more useful, useable, and meaningful data-driven government reports for a broad target audience. The thesis addresses two challenges: 1) The methodological challenge of defining a participatory information design approach; and 2) The applied challenge of developing a proposal for an online report format that addresses the needs of researchers, policymakers, journalists, and citizens alike. Following a *research through design* approach, the thesis constructs the *participatory information design approach* in theory and applies it in a design project, using the report *Key Data on Early Childhood Education and Care in Europe* as a case study. The project employs participatory field research methods to involve audiences in the design process, and design methods to create a design solution that meets their needs. Narrative design patterns, in particular, are examined and applied as a means to translate tacit audience needs into meaningful design artefacts.

The outcomes from the design project address the applied challenge. They consist of a visual summary of the audiences' needs, tasks, and behaviors and a prototype of an online report portal that provides new tools and content formats to engage these audiences on multiple levels. Regarding the methodological challenge, the study demonstrates how participatory, information-focused, and designerly methods can be applied to further the dissemination of insight from government data.

Acknowledgements

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1 INTRODUCTION

Context and Overview

In a time of dis- and misinformation, government bodies in functioning democracies that produce and disseminate data have the potential to offer reliable and engaging resources for evidence-based policy-making and informed citizenship. Changing user demands have forced these institutions to widen their focus from the mere production of statistics to include the communication of insights from their data to a wide range of audiences (Smith, 2013). At the same time, technological advances in the field of information design have made interactive, personalized data visualization more easily available (ten Bosch & de Jonge, 2008). This combination of technological possibilities and user expectations have led to new approaches to publishing data online (Zigure, 2005). Some statistical offices, for example, now provide tools for users to visually explore data on their own (c.f. Grünewald & Mittag, 2006) or present insights from their data as interactive stories (ten Bosch & de Jonge, 2008). Especially the latter, more narrative products are often created to communicate statistics that might be of interest to a broad public (c.f. Smith, 2013). However, the majority of statistical insight – aimed both at experts and at regular citizens –, is still published in the form of PDF reports. This print-oriented format is not suited to the digital, online consumption of data. Such publications are hard to update and reuse for the report's producers and difficult to access, read, and navigate for the report's target audiences (Williams, 2018). The format thus limits the report's potential to provide a wider range of people with insights from government data.

The design study at hand outlines and applies a participatory information design approach to explore how data-driven government publications can become more useful to a broad target audience. *Information design* is uniquely equipped to tackle the organization, visualization and communication of data and information, while taking into consideration the needs of the intended users (Pettersson, 2002). *Participatory design* provides a framework for the involvement of those users in the design process (Spinuzzi, 2005). *Narrative design patterns* are also applied and evaluated as additional methods to make data-driven government publications more meaningful to both expert users and the broad public.

The design study follows a *research through design* approach that combines design theory with an applied design project in the context of academic research (Frayling, 1983). This design project uses the publication *Key Data on Early Childhood Education and Care in Europe* (*Key Data* report, for short) by the Education, Audiovisual and Culture Executive Agency of the European Union as a case study. The report was published as a 218-page PDF in 2019 and is aimed at policy-makers, researchers, parents, and journalists. Following the participatory information design approach, the project uses qualitative, participatory field research methods, design research methods and design methods to capture and document these audiences' needs and to address these needs through the development of a design artefact. The original PDF-report is thus re-designed as an online portal (Figure 1).
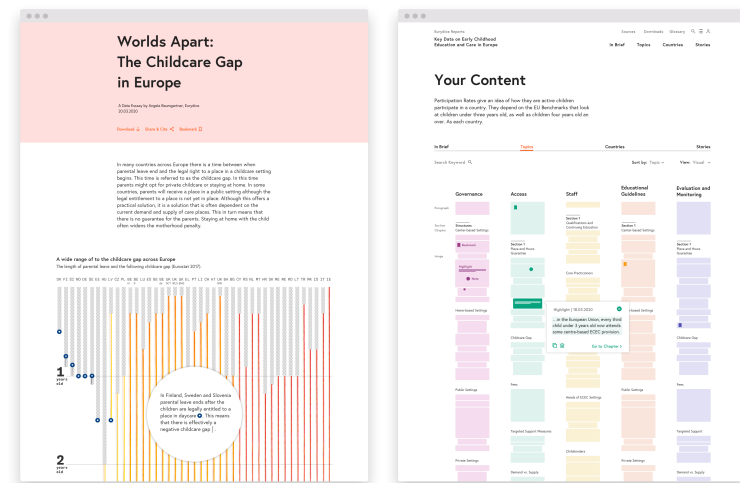
Figure 1.   Two screens from the prototype of the portal that was developed for this thesis.

This portal – presented in the form of a visual, interactive prototype – allows for an individual approach to the content of the report. It makes text and visualizations available in various volumes and depths, provides interactive features that allow for different levels of engagement with the content, and gives users the possibility to identify with the topic of the report.

Choosing the Case Study

In 2017, in one of the first courses I took at Aalto University[1], we were asked to create a data visualization on a topic that was of personal interest to us. Going through the list of possible data sources the lecturers had suggested, I came across the 2014 edition of the report *Key Data on Early Childhood Education and Care in Europe* (European Commission/EACEA/Eurydice/Eurostat, 2014) (Figure 2). The topic resonated with me on a personal level: Nearing our 30s, my Swiss friends and I had caught on to the fact it was not that easy to have both a family and a career in Switzerland due to the country's restrictive family policies. The report's data- and science-backed content and analytical tone transcended the ideological and monetary arguments that were used ever so often to justify those policies: Effectively ranking countries across indicators, the report revealed how strongly Switzerland lagged behind its European peers in terms of childhood education and care. Enthusiastic about this trove of information, I became interested in how such reports are used and how they might ultimately lead to a change of mind and a change of policies.
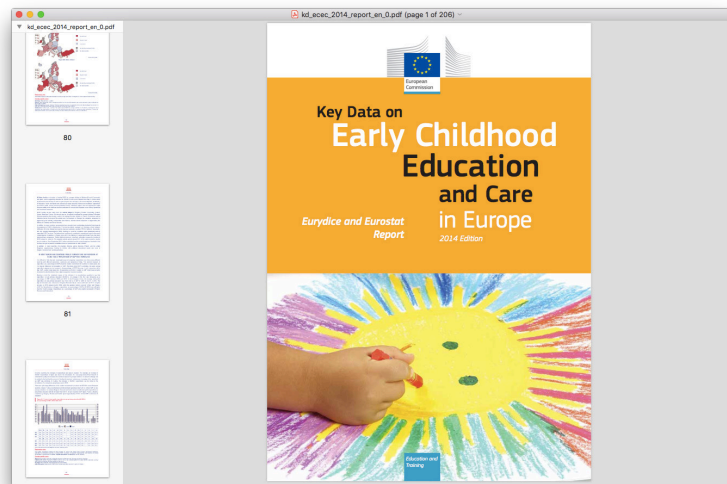
Figure 2. The 2014 edition of the *Key Data* report as seen in Apple's preview application.

For the course's project, I designed a prototype of a website that strived to make the topic of parental leave more accessible to ordinary citizens. At my final presentation, our lecturers commented on the vast amount of reports that are never read. Indeed, this was a problem I had faced when working as a designer at an environmental consultancy: Engineers and scientists would spend a lot of time creating relevant but dense reports that would end up on obscure websites. The communication of the results of these reports was mostly treated as an after-thought. This meant that there was often only a small budget and, at the same time, a necessity to completely overhaul the report to turn it into a product suitable to the target audience.

Two years later, when the time had come to choose a topic for my master's thesis, the topic of the *Key Data* report was still very much present. I had noticed how institutions were beginning to experiment with publishing and disseminating statistics online (e.g. Leake, 2018). And I had been able to observe first-hand what a difference progressive childhood education and care policies can make to women's participation in the labor market in Finland. Meanwhile, in Switzerland, the parliament was debating whether two weeks of paternal leave were not a little too generous[2] (the EU average for parental leave lies at 13 weeks, only two countries besides Switzerland do not provide paternal leave (European Commission/EACEA/Eurydice, 2019)). I knew that a new edition of the *Key Data* report was scheduled to be published in 2019. So, I decided to use my master's thesis to explore how to make these kinds of reports more relevant to a broad range of people.

Research Questions, Scope and Objectives

The thesis *Beyond the PDF* focuses on making data-driven government reports more useful, useable, and meaningful to a broad audience. It combines inquiries into design theory and design practice and employs qualitative, participatory methods, design research methods and design methods to examine the following question:

How can a participatory information design approach make data-driven government publications more useful, useable, and desirable to a broad target audience?

This question is divided into two research questions:

RQ1: How can a participatory information design approach capture the diverse needs of a broad audience and address those needs in the design of a data-driven government report?

RQ2: How can narrative design patterns enhance this approach to create data-driven government reports that are not just useful and useable, but also meaningful to that audience?

Each question contains both a methodological challenge and an applied challenge that concerns creating a design solution. These challenges are tackled both through the study of design theory and through a design project. In the first research question, the thesis explores what such a participatory information design approach could look like in the context of the communication of government data (*methodological challenge, RQ1*) and applies this approach to the design of an online report portal (*applied challenge, RQ2*). In the second research question, narrative concepts for data visualization are examined (*methodological challenge, RQ1*) and used as a method in the development of said portal (*applied challenge, RQ2*).

As the design project is aimed at creating solutions that serve the audiences of government reports, the production pipeline of such government reports is considered only marginally. Furthermore, the thesis assumes that the data on which the publication is based is relevant and of high quality, and that the intention to communicate insights derived from the data is genuine. Therefore, the thesis does not address potential shortcomings in the data collection and aggregation, nor does it address potential pitfalls of government communication related to impartiality, intention and truthfulness.

The thesis is addressed at scientific officers, communication officers, and designers in government institutions as well as at external designers and design agencies that work in a government context. It aims to provide both an overview of relevant concepts in information design and applicable ideas to the publication of data-driven government reports. The thesis follows the belief that a more transparent, clear and accessible communication of government data ultimately benefits – both directly and indirectly – ordinary citizens.

Related Research and Research Gap

Only a small number of academic studies deal specifically with the visual communication or the information design aspects of publishing government data. Most of these studies can be found in the field of official statistics. Some of them examine the dissemination of statistics on a strategic level, examining and proposing certain goals and functions that the communication of statistics should fulfill (e.g. Keuning & Morais, 2005; Snorrason & Gylfadóttir, 2001; Radermacher, 2013). Many of those studies stress the importance of addressing users' needs adequately and some list design and visualization as one way to make statistics more accessible to a heterogenous group of people (e.g. Snorrason, 2005; Zigure, 2005). Most of these studies do not explicate a specific process to address the communication strategies they propose, nor do they examine dissemination products.

Other papers on the dissemination of official statistics come in the form of case studies. These studies provide insights into the practices that lead to visual dissemination products such as data explorers or story maps (e.g., Grünewald & Mittag, 2006, Smith, 2013; ten Bosch & de Jonge, 2008). They offer practical learnings for using information design for the dissemination of official statistics. However, due to their format, they mostly lack in-depth discussions that place those learnings within the larger field of information design.

Within the field of information design, document design is maybe the study area closest to the intersection of design and government. In the context of the communication of public information, document design is mostly concerned with the design of forms that have to be understood by a wide range of

readers, such as tax forms, medical package leaflets (Gerritsen et al., 2006) or utility bills (Delin et al., 2006). One might argue that the challenge in document design to make information useful and pleasing to readers (Redish et al., 1981) is similar to the issue considered in this thesis. However, the design of an entire report holds different requirements than the design of a form. Furthermore, while government reports have to reach a broad audience, forms that are essential to being part of a society (such as tax forms) need to reach all audiences. This calls for a slightly different design process. Finally, the solutions described in document design studies are mostly limited to print applications. Their findings thus need considerable adaptation to the media landscape of today. Therefore, the thesis does acknowledge this legacy, but does not make direct use of the document design concepts.

The field of science communication, also considered a field within information design by some, is, in a way, more related to the issue of publishing government data than document design. It also deals with communicating often abstract, complex topics. And, just like the field of official statistics, science communication has traditionally catered to expert users and is now beginning to open its doors to interested novices. Luc Pauwels offers an interesting framework for "analyzing and producing visual representations in science" (2006, p. 23). This framework allows designers and scientists alike to consider characteristics of scientific data, production and process aspects, the visual representation, and the uses and contexts of that representation (Pauwels, 2006). Recent projects at the intersection of science and information design are also tributes to these developments. Examples of such projects include the designs project by the *Urban Complexity Lab* that form part of the *SENSES* project[3] and the *Map of Mathematics*[4] published by the Quanta Magazine – an online publication that aims at boosting public understanding of science.

Similarly, the growing number of cultural collections that are available online have become a new focus for information design (Windhager, 2018). Work from these realms often yields inspiring concepts and designs at the intersection of interaction design and data visualization (see for example Dörk et al., 2017; Whitelaw, 2015). Both these topics, science

3 See for example: www.climatescenarios.org/primer

4 www.quantamagazine.org/the-map-of-mathematics-20200213

communication and cultural heritage communication, serve as inspirations. However, literature from this field is not addressed directly in this thesis. Mostly, the projects and papers from these fields are used as inspiration in the practice part.

The field of data journalism also offers insights as to how complex topics can be packed into text and visualizations that speak to a broad audience in a competing information landscape. Beyond a vast repository of inspiring examples, data journalism also offers relevant literature in the area of data-driven storytelling (c.f. Riche et al., 2018) and data visualization (c.f. Cairo, 2013, 2016). At the same time, a number of data visualization research papers that deal with narrative aspects of visualization are based on the examination of journalistic work (c.f. Kosara, 2017; Segel & Heer, 2010). As the idea of *data stories* has recently taken hold in many fields beyond journalism, including in statistical dissemination (c.f. ten Bosch & de Jonge, 2008), the thesis examines this idea of using data narrative concepts from journalism and applies some of these concepts in the practical part of the thesis project.

Beyond the field of information design, at the intersection of design and government, fields such as participatory design for e-government, service design for government, and, in general, design-led approaches for government, produce a large body of literature. Many of the studies are concerned with these topics on a theoretical, conceptual, or strategic level and rarely deal with aspects of data and information design in specific. As this thesis focuses on the application of information design in a government context, literature from these fields is considered only marginally.[5]

5 Many interesting theses at the intersection of design and government have been produced at Aalto University. This page offers a selection of them: dfg-course.aalto.fi/2020/recommended-reading

In summary, the thesis addresses the gap between studies that propose data dissemination strategies on a theoretical level and applied case studies on governmental data dissemination products. The main body of literature that is considered in this thesis stems from the field of information design, interaction design, and design in general. Data journalism serves as an additional field of interest, while accounts from document design, science communicatio,n and cultural heritage communication serve as background information and inspiration.

Research Approach

The approach used in this thesis is anchored in the field of design research. As design is still a fairly young academic discipline, there is some confusion when it comes to defining what design research entails (Cross, 2007). The discussion is not aided by the fact that both design and research are often discussed on such generic levels that they "carry more implicit connotations than explicit denotation" (Stappers, 2007, p. 81). To address this issue, this thesis will rely on the following two definitions of design and research:

> Design is the human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes. (Buchanan, 2001, p. 9)

> Research is systematic enquiry whose goal is communicable knowledge. (Archer, 1995, p.6)

Design research can thus be described as systematic investigation into the human activities of conceiving, planning, and making and into the products that arise from these activities with the aim to generate transferable knowledge.

Just as numerous researchers have philosophized and written about what design and what research might be defined as, many have pondered on the relationship between design theory and design practice in design research. Despite differences in terminology and interpretation, the relationship between theory and practice in design is often described along the lines of Frayling's three categories *Research for Design*, *Research into Design* and *Research through Design* (Jonas, 2007). This thesis follows a research *through design approach* which includes elements of *research into design* and *research for design*. The following paragraphs describe each approach by summarizing the definitions of prominent design researchers:

Research for Design
Research for design is research that enables design practice. Buchanan uses the term clinical research and defines it as research that is undertaken to gather information to solve a particular design problem (2001). This kind of research can take place both in design practice and in design research: In design studios, research for design often equals the project phase in which design practitioners collect and organize information about already existing solutions, potential users, and markets (Crouch & Pearce, 2012) with the aim to "ground, inspire, and inform their product development process" (Zimmerman, Forlizzi, Evenson, 2007, p. 494). In the academic field, research for design is mainly used for case studies (Buchanan, 2001). This kind of research does not necessarily yield written accounts, instead, reflections materialize in the design product itself (Frayling, 1993). However, outcomes of research for design can still include "frameworks, philosophies, design recommendations, design methods, and design implications." (Zimmerman, Stolterman, Forlizzi, 2010, p. 313).

Research Into Design
Research into design is the study of design – it's practices, artefacts, and stakeholders – with the aim to generate knowledge about design. It thus encompasses "understanding the human activity of design" (Zimmerman, Stolterman, Forlizzi, 2010, p. 313). According to Frayling, this can include historical research, aesthetic or perceptual research, and research into theoretical perspectives of design. Buchanan calls this category basic research as it examines fundamental issues that "govern and explain phenomena" (2001, pp. 18–19) The outcomes of this kind of research are written dissertations, theses, and papers (Frayling, 1993).

Research through design
Research through design combines both theory and practice to generate knowledge that improves the practice of design (Zimmerman, Stolterman, Forlizzi, 2010). Buchanan calls this kind of research "applied research" and points out that the main differentiator to clinical research is that, instead of looking at one individual case, it gathers from many cases to find principles that can be applied to a class of problems. Zimmerman et al. have found that outcomes can include conceptual frameworks, guiding philosophies,

new research and design methods, and novel artefacts. In contrast to research for design, these outcomes should serve as first steps into the generation of design theory. Theory is developed from practice through articulation and inductive inquiry (Friedman, 2003). On a more practical level, Frayling suggests that the outcome of research through design in a master's level education is studio work combined with a research report (1993).

Following a research through design approach, this design study[6] is guided by a process in which inquiries into the practice of design and inquiries into the theory of design go hand in hand. Inquiries into design theory are not preemptive to practice. Instead, they are guided by the issues and questions that arise throughout the applied design project. A comparison between the findings made in theory and the ones made in practice, yields what Zimmerman et al. call *nascent theories* (2010) – early propositions for theories on using information design approaches in the context of government publications.

Research Methodologies

An approach, such as the research through design approach discussed in the previous section, does not specify a process to follow. For this purpose, we can turn to the thesis' field of study – information design.
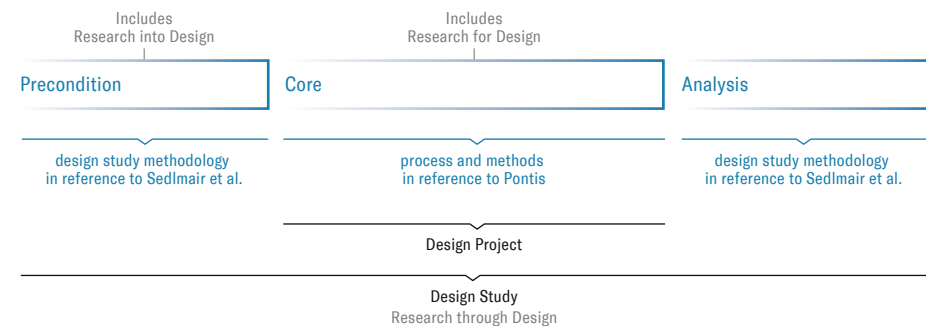
Just like the overarching discipline of design, information design also encompasses both practice and theory. Pettersson calls these areas of knowledge infology – "the science of verbo-visual presentation and interpretation of information" – and infography – "the actual, practical formation and execution of structured, combinations of text, pictures, and graphic design" (2003, p. 20). While the field of infography generates a plethora of methodologies and methods that guide the practice of information design, detailed step-by-step processes for information design research are rare. An exception is the *design study methodology* by Sedlmair et al. (2012). It differentiates itself from other methodologies in that it embeds a practical design process (the *core* phase) into a research specific context by adding a *precondition* phase at the beginning and an *analysis*

6 The terms *design study* and *design research study* are used interchangeably. They reference the entire thesis. The terms *research project* and *design project* are used to delineate the work done in the core phase of the process (see Figure 3).

phase at the end (Sedlmair et al., 2012) (Figure 3). Each phase of the *design study methodology* consists of multiple steps. In the *precondition* phase, the *learn* step allows the researcher to engage with information design literature, essentially enabling *research into design*. In the *core* phase, a *discover* step is meant for *research for design* – methods that yield information that supports the further design process. And the *analysis* phase includes steps for reflection and writing.[7] Including both reflective and applied design phases is what makes the *design study methodology* suitable for a research through design approach.

7 The design study methodology is explained in more detail in chapter 2.2.

The aim of this thesis is as much to understand what needs a diverse audience has in terms of data-driven government reports, as it is to explore solutions to those needs. Therefore, it was important to adopt design methods that allow for the inclusion of these audiences. At the same time, it was also necessary to incorporate methods for the in-depth analysis of the data and information from the *Key Data* report. Although the *design study methodology* provides some examples for these kind of design methods, it shies away from describing them in detail. For that reason, the *research-led information design process* after Pontis was followed in the core phase of the *design study methodology*. It allows designers to include both participatory field research methods and information-focused methods. In this thesis, the *design study methodology* and the

Thesis Approach and Methodologies

Includes Research into Design	Includes Research for Design	
Precondition	Core	Analysis
design study methodology in reference to Sedlmair et al.	process and methods in reference to Pontis	design study methodology in reference to Sedlmair et al.

Design Project

Design Study
Research through Design

Figure 3. The thesis approach and the thesis methodologies after Sedlmair et al. and Pontis.

information design process by Pontis are enriched with design methods and are combined into a coherent approach. This approach is explained in detail in *2.2. A Participatory Information Design Approach.*

Thesis Structure

The thesis at hand is divided into five parts: *Introduction, Theorectical Background, Design Study Documentation, Discussion,* and *Conclusion.* The *Introduction* has sought to outline the thesis topic and the thesis approach. The *Theorectical Background* summarizes information design theory that is relevant to the design research study. The chapter explains how information design is defined in this thesis; it examines design methodologies, participatory methodologies, and information design methodologies; and it explores the qualities of successful information design products. In doing so, it explains the core elements of the research questions, namely "participatory information design approach", "narrative patterns", and "useful, useable and meaningful government reports". The *Design Study Documentation* describes the entire design study, following the participative information design approach established in the chapter *Theorectical Background.* The design study process, methods, and results are documented in enough detail for other information designers to be able to use them as a basis for their own design or design research projects. In the *Discussion,* I critically assess advantages and shortcomings of both the applied approach and the design outcomes. Finally, the *Conclusion,* summarizes the design study and places this thesis in the broader context of information design research and the dissemination of government data.

2 THEORETICAL BACKGROUND

2.1 What is Information Design?

Forms of classification, taxonomy, or information organization embody ideology. Ontologies are ideologies through and through, as naming, ordering, and paramaterizing are interpretative acts that enact their view of knowledge, reality, and experience and give it form.
   **— Johanna Drucker, 2014, pp. 178–179**

Still regarded as an emerging field, the term Information Design has lent and lends itself to many different usages and interpretations. It can denote a specific design field or describe more generally an approach to a design problem. It is sometimes used as a synonym for other design fields, such as Information Architecture or Environmental Design. And it is inherently difficult to understand the relationships between the field of information design and related concepts such as Information Visualization or Information Graphics. The confusion as to how to delimit and define information design can be traced back to the circumstance that there are multiple, overlapping historical perspectives that explain the formation of the field. In his recent blog series, Paul Kahn (2019) therefore outlines three frames through which the history of information design can be told. In the following paragraphs, these three frames are explained and supplemented with further sources. In addition, the historical accounts are linked to current definitions and applications of information design today. In the end of his first blog post, Kahn also proposes a fourth frame that offers a new perspective on the history of information design. The attempt to follow the origins of information design and Kahn's reflections on what would constitute a better frame to encounter information design, serve as stepping stones to a definition of what information design means in the context of this thesis. This definition is the basis of the futher inquiries into the theory and practice of information design.

Frame One: Information Design for Statistics

The first frame entails the history of data visualization, developed and written by "scientists, engineers, mathematicians, and statisticians" (Kahn, 2019). This history's origins lie in Descartes' invention of analytical geometry in 1637, which allowed the translation of a mathematical formula into a visual representation (Meggs & Purvis, 2012). Two centuries later, nation-building efforts and the advent of industrialization fueled the formation of national statistics offices and the empirical method became the foundation of scientific inquiry (Drucker, 2014, Rendgen, 2019). Using the newly available data, scientists and engineers such as William Playfair (Figure 4), Charles-Joseph Minard, and Florence Nightingale began to put Descartes' principles to use, producing many of the common chart types we know today, such as the line and the bar chart (Meggs & Purvis, 2012; Rendgen, 2012, 2019)[8]. Their efforts consolidated the visualization of data as a means to analyze, inform, and convince in the realms of government, science, journalism, and politics (Rendgen, 2019).

8 Interestingly, Playfair's visualizations were regarded with suspicion by his contemporaries because the visual display of information was seen as untrustworthy (Spence & Wainer, 2017, p. 43)
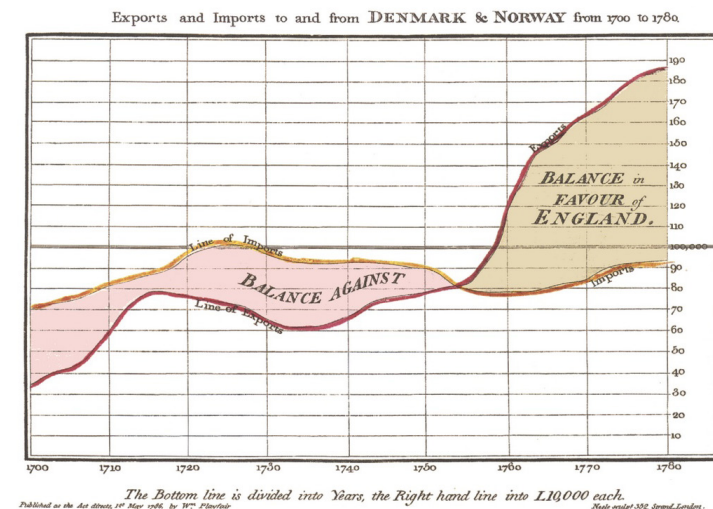
Figure 4. Exports and Imports to and from Denmark & Norway from 1700 to 1780. (William Playfair, 1801)
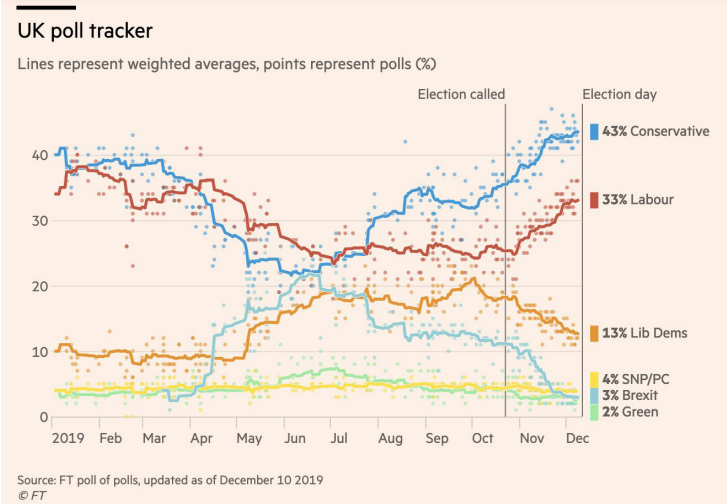
Figure 5. UK poll tracker. Chart on the Financial Times' Website. (Burn-Murdoch, J., Stabe, M., & Tilford, C., 2019).

La Méthode Graphique by E.J. Marey (1885) documents these advances of the early 1800s before outlining his own "graphic method" to visualize data, solidifying data visualization as a field (Kahn, 2019). According to Kahn, the continuation of this history can be traced through similarly structured books published in the 20th century – from W. C. Brinton's *Graphic Methods for Presenting Facts* (1914) up to *The Visual Display of Quantitative Information* by Edward Tufte (1983).

Today, data visualization is mostly regarded as a subfield of information graphics which in turn is part of information design (Mollerup, 2015, Cairo, 2013, Koponen & Hildén, 2019). Data visualization is based on measurable information – abstract, non-visual data – and renders a readable and recognizable image (Kosara, 2007). The field of information graphics also contains further subfields such as infographics, information visualization, knowledge visualization, and cartography. Data visualization is practiced in all fields concerned with the communication of quantitative data such as government, business, engineering, and data journalism (Figure 5). In education, this strand of information design is often taught as a course within engineering, business or design tracks.[9]

9 A search for the terms "visualization" and "information" in the course catalogue from Aalto University in April 2020 shows courses in the Department of Media, Department of Built Environment, and Department of Computer Science.

Frame Two: Information Design for Communication

In the second frame, information design is regarded as a type of visual communication (Kahn, 2019). The origins of this frame lie in the endeavor of understanding how form produces meaning (Drucker, 2014). Driven by a need for reproducible design techniques for industrial production, the systematization of visual expression was developed in the 19th century by craftsmen and artists such as Walter Crane and Eugène Guillaume (Drucker, 2014). Their efforts decoupled geometric, visual forms from the arts, laying the foundation for graphic principles (Drucker, 2014).

As design became a profession in the early 20th century, designers such as Jan Tschichold shifted their focus from technical design manuals to the formulation of graphic principles. At the same time, artists like Wassily Kandinsky and Paul Klee, engaged in the exploration of "'universal' principles of visual form" (Drucker, 2014, p. 35). Their findings were incorporated into the Bauhaus[10] curricula (Meggs & Purvis, 2012) and educated a generation of designers on the interplay of form and function.

10 The Bauhaus was a school of design, architecture, and applied arts founded in 1919 in Weimar, Germany (The Editors Encyclopaedia Britannica, 2019). It "laid the foundation for what we today think of as modern design – 'useful', functionalist, transparent objects of design" (Bannon & Ehn, 2013).
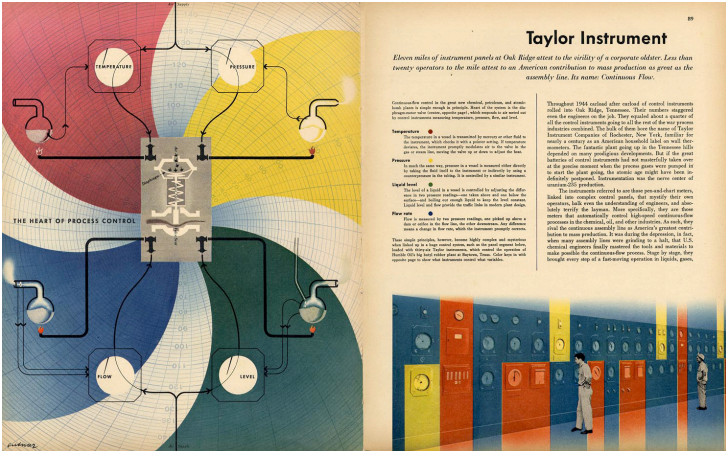

Figure 6. Taylor Instrument, Fortune, August 1946. Graphic information by Ladislav Sutnar. Photogravure.

As the Bauhaus disciples fled persecution by the Nazis in the 1930s, they dispersed the Bauhaus ideology across the globe. Herbert Bayer, for example, emigrated to the United States where he went on to publish the *World Geo-Graphic Atlas* in 1953 (Meggs & Purvis, 2012). The atlas – 368 pages of maps, diagrams, and charts – represents "a milestone in the visual presentation of data" (Meggs & Purvis, 2012, p. 367). Will Burtin, another refugee from Europe, charted new territory in the way information was communicated in magazines when he became the art director of Fortune Magazine in the U.S. (Meggs & Purvis, 2012). Hiring graphic designers such as Ladislav Sutnar (Figure 6) and Max Gschwind, the magazine published stark visual explanations that combined photography, graphic elements, and text (Kindel, 2017). In 1961, Ladislav Sutnar became one of the first to outline how information design could be defined in the tradition of visual communication. Differentiating it from a form of graphic design more concerned with representational aspects, he defines information design as

11 Examples of such design studios include Beyond Words in London, United Kingdom, Interactive Things, in Zurich, Switzerland, and Koponen+Hildén in Helsinki, Finland.

the integration of meaning [content] and visualization [format] into an entity that produces a desired action. (Sutnar, 1961, "introduction", para. 6)

12 A Google search for Master's in Information Design lists, among others, the Master's program in Information Design at the Design Academy Eindhoven, Netherlands, the Information Design and Data Visualization Master's at Northeastern University, and the Master's Program in Visual Communication Design at Aalto University.

Following these traditions, information design today is sometimes placed alongside other design areas such as graphic design, interaction design, and product design. In *A Dictionary of Media & Communication*, for example, Chandler and Munday highlight information design's close relation to graphic design when they define it as "the organization and presentation of information in order to make it easier to navigate and understand, particularly through graphical means" (2020). Today, this kind of information design is practiced by design studios that specialize on the communication of both quantitative and qualitative data (Figure 7).[11] In education, the legacy of this history can be observed in the recent development of master's degrees in Information Design in design schools across the world.[12]
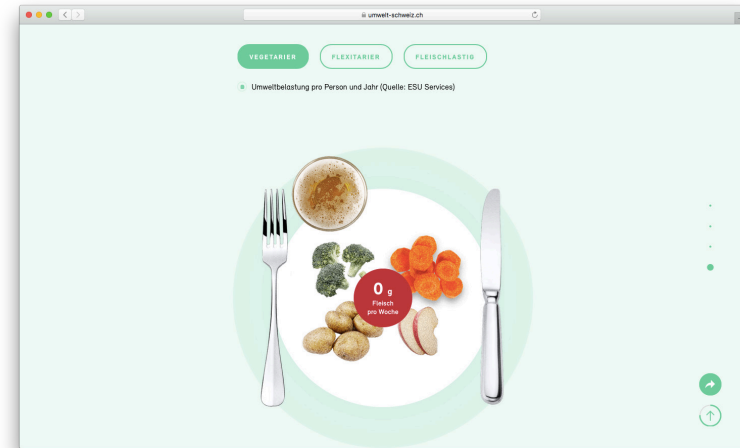
Figure 7. Interactive visualization that shows the environmental impact per person and year. Website for Umwelt Schweiz (german, Environment Switzerland) (Bold, 2018)

Frame three: Information Design for Orientation

In Kahn's third frame, information design equals structure and design in the service of orientation. This strand of information design is tightly intertwined with the emergence of mass telecommunication systems, the arrival of personal computers, and the rise of automation in the workplace in the second half of the 20th century. Arguing on behalf of the user of these complex machines, ergonomists such as Conrad, Chapani and Broadbent, began to call for "well-considered design of information to guarantee the easy and effective use of technical systems for everyday use" (Zwaga, 1998, p. xxx). Thus, this early phase of information design formalized in the writing and design of technical instructions and catalogues (Stiff, 2017). In this sense, information design is "the development of all these different kinds of text or graphics to support or aid the use of products or to guide behavior" (Zwaga, p. xxx).

In 1978, this definition of information design was advanced at the NATO Conference on *Visual Presentation of Information* (Figure 8). The conference focused on analogue means of presenting information (e.g. signs, printed forms, instructional material, etc.), countering conferences that were focused on the visual display of information on screens (Easterby & Zwaga, 1984). In addition, the conference organizers stressed the multi-disciplinary nature of the field:

> ... information presentation involves a wide range of professional interest groups concerned with its development and use; graphic designers, industrial designers and typographers are primarily concerned with design but will acknowledge the importance of evaluation; psychologists and ergonomists have an interest in evaluating the effectiveness of displayed information and some, but not all, will acknowledge the importance of graphic design; architects, planners and engineers have a professional interest in using information as a component in the artefacts they create for society – buildings, roads, industrial machinery and consumer products – but many may not be prepared to acknowledge the importance of design and evaluation of such information. The problem that arises is that each of these professionals approach information display from different standpoints – aesthetic, empirical, evaluative, quantitative, pragmatic, practical – and also to differing degrees, depending on the relative importance that these aspects have in relation to their professional interests and obligations. (Easterby & Zwaga, 1984, pp. xxi – xxii)

A year later, as a direct result of the conference, the *International Design Journal* (IDJ) was founded, lending the field an outlet for professional exchange and research (Pettersson, 2002).

The gap between print and digital technologies in Information Design was closed with the publication Information Architects (Wurman, 1996). According to Wurman, an information architect engages in "creating systemic, structural, and orderly principles to make something work – the thoughtful making of either artifact, or idea, or policy that informs because it is clear" (Wurman, 1996, p. 16).
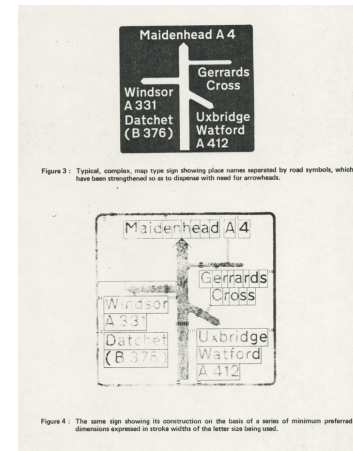
Figure 8. (left) The practical and graphic problems of road sign design (Jock Kinneir, Nato Conference, 1978, p. 6).
Figure 9. (right) Legible London (Applied Wayfinding, 2009).

The examples presented by various contributors span digital, graphical, and spatial applications of information design. The field was further advanced through another collection of essays published by Robert E. Jacobson under the name Information Design (1999). Alongside articles by architects, computer scientists and designers, Horn, himself a biologist, defines information design as:

> The art and science of preparing information so that it can be used by human beings with efficiency and effectiveness. (Horn, 1999, p. 13)

It remains one of the most widely cited definitions in popular information design books (cf. Cairo, 2013, Koponen & Hildén, 2019). Another popular definition of information design as seen in this frame was published online in 1997 by the IIID – the International Institute for Information Design:

> Information design is the defining, planning, and shaping of the contents of a message and the environments it is presented in with the intention of achieving particular objectives in relation to the needs of users. (Pettersson, 2002, p. 6)

Horn's definition emphasizes the intersectional nature of information design, while IIID's interpretation lists the activities of defining, planning and shaping as fundamental to information design. The concepts of visualization, on the other hand, are completely amiss in both definitions. As Kahn points out, graphic design in this frame is only a means to make information understandable to a certain audience (2019).[13]
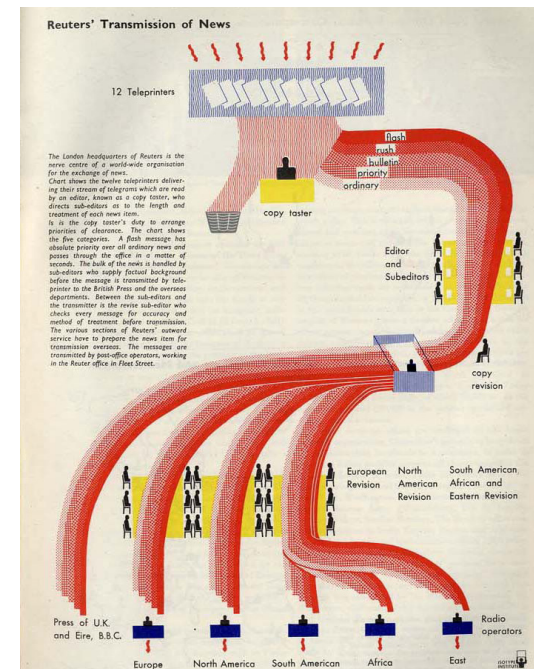
Despite the efforts of editors such as Jacobson and Wurman, frame three remains split into fields that deal with the navigation and visualization of information solely on screens, and fields that use information design to help people navigate a physical environment. The screen-based fields include disciplines such as interaction design and human-computer interaction. In education, these disciplines might offer a course in information architecture or data visualization.[14] In the marketplace, there are countless design companies that work on interface design and user experience design. They might or might not be conscious of the connection of their field to the field of information design.

Disciplines that operate in the physical environment include exhibition design, environmental graphics, and wayfinding. These fields stand at the intersection of communication design, architecture, and interior design. Again, an information design course focused on wayfinding or exhibition design might be taught within those disciplines. Similarly, wayfinding might be created in-house by an architecture firm or by a specialized design agency.[15] Despite these differences in media, both the screen-based and the environment-based fields are similar in that they tend to pay more attention to the needs of the users than other information design disciplines do.

A New Perspective: Global Information Design

Kahn notes how – while the first frame can easily exist within the other two frames – there is an inherent struggle to define the border between frames two and three. Kahn cites an article by Paul Stiff (2013) to illustrate this tension, but we

can instead turn to look at examples from history and today to understand how many successful designers straddle frame two and frame three and incorporate frame one. One of the most cited and picturesque examples in information design is Otto and Marie Neurath's invention of ISOTYPE (International System of typographic picture education). Isotype was and is a method to show quantitative as well as qualitative concepts through a system of pictograms (Koponen & Hildén, 2019). It was developed in the first half of the 20th century to address a need for "clear communication to assist public understanding of important social issues relating to housing, health, and economics" (Meggs & Purvis, 2012, p. 341) (Figure 10). At the same time, the process that the Isotype group used in their work under the name "transformation" included an extended engagement with domain experts and with the users of their designs (Walker, 2017). These accounts paint the Neuraths as generally more concerned with the communication of complex

Figure 10.   Reuter's Transmission of the News, Future Magazine, Marie Neurath, 1947

13 Many of the sources for this section are inspired by Michael Babwahsingh's blog post "Saving Information Design History, Part 2".

14 At the Zurich University of the Arts, for example, the Bachelor's in Interaction Design includes a course in interactive visualization.

15 Agencies specialized on wayfinding are, for example, Applied Wayfinding in London, United Kingdom or BIV Grafik in Zurich, Switzerland.

topics than with the explorations of visual form. This, in turn, would speak for Neuraths' work to be placed within frame three. However, their collaboration with designer Gerd Arntz suggests otherwise: Isotype functioned precisely because of its strong and skillful visual language (Kinross, 2017). When Arntz joined the Isotype group, he established a stringent design language, created a catalogue of symbols, and introduced automated production for recurring pictograms (Koponen & Hildén, 2019). The importance of Arntz's visual contribution is confirmed when we look at unsuccessful contemporary examples that emulate ISOTYPE but fail to be attentive to its visual qualities (Kinross, 2017).[16] The work by the Isotype group therefore bridges frame one, two and frame three – it is attentive to qualitative and quantitative characteristics of

16 See the *Data Visualization Handbook* (Koponen & Hildén, 2019, pp. 130-131) for an introduction to potential pitfalls to using pictograms in information graphics.

Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO_2, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM.3b.

Figure 11. Global Emission Pathway Characteristics (Figure SPM.3A), IPCC Special Report Global Warming of 1.5 ºC (Morelli & Johansen, 2018)

data, sees design as a means to communication, and is observant of design's visual qualities.

Many information designers today also cover all three frames in their work. Nadieh Bremer,[17] for example, is an astronomer-turned-information-designer who creates visually stunning, custom-made data visualizations. She is as much concerned with how the user navigates her work, as she is with the translation of data into form and the engaging aspects of aesthetics. The studio *Interactive Things*[18] creates data-centered online applications that include multi-layered interactive patterns, an attention to visual detail, and an adherence to the qualities of the data. The duo Angela Morelli and Tom Gabriel Johansen from the *Info Design Lab*[19] create data visualizations about complex, global topics such as public health and climate change (Figure 11). In their process, they work closely with experts and users and are mindful of not reducing the complexity of the data while seeking visual simplicity at the same time. All the examples, from Neurath to Nadieh Bremer, *Interactive Things*, and the *Info Design Lab*, create work that is recognized and widely admired. Their ability to combine the manifold skills from different subfields of information design into a coherent product might be one reason for this success.

Beyond the impossibility to arrive at a clear distinction between the different frames, Kahn also criticizes that all the frames are focused on western culture and regard non-western artifacts as mere subjects of anthropological studies. Kahn therefore proposes a fourth frame that does away with the differences in history between quantitative and qualitative data, and between non-western and western examples:

Frame Four is meant to kick information design history out of this Venn diagram of overlapping restrictions and into a global context, where we can appreciate and learn from examples that are currently segregated into further restricted frames such as art history, archaeology, ethnography, and the Western study of non-Western culture. In the context of Frame Four, we can see our collective strategies of visual logic, the many ways we have found to transfer a chosen signal, across time and space, from sender to receiver. (Kahn, 2019)

17 Nadieh Bremer's work can be found under visualcinnamon. com

18 Interactive Things publish their work under interactivethings. com

19 The Info Design Lab publish informative blog posts about their design process and work under medium. com/infodesign-labposts

Under this new frame, Kahn then proceeds to look at information design through functional themes. This allows the reader to learn from "design examples that are currently scattered among many disciplines" (Kahn, 2019). While Kahn's new frame is certainly helpful for the analysis of information design work, we will follow a slightly different interpretation of the fourth frame in this thesis.

Global Information Design in this Thesis

An attentive reader might feel slightly disconcerted at this point. Why go to the lengths of segregating the history of information design into separate frames only to synthesize it into one undifferentiated mass? It is maybe here where the fourth frame outlined by Kahn differs slightly from the frame in which this thesis can be placed. While Kahn's fourth frame does away with the distinction between the three frames, this thesis strives to carry all frames within it. It does not "kick information design history out of this Venn diagram" but instead draws a wiggly circle to include all the histories and presents of information design in a sort of nested bubble chart. As mentioned, this is not to say that a more consolidating approach does not make sense: For the analysis of artefacts across time and place, the fourth frame after Kahn allows for the selection and comparison of a wide range of different artefacts. This can yield new insights that only come from a point of view that strives to be free of prejudice. However, I believe that in information design practice, it is more beneficial to consciously uphold all three frames, including a more global perspective in each frame.

This kind of nested bubble chart of information design fields allows designers to look at the design space from multiple perspectives, imagine a wider range of solutions to that problem, and evaluate the solution in different contexts. Frame one reminds us how information design is attentive to the qualities of information and data. Frame two allows us to uphold the importance of visual language and aesthetics in communication.

Frame three brings our attention to how people navigate information on screen and in physical environments.

In information design research, this approach will also allow researchers to communicate more clearly under which viewpoint the study was created and evaluated. It will become clear that some research is focused on a very particular field of information design while other research – like this thesis – embodies multiple subfields. Narrower research will primarily yield benefits to a particular subfield. However, this larger information design frame will allow others to fully understand the benefits to that area and extract and apply useful findings to other subfields in an appropriate manner. In a more comprehensive study, this fourth frame of information design allows researchers to use many different design fields under the service of information design. This approach is uniquely suited to provide a holistic viewpoint on a multi-layered design space. The design space in this thesis deals with a variety of different types of information, has to reach a large but diverse audience, and aims at simultaneously persuading, engaging, and informing this particular audience. As this thesis deals with such a multi-layered design space, it can be characterized as a broader information design study.

While this thesis spans a variety of fields, it also bypasses many fields that might be regarded as part of or at least highly influential to information design. Specifically, this thesis does not cover what Pettersson calls the secondary supporting sciences of information design – language disciplines, cognitive disciplines, and art (2016). While this thesis acknowledges the influence of these disciplines on information design, they are not subject to further inquiries in the following chapters. Instead this thesis focuses on the primary sciences of information design – information, design, and communication disciplines (Pettersson, 2016). It combines graphic design, interaction design, and data visualization under the objective of rendering data-driven government reports navigable and understandable to a broad audience. Information design in this thesis includes planning, observing, documenting, understanding, making, shaping, and visualizing. It aims at being at once true to the data, aesthetically engaging, and effective and efficient for the user.

2.2   A Participatory Information Design Approach

Rather, we have to accept that design methods bring something to the design situation, and that this something has a history we need to understand if we are interested in not only what they do for us but also what they do with us.
 — **Göransdotter & Redström, 2018, p. 22**

The following chapter provides some theoretical background to explore what kind of approach would support the development of an information design product that is – as outlined in the previous section – true to the data, aesthetically engaging, and effective and efficient for the user. According to the Oxford English Dictionary, an *approach* is "a way of considering or handling something" (OED Online, n.d. a). Closely related but more specific, a *methodology* is both a set of methods – a collection of procedures and techniques – used in a study or a particular activity, and the study of those methods (Chandler & Munday, 2011; Oxford Reference, 2016; OED Online, n.d. b). To arrive at a preliminary idea of what an information-, user-, and design-focused approach could entail, this chapter, therefore, examines relevant, already established design methodologies. It focuses on the three aspects: What makes a methodology designerly? How can users be involved through a design methodology? And what constitutes methodologies that take into account the particularities of working with data and information? The answers to these questions are consolidated into a participatory information design approach in the final section. The methodological framework established in this chapter serves as a model process for the applied thesis project.

Design Methodologies: From Craft to Designerly Ways

Nigel Cross, a prominent chronologist of the development of design research describes Design Methodology as follows:

> Design Methodology is, then, the study of the principles, practices and procedures of design in a rather broad and general sense. Its central concern is with how designing both is and might be conducted. This concern therefore includes the study of how designers work and think; the establishment of appropriate structures for the design process; the development and application of new design methods, techniques, and procedures; and reflection on the nature and extent of design knowledge and its application to design problems. (1984, p. vii)

Cross' definition of design methodology is relatively novel and is inherently connected to the search of what might constitute a discipline of design. Traditionally, the history of design has been told along the lines of artefacts and their creators (Friedman, 2000). Missing from these accounts are the "why" and "how" of these objects – the methodologies that were followed, the methods that were employed, the decisions that were made, and the resources that were used (Göransdotter & Redström, 2018). One reason for this focus on outcomes rather than on processes is the fact that design is mostly judged by the quality of its output, rather than the quality of its process (Stolterman, 2008). Another reason lies in the nature of knowledge in design: design emphasizes the ability to create – knowing "how" or *tacit knowledge* – over the ability to express how something is created – knowing "that" or *traditional knowledge*[20] (Fantl, 2017; Cross, 2006a). Tacit knowledge escapes articulation; it resides within personal knowledge and becomes embedded in objects (Cross, 2006a). However, for a collection of loose activities to become a discipline in its own right, knowledge has to – at least to some extent – become "externalized, shared, evaluated and refined" (Conley, 2004, p. 202). Thus, the evolution of design from craft to profession to discipline (Friedman, 2000) is also the evolution of design methods and the emergence of the study of these methods.

[20] The term tacit knowledge was coined in 1958 by Michael Polanyi in his book *Personal Knowledge*. The relationship between this concept and design research is examined, for example, by Claudia Mareis in *The Epistemology of the Unspoken* (2012).

Although their accounts are missing from history, the use of design methods is nearly as old as design itself. Broadbent differentiates between four generations of design methodologies, starting with the evolution of consciousness some 250'000 years ago (2003). Back then, design equaled the ability to create aesthetically pleasing objects and tools for everyday use (Broadbent, 2003). Craft was not externalized in drawings or texts but passed on through a system of apprenticeship and developed through experimentation. According to Broadbent, this changed in the 1450s, when architects began to draw plans to communicate their intentions and ideas. The externalization of knowledge allowed design to become distinct from production – a profession in its own right. The third generation of design methodologies has its roots in the 1940s (Broadbent, 2003, Cross 2006b). At that time, an enthusiasm for scientific methods, the development of management theory, and the rise of computational power, drove the systematization of the design process and the determination to create a *science of design* (Cross, 2006b). These endeavors culminated in the first *Conference on Design Methods* in 1962 (Cross, 2006b). Already by the 1970s, however, the early proponents of science-based design methods had become disenchanted with their ideas (Cross, 1984). Recognizing the limitations of a reductionist world view, scholars became interested in the nature of design practice itself (Broadbent, 2003). From their studies emerged the recognition that design comes with a unique capacity to confront the ever-growing complexity of our world by turning human intention into systems, and artefacts (Nelson & Stolterman, 2012). Design became a discipline in its own right – distinct from the cultures of the sciences and humanities.

In looking for the unique features that make up design as a discipline, we may turn to the **type of problems** that are encountered in design and the **type of solutions** that design can contribute. Design problems have often been characterized as *wicked*, *ill-defined* (Rittel & Webber, 1973), and *messy* (Schön, 1983), as opposed to the problems that are tackled in the natural science which are "definable and separable and may have solutions that are findable" (Rittel & Webber, 1973, p. 160). Stolterman (2008) believes that both the sciences and design face equally complex problems but that the solutions

that are proposed to counter this complexity are fundamentally different: While design seeks to synthesis the many aspects of a problem into a solution that is particular to a certain context of use, the pursuit of science is to break down and analyze a problem in order to find answers that will contribute to the unveiling of a universal truth (Cross, 2006a; Stolterman, 2008).

Another aspect we can look at in search of the unique attributes of the design discipline is then the **design process**. The idea that design deals with complex problems through synthesis means that there is as much, if not more, focus, on framing as there is on solving the problem (Schön, 1983). Designers tend not to analyze problems in-depth but instead seek to define the scope of the problem by applying "a focused or directed approach to gathering problem information and prioritising criteria" (Cross, 2006a, p. 91). Because problem and solution are mostly *co-developed* (Cross, 2006a), design has a strong cyclical, iterative nature of exploration and refinement. An important tool in this process is the combination of sketching and reflection (Schön 1983; Ware, 2008;). The alternation between visual manifestation and cognitive critique drive exploring and refining activities throughout the process (Cross, 2006a). Subsequently, the design of the process is often as important as the process itself (Buxton, 2007). Designing a particular solution calls for a deliberately created process that fits the context of a particular problem (Stolterman, 2008). For this, designers need an in-depth understanding of how different parts of a design process can work together (Cross, 2006a).

Finally, we can talk about what design might be able to contribute that other disciplines cannot – the **impact of design**. One might argue that the *designerly* approach to complexity already constitutes a unique feature of design. However, each discipline comes with its own strengths in problem solving. Therefore, a growing number of researchers propose that it is neither the nature of design problems nor the features of the design process, but the aesthetic knowledge embedded in artefacts that ultimately differentiates the discipline of design from others (e.g. Ilstedt Hjelm, 2005; Renner, 2019). Aesthetic in this sense is not to be confused with the concept of beauty but is instead to be understood in the original Greek

sense as "what meets the senses" (Ilstedt Hjelm, 2005). The activity of *form giving* through the application of aesthetic knowledge allows intention to manifest in concrete and visible artefacts that prompt social (ex)change.

Knowledge about the history of design methodologies and a loose list of designerly attributes does not yet constitute a methodology. However, design has not suddenly shed past and future when it proclaimed itself an independent discipline. Each generation of methodologies has inspired practical applications, most of which are still very much alive today. Design is thus still practiced as craft, as profession, as science, and as its own discipline. The ability to distinguish these different modes of design in theory and weave in and out of them in a reflective practice allows us to make use of the rich possibilities of design. Finally, we might use the reflections on what constitutes designerly modes of thinking and creating, in order to reflect on the "designerlyness" of existing and novel methodologies – especially those that claim to be a solution to the complexity of design.

Involving the User: From user-Centered Design to Co-Creation

The design methods movement was largely dedicated to the development of the study of design as a whole and the study of design methodology in particular. As such, its efforts were directed more towards the establishment of a design discipline and less towards the development of particular methodologies and methods. More applied design methodologies began to emerge in the 1980's at the intersection of ergonomics, engineering, and design. These methodologies arose from an interest in the users – the people who would end up working with, consuming, and, hopefully, enjoying the products created by designers and engineers. Two such methodologies emerged almost simultaneously in different regions of the northern hemisphere: User-centered design in North America and participatory design in Northern Europe. The following paragraphs describe developments and attributes pertinent to these methodologies, providing an introduction on how meth-

odologies can incorporate various forms of user involvement.

Despite its name, the user-centered design methodology does not have its roots in the design field. Its origins lie instead in ergonomics and human factors, scientific disciplines "concerned with the understanding of interactions among human and other elements of a system" (International Organization for Standardization, 2019, p. 2). Traditionally, these fields considered humans as one contributor to a larger system of interconnected factors (Ritter et al., 2014). However, as complex technical systems became available to the broader public in the 1980s,[21] ergonomists began to call for a stronger focus on the user, usability, and user-friendly design (c.f. Gould & Lewis, 1985; Norman & Draper, 1986; Stiff, 2017). The term *user-centered design* was coined by Don Norman in 1988, in his seminal book The Design of Everyday Things. Working as a cognitive engineer, Norman had observed how fatal accidents were often unjustly attributed to human error, when, instead, poorly designed systems were at fault as they failed to take into account the abilities of their users (Norman, 2002). The shift away from ergonomic methods to a more user- and design-centered approach meant "less of a focus on formal methods for requirements gathering and specification, and a move from linear, rigid design processes to a more flexible iterative design methodology" (Ritter et al., 2014, p. 43).

Today, user-centered design is considered both a mind-set that sees the user at the center of the design process and a collection of methods and procedures (Rubin & Chisnell, 2008). The methodology has also been formalized in the *ISO Standard 9241-210* which uses the term *human-centered* to include all stakeholders, not just the product's end-users (ISO, 2019). The standard describes the human-centered design process as an iterative cycle consisting of four steps: understanding and specifying the context of use, specifying the user requirements, producing design solutions, and evaluating the design (ISO, 2019) (Figure 12).

While methods are not specified by the ISO Standard, various websites and papers offer a wealth of resources for the implementation of a user-centered design process. IDEO's *Design Kit*[22], for example, provides a list of methods for each of the three design phases – inspiration, ideation and

21 The concept of 'users' began to surface when the first micro-computers were developed (Kensing & Greenbaum, 2013).

22 IDEO's Design Kit can be found under www.designkit.org

implementation. Many of these methods have their roots in other research fields and have been adapted for the use in a product development process: Surveys and experiments, for example, stem from traditional research, while methods such as participant observation and cognitive walkthroughs have their roots in ethnography and psychology (Hanington, 2003). More recently, user-centered design has begun to include more creative means of gathering user information, for example through workshops or visual diaries (Hanington, 2003).

User-Centered Design Process
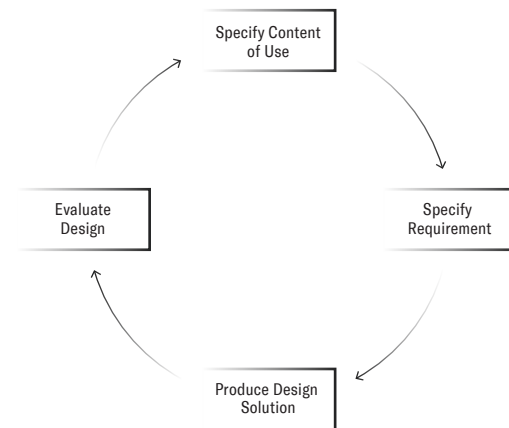
Figure 12. The user-centered design process model after the ISO Standard 9241-210.

Criticism of user-centered design methods is mostly directed at the passive role of the user. Despite its human-centeredness, user-centered design remains largely focused on design outputs (Sanders, 2002). Users are therefore involved only as "records, subjects, or cases" (Carroll, 1996, p. 285) and even if participatory methods are applied, participation is seen as a "technical method to ensure better design results" (Carroll, 1996, p. 286). The focus on results is reflected in the widespread application of user testing by user-centered design practitioners (Vredenburg et al., 2002). This method is mostly employed to evaluate a design proposition towards the end of

the design process (Hanington, 2003). A growing body of literature rejects the idea that such evaluative methods used only in the final design phases are an adequate tool to fully grasp human concerns in the interaction with a design product (e.g. Hanington, 2003; Spinuzzi, 2005; Stolterman, 2008). Thus, while user-centered design methods might lead to a more useable product, they do not necessarily bring about a more enjoyable or satisfying experience (Hanington, 2003). In summary, the idea of a passive user as source of research data disregards the importance of more intangible aspects of the human experience.

Participatory design seeks to change the passive role of the user into active involvement. Similar to user-centered design, participatory design emerged in the 1970's against the backdrop of rapid technological developments (Kensing & Greenbaum, 2013). These developments were accompanied by a tayloristic management style that sought to de-skill workers through automation (Spinuzzi, 2005, Kensing & Greenbaum, 2013). In Northern Europe, influential labor unions and a strong concept of workplace democracy enabled a growing discourse on the well-being of the worker in a computerized environment (Carroll, 1996). In Norway, for example, workers of the Iron and Metal union hired two researchers – Kirsten Nygaard and Olav Terje Bergo – to help them gain influence over the decisions on the technology that was introduced in their workplace (Kensing & Greenbaum, 2013). As Nygaard and Bergo proceeded with the project, they noticed that the traditional research approach would only lead to irrelevant reports no one would read (Kensing & Greenbaum, 2013). Upon this realization they began to apply action research methods that allowed workers to actively participate in the research process. The outcome of this was a strategy report with tangible actions, new teaching materials, and a process that would ensure continuous participation (Kensing & Greenbaum, 2013). Thus, while the development of user-centered and human-centered design was driven mainly by the goal to minimize human error by creating more human-friendly products (Norman, 2002), participatory design emerged as a means to empower people to "gain a voice in the technologies that affect their working lives" (Kensing & Greenbaum, 2013, p. 21).

Participatory design today can be approached both as an ideology (Bannon & Ehn, 2013) and a methodology that includes a process and various applied methods (Spinuzzi, 2005). A participatory design process begins with an initial exploration, followed by a discovery phase, and a prototyping phase (Spinuzzi, 2005)(Figure 13). The exploration phase typically employs ethnographic methods such as observations and interviews; the second phase uses methods that originate from ethnography but are appropriated to be more collaborative, such as role-playing games and workshops; the third phase applies iterative design methods such as the development of mock-ups and paper prototypes (Spinuzzi, 2005).

Participatory Design Process
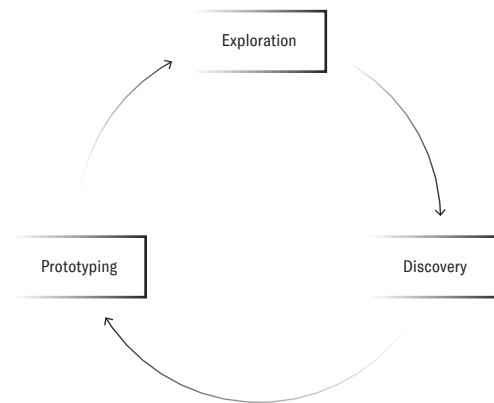
Figure 13. The participatory design process model after Spinuzzi (2005).

In contrast to user-centered design, participatory design is done *with* the user, instead of *for* the user (Sanders, 2002). It acknowledges the tacit knowledge users possess and focuses on empowering them by providing tools that "can fit into the existing web of tacit knowledge, workflow, and work tools, rather than doing away with them" (Spinuzzi, 2005, p. 166). The participatory design methodology is therefore uniquely suited to arrive at a design solution that is based on a deep understanding of the users' needs.

In the context of design methodologies that involve users through various means, it is also important to mention the concept of *co-design*. Co-design can be understood as the "collective creativity as it is applied across the whole span of a design process" (Sanders & Stappers, 2008, p. 6). In co-design, the user evolves from a participant to a co-creator. In fact, all stakeholders – researchers, designers, developers, and (potential) users – are seen as "experts on their own experiences" (Visser et al., 2005, p. 10). Sanders proposes to engage these co-creators "through an iterative cycle of making, telling, and enacting" (Sanders, 2016, 8:20). Each of these components of the cycle brings with them various tools and techniques that, just as in participatory design, constitute a mix of methods appropriated from fields such as marketing, psychology, anthropology and sociology (Sanders & Stappers, 2018). In summary, co-design is similar to participatory design but takes the premises of participation a step further by turning participants into creators.

Criticism of participatory design and co-design is mostly voiced in terms of the practical application of these methodologies. In a political system that is oriented towards maintaining a competitive marketplace and boosting consumerism, participatory design comes at a relatively high cost as it requires time, resources, and commitment to continuous participation (Sanders & Stappers, 2008; Kensing & Greenbaum, 2013). In a capitalist environment it has also proven hard to maintain the focus on democratic empowerment which lies at the core of participatory design (Spinuzzi, 2005; Sanders & Stappers, 2008; Bannon & Ehn, 2013). Recent papers have therefore begun to examine how participatory design can be employed in long-term, large-scale projects that include many stakeholders and run under real market constraints (e.g. Dalsgaard, 2012).

From a design point of view, the fact that the participatory process is shared among participants means that it can be directed towards applications outside the realm of design, such as, for example, politics, planning, or management. This raises the question if participatory design and co-design are indeed design methodologies or if they are simply a way to organize and manage stakeholders. Then, although Sanders defines

co-design as an ongoing process, methods for co-design are mostly focused on the "fuzzy frontend" of the process in which collaborators explore the problem space and generate ideas (c.f. Sanders, 2016). Examples of participatory design projects rarely speak about the actual development, production, and implementation of the solution, leaving the reader in the dark as to what value was added to the project through participatory design (c.f. Visser et al., 2005). This leads to the question if these methodologies don't assume an overly naïve view of the design process in which idea generation and innovation happens only before the actual development and implementation of a solution. It is then also under this perspective that Bannon and Ehn (2013) call for a shift in how design is currently employed in participatory design: instead of using design merely to produce toolkits and prototypes that advance the participatory process, they argue that the design of the outcome as well as the continuous maintenance of this outcome should form part of the participatory process. Thus, we can argue that participatory design only becomes a design methodology, if the actual design development phase is considered as important as the other phases aimed at idea generation.

Despite the diverging cultural contexts of user-centered and participatory design, many methods are shared among both methodologies (Carroll 1996, Kensing & Greenbaum, 2013). In a study on how user-centered is practiced within the human-computer interaction (HCI) community, for example, Vredenburg et al. (2002) found that participants of the study mentioned participatory design as a method within their user-centered design practice. Similarly, when the use of participatory design began to spread beyond Northern Europe, practitioners began to incorporate some of the more market-oriented and evaluative methods from user-centered design (Carroll, 1996). The assimilation of the two methodologies means that, today, designers can choose from a wide range of different methods that involve the user to varying degrees. This freedom of choice brings the responsibility to choose the right methods for a particular design problem. The deliberate design of the design process is more important than ever.

Comparing the nature of design methodologies described in the previous section with user-centered design, participatory design and co-design, we can observe both similarities and discrepancies. Some methods applied under a user-centered design approach, such as user testing and surveys, are still based on the idea that design – and the human experience of design – is a measurable and, thus, a scientific endeavor. In contrast, participatory design moves away from the quantification of human experience to attempt to understand the nature of human needs and intentions. The idea of collaborative doing and making is akin to the designerly way of creating and reflecting. On the other hand, participatory design is focused first and foremost on the collaborative development of concepts, while user-centered design aims more narrowly at product development. This latter goal matches a core activity of design – creating and giving form to material artefacts. Both methodologies speak of iterative design, and especially participatory design uses prototypes to make ideas more material, bringing them into the community that will one day use them (Spinuzzi, 2005, Ilstedt Hjelm, 2005). However, both methodologies lack a discussion of the impact of the aesthetics and form of these artefacts on experience.

Designerly Ways and User Involvement in Information Design

The choice of methodology in information design depends strongly on the topic area of the particular project. If the focus of the project lies more on one of the adjacent fields of information design, such as graphic design, interactions design, or user experience design, a methodology might be chosen directly from that field. However, if the project demands a strong focus on the communication of information or data, a designer might adapt common design methodologies for this purpose or choose a methodology specific to information design. The following paragraphs describe three information design-specific approaches: an applied information design process, an information design methodology that allows for user involvement, and a methodology for information design research.

In the area of applied information design, processes tend to take a pragmatic, data- and design-focused approach. In the

Data Visualization Handbook, Koponen and Hildén detail a workflow that is inspired by Ben Fry's and Moritz Stefaner's process and enriched with experience from their own information design practice (2019) (Figure 14). They begin their workflow by defining communicative objectives, target groups, and context of use of the visualization or the graphics. This step is closely interlinked with the process of finding, collecting, and cleaning the data that will be used for the project. In the following steps, they then explore and organize the data and sketch and experiment with visual ways to present the data. They stress that sketching is one of the most important activities in the design process as it allows for quick iterations across different solutions. The sketching and experimenting step leads to a decision on the presentation method for the data. Then, the visualizations are produced, refined, and, finally, published. After publication, the final visualizations can be assessed against the objectives laid out in the first step. If necessary, they can be updated and expanded. As each step can bring new challenges or ideas to light, it is sometimes necessary to revisit and revise previous work. Although this process details how various collaborators, such as content owners, information designers and implementers work together in this process, it does not account for any involvement of the user.
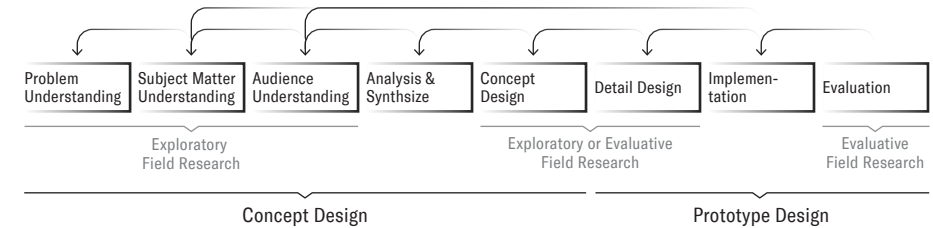
Applied Information Design Process
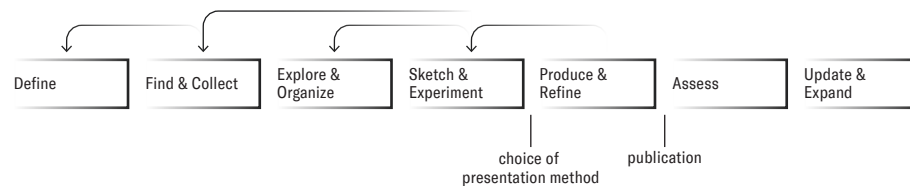
Figure 14. An information design process model that stems from design practice after Koponen and Hildén (2019).

Pontis and Babwahsingh on the other hand propose a design methodology that allows for a more in-depth research of the problem space and for the involvement of (potential) users (2016). The methodology stems from their belief that

there is often too much focus on the final product of the information design process and "too little attention paid to fundamental understanding" (Pontis & Babwahsingh, 2016, p. 249). In her recent book *Making Sense of Field Research: A Practical Guide for Information Designers*, Pontis explains the process in more detail and provides methods for the collection and analysis of qualitative data to support the design process (2019) (Figure 15). The design process she proposes is separated into conceptual design and prototype design. The conceptual phase consists of understanding the problem, the audience and the subject matter; analyzing and synthesizing the findings from the previous step; and creating a design concept based on these findings. The prototype phase consists of detail design, implementation, and evaluation. The process is displayed in a linear fashion but allows the designer to cycle back to previous steps.

Research-led Information Design Process

Figure 15. The research-led information design process model after Pontis (2019).

Pontis' methodology is based on the premise of a constructive-interpretative paradigm. This worldview postulates that people are complex, dynamic beings that each hold their own subjective realities and defy measurement and prediction. Pontis contrasts this attitude to the positivist worldview in which "truth is provided by numerical data gathered via scientific methods" (p. 28). Positivist researchers thus apply quantitative methods in the search of an objective evaluation to a design solution. Constructive-interpretative researchers, on the other hand, "look for descriptions of human experiences and meanings manifested through stories, behaviors, feelings,

and opinions. In other words, they seek depth of understanding" (p. 29). Using qualitative methods within a constructive-interpretative paradigm, can help designers understand the *why* behind a design problem and arrive at a useful *how* of a design solution.
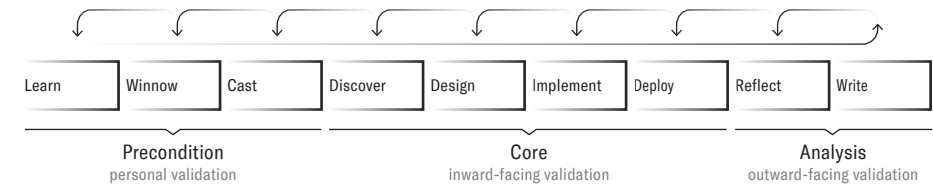
Next to a process and the constructive-interpretative framework, Pontis also details various methods that can be deployed at different stages of the process, both to explore the design space and to evaluate possible solutions. All methods are qualitative, human-centered research methods with roots in ethnography, participatory action research, contextual inquiry, usability testing, and self-documentation. Explorative methods include observational studies, contextual interviews, contextual inquiry, diary studies, design probes, and collaborative workshops. The choice of a method or a combination of methods is left to the design researcher and Pontis actively encourages adapting the methods to the audience's needs. The same qualitative methods can also be used to evaluate the design. Here, the choice of methods depends on how far along the design solution is and if the design researcher is present at the evaluation setting.[23] Pontis also describes how to derive insights from the field studies through the organization and coding of the collected data. Methods for this stage include *Five Ws+One H*, *visual content analysis*, *affinity diagrams*, and *empathy maps*. Finally, for the interpretation of the data, Pontis propose the methods *needfinding*, *personas*, and *visualization*.

Overall, Pontis' methodology is aimed at information design practitioners who want to add qualitative research methods to their own design process. Therefore, the methods proposed by Pontis are suited for exploration and evaluation and do not directly apply to the development and implementation of a design solution. The process also does not include steps to document or reflect on the design work.

To the contrary, the *design study methodology* by Sedlmair et al. is intended specifically for applied information design projects that are developed in the field of information visualization research (2012). Due to this focus, the methodology includes research specific steps, such as writing and learning. All in all, it consists of 9 steps, divided into three phases: The

23 Pontis' book includes a nice flow diagram that helps the designer find out which evaluative method works best for which situation (2019, pp. 120-121).

precondition phase is comprised of the learn, winnow, and cast steps. The *core* phase contains the discover, design, implement, and deploy steps. Finally, the *analysis* phase consists of the reflect and write steps.

Design Study Methodology

| Learn | Winnow | Cast | Discover | Design | Implement | Deploy | Reflect | Write |

Precondition
personal validation

Core
inward-facing validation

Analysis
outward-facing validation

Figure 16. The process model of the design study methodology after Sedlmair et al. (2012).

The authors stress that, although the process is linear in that each step succeeds a previous one, steps can also overlap and be repeated. Alongside an explanation of each step, the authors list possible pitfalls which can lead to an unsuccessful study. Despite being called a methodology, the *design study methodology* does not include many details on tools or techniques that could be applied for each step. It has, however, been successfully used in multiple applied design research projects, such as Project Ukko (Christel et al., 2017) and VisInfo (Bernard et al., 2015).

The Participatory Information Design Approach in this Thesis

We have now looked at what constitutes designerly ways of doing and thinking and how certain methodologies support the involvement of the people who are at the receiving end of the design process. While each of these approaches and methodologies contributes a unique and essential perspective, they are – to a certain degree – incomplete. Knowledge of what constitutes designerly ways of doing and thinking might support the

reflective practice of an individual designer but fail to provide a broader framework for design as a collaborative, in-situ undertaking. On the other hand, user-centered and participatory design methodologies contribute an extensive repository of methods that allow the designer to involve the user but lack sensitivity when it comes to incorporating designerly ways into the process.

This divide between designerly approaches and human-centered or participatory research is reflected in the information design methodologies detailed in the previous section. An applied information design approach allows for iterative explorations and the convergent and divergent patterns typical to the nature of design practice but neglects methods that would allow for any involvement of the user. The process proposed by Pontis (2019) focuses on the conceptual part of the process, allowing the designer to employ participatory field research. The process does not, however, include any methods for the actual design development phase. The design study methodology after Sedlmair et al. (2012) helps designers develop studies under the research through design (Frayling, 1993) approach but mentions only a few specific design methods. In contrast to Pontis' process, the design study methodology also puts less emphasis on a fundamental understanding of the design problem and is more geared towards task analysis and data abstraction common to the information visualization field. It is interesting to note that both the design study methodology and Pontis' information design process differentiate between a conceptual phase and a design phase instead of regarding the entire process as a design process.

In the previous chapter, I stated that the objective of the thesis is to be "true to the data, aesthetically engaging, and effective and efficient for the user". As there is a lack of research on the users of data-driven government reports, one part of the design process applied in this thesis is aimed at involving these users in the design process to understand how they use such reports. At the same time, the thesis attempts to leaves space for a design practice that focuses on creating aesthetically engaging, functional, effective, and efficient information design solutions. Finally, the design process must include reflecting, learning, and writing, as the insights gained

in the thesis have to be communicated in an academic environment. The thesis project, therefore, calls for a design methodology that is at once designerly, participatory, research-friendly and appropriate for data-based projects. In summary, such a methodology would include the following possibilities:

- The possibility to learn, reflect, and document
- The possibility to involve users in different ways throughout the process
- The possibility to familiarize oneself fully with the subject matter
- The possibility to engage in visual form-giving – to iterate, sketch, and experiment with particular attention to aesthetic qualities
- The possibility to combine qualitative and quantitative research methods and to consolidate theory and practice

We can construct such a methodology as described above by combining the *design study methodology*, Pontis' *information design process* and the designerly approaches outlined in the first section, and the section on applied information design processes.
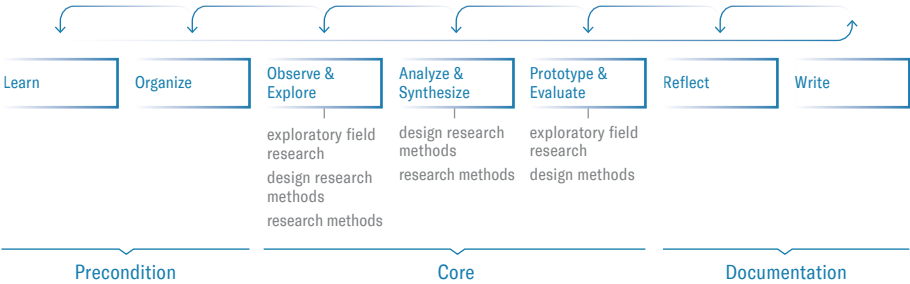
Figure 17 delineates the steps and methods of this particis patory information design approach. The *learn* step is the same as in the design methodology. The *winnow* and *cast* steps are the same as well but have been combined into an *organize* step. The core phase consists of the *observe & explore*, *analyze & synthesize*, and *prototype & evaluate* steps. These steps employ field research (which can be observant or participatory, as is the case in this thesis), design research methods (e.g., benchmark analysis, visual content analysis), design methods (e.g., sketching, prototyping, wireframing), and research methods (e.g., interviews).

The *observe & explore* step consolidates Pontis' *problem understanding*, *subject matter understanding*, and *audience understanding*. In this step, the researcher explores the design space and learns from the audiences and the domain experts. In the following step, the researcher *analyzes and synthesizes* the findings from the *observe & explore* step. They then incorporate these findings into a *prototype* and the prototype is

evaluated – again in collaboration with the target audiences. The core phase is followed by what Selmair et al. call the *Analysis* phase. This phase is renamed *Documentation* to avoid any confusion with the *analyze & synthesize* step. It includes the *reflect* and the *write* steps, both of which are identical to the two last steps in the *design study methodology*.

Participatory Information Design Process

| Learn | Organize | Observe & Explore | Analyze & Synthesize | Prototype & Evaluate | Reflect | Write |

exploratory field research

design research methods

research methods

design research methods

research methods

exploratory field research

design methods

Precondition   Core   Documentation

Figure 17.   The process model used in this thesis, inspired by the design study methodology by Sedlmair et al. and the research-led information design process by Pontis.

This participatory information design approach is used in the applied thesis project. The *precondition* phase and the *analysis* phase allow for a project to be embedded in research environment but are also useful to projects that are in need of extensive documentation. The core phase makes use of the qualitative field methods detailed by Pontis as well as designerly methods. They allow for a participatory, information-focused, visualization-driven approach which is suited for projects that aim at being both generative and productive.

2.3 The Information Design Product

What we need is not more information but the ability to present the right information to the right people at the right time, in the most effective and efficient form.
  — Horn, 1999, p. 16

Beyond looking at information design from a historical perspective that traces the histories and meanderings of different fields, it is also possible to look at information design through the perspective of the products it produces and the guidelines that can be used to create these products. This is often the approach preferred by practitioners less concerned with the delineation of terms and concepts and more focused on producing a vocabulary that allows for a communication to clients. It is important to point out here, that these typologies often concentrate on a particular artefact while information design in this context is seen as more an interplay of different media and visualizations. Nonetheless, the typologies offer important vocabulary to define design decisions and thought processes.

Terms and Typologies

As we saw in the previous subchapter, information design spans a large variety of different fields. Naturally, this means that a large variety of design outcomes could be classified as information design products. A common denominator to all these information design products is their objective of "revealing patterns and relationships not known or not so easily deduced without the aid of the visual representation of information" (Meirelles, 2013, p. 11). After Wurman (1996), Pontis proposes that "information design work of any kind seeks to enhance understanding – of a situation, concept, space, place, time, quantity, phenomenon – for an intended audience" and

that "information designers aim to design clear communication on any medium from paper to digital devices and public information displays" (Pontis, 2019, p. 3). An information design product is therefore an artefact that allows users to understand patterns and relationships through the visual presentation of information on any kind of medium.

Knowledge of what is common to all information design products does not yet allow us to imagine the plethora of possible products. We can therefore look at different kinds of classifications that help us imagine possible design solutions. For one, we can differentiate between product classifications used for the whole field of information design and classifications that focus specifically on the field of information graphics.

A very straight-forward way to categorize information design products is by dividing them by the medium they use. In *Introduction to Information Design*, Coates and Ellison group information design products into three larger categories: Print, Interactive, and Environmental (2014). According to the authors, the print category includes all information that is communicated on paper. This encompasses products such as instructions for flat-packed furniture, visualizations we encounter in newspapers and textbooks, and any kind of printed forms such as utility bills. These products are characterized by static images or a sequence of static images. The interactive category includes digital interfaces, such as websites, apps, and displays, which present information visually. This category yields products such as digital magazines, interfaces that present data, and in-car navigation systems. In digital environments users usually have a variety of different possibilities to interact with the information, for example through selecting, filtering or sorting. Coates and Ellison include wayfinding, exhibition design and large-scale installations in the environmental category. Wayfinding encompasses signage, lighting and three-dimensional objects that help people navigate a physical environment (Lynch, 1960, as cited in Coates & Ellsion, 2014). This category can include both interactive and static images. In fact, as Ellison and Coates point out themselves, the three categories are not exclusive: nowadays, instructions can be found both in print and in digital environments, as can data visualizations, bills, maps, and magazines.

The categorization they propose is therefore only useful for a first broad overview of the different products that can possibly be created in information design.

Especially in books about the field of information graphics, many authors do away with a division by medium. Instead, they propose placing different types of information graphics along various axes. One popular axis is the explanatory-exploratory continuum (e.g. Koponen & Hildén, 2019; Lankow et al., 2012). According to Koponen and Hildén, explanatory information graphics communicate by declaring, explaining, and affirming information, while exploratory information graphics enable users to discover and analyze information (2019). In other words, "an explanatory graphic tells a story, while an exploratory graphic is a tool for the reader to find their own story in the data" (Koponen & Hildén, 2019, p. 26). In information design, the term exploratory is often associated with interactive information graphics which reintroduces a categorization by media format. However, Drucker offers an interesting set of terms that allow also static information graphics to be regarded as exploratory: She uses the word representation for visualizations that show information that is already known, and knowledge generators for visualizations that are "capable of creating new information through their use" (Drucker, 2014, p. 65). Under this continuum, a bar chart that displays voting statistics is a representation, while a train table (printed or digital) can be regarded as a knowledge generator as it can be used as a tool to plan a journey (Drucker, 2014).

Another continuum that is also used by Koponen and Hildén is the conceptual-measurable axis. While the explanatory-exploratory continuum points to the way a user is guided through the structure of an information graphic, the conceptual-measurable continuum is based on the type of information that is visualized in the graphic. A concept is defined by the Oxford English Dictionary as "a general idea or notion" (OED Online, 2020). Measurable information, on the other hand, is abstract and/or invisible to the eyes (Koponen & Hildén, 2019). Abstract, measurable information is often displayed non-figuratively, while conceptual information can lend itself to more figurative visualizations. The figurative-non-figurative continuum is another interesting axis. It references not the

purpose or the information of the graphic but the type of visualization it uses. Figurative visualizations emulate forms found in real life to illustrate information, while a non-figurative visualization uses abstract shapes to display data or information (Cairo, 2013).

The axes listed above help us understand and talk about what kind of information we are dealing with, how information type influences the type of representation we choose, and how our user will interact with that representation. Although the axes are mostly described in books that deal with information graphics rather than the whole information design space, we can still use them to think about other information design products. In fact, once we decide which media our project spans it is likely more helpful to think of the product along the axes described above. When faced with the challenge of designing a data-driven government report, for example, we can first broadly think which media is most appropriate to the problem. A digital, data-driven report, for example, includes interface design, as well as interactive visualization. We can then imagine a report application that is explanatory – guiding the user through every step – or exploratory – allowing the user to delve into the report on their own – and all possibilities in between.

The Information Design Product in Official Statistics

Governments employ a variety of different products to inform, communicate and engage with their citizens, ranging from tax forms, to public health pamphlets, open data portals, and statistical publications. Although many of these products have information design components or could be examined through the lens of information design, doing so would force us to venture into many government-related fields that go beyond the scope of this thesis. By focusing on the field of official statistics, we can arrive at an understanding of statistical dissemination products and specifically concentrate on statistical reports which are the focus of this thesis.

Literature on the dissemination of official statistics often applies a dichotomy to separate "raw" data from the interpretation of the data. Already in 1986, Carlo Malaguerra, the director of the Swiss Federal Office for Statistics from 1987 to 2001, talks about distinguishing between "information needs relating to statistical results alone (raw figures) and needs relating to statistical results with descriptive or interpretative commentary" (p. 103) (note). For the latter category of needs he defines three types of information products:

Scientific analyses which are studies on a specific statistical topic, or a combination of topics (interdisciplinary work), and are intended to provide the user with processed data on a given problem;

Popularized presentations designed to explain the accompanying statistics in easily understandable terms. They may be specific (on a particular topic) or general;
Key words which are brief comments or information on particular data or topics (e.g. the growth rate of a variable over a given period). (Malaguerra, 1986, p. 103)

Thus, Malaguerra's three types of interpretative products differentiate between statistical interpretation for an expert audience, statistical interpretation intended for the broad public, statistical interpretation for the quick reader.

Besides listing different types of interpretations, Malaguerra goes on to look at different dissemination formats. He divides these into written, verbal, phototechnical, and electronic categories (1986). Publications form part of the written category. Already then, he states that the advances in the field of computation mean that printing publications "no longer entirely meets present and future needs" (p. 107) and therefore proposes to "reconsider its function and to develop a modern concept which, at the same time, ensures that it can be used in a variety of ways" (p. 107).

More than 30 years after Malaguerra's typology of statistical products, the general aim of statistics offices to provide both data and interpretation remains the same. However, the idea of what format this interpretation should take has shifted.

In 2008 paper, Olav ten Bosch and Edwin de Jonge, two data scientists from Statistics Netherlands, write about how, although many offices have made the shift to disseminate data online, the traditional table layout used in printed statistical yearbooks is still very much present. They propose a dichotomy between publishing numbers in tables and publishing numbers as visualizations. The latter category is divided into visualizations for analysis and visualizations for communication. Visualizations for communication guide the user through the data by explaining and highlighting important aspects (explanatory visualization), while visualization for analysis provides the user with tools and visualizations that allow them to explore the data on their own (exploratory visualization). Since Malguerra's elaborations in 1986, the interpretation of data has thus become more interlinked with the idea that data visualization can represent a more approachable way to communicate statistics.

In a more recent paper, Allan Smith, head of digital content at the UK's Office for National Statistics (ONS) from 2014 to 2015, builds on Malaguerra's dichotomy as well (2013). He recalls Sir Andrew Dilnot's pre-appointment hearing for Chair of the UK Statistics Authority. In his address, Dilnot stated that "the ONS website should be both a source of data and interpretation – and that if the ONS website was not better in this respect within one year of his appointment, he would consider his appointment a failure" (Smith, 2013, p. 174). The last sentence speaks of a common sentiment in official statistics today: statistical offices are under a mounting pressure to produce better products for interpretation. In fact, many researchers speak of a change of expectations towards their services – both in terms of the data they offer and the way this data is presented (Grünewald & Mittag, 2006; Keuning & Morais, 2005; Malaguerra, 1986; Smith, 2013). These expectations are linked to how people have become used to high-quality, interactive data visualization in every domain of their life – on the internet, in newspapers, in computer games, at school, at work and on TV (ten Bosch & de Jonge, 2008). Therefore, statistical products in the public sector have to meet the user's expectations in order to become relevant to them.

The "good" information design product

There are countless books on what makes a good information design product. On a practical level these books outline guidelines and teach knowledge that, together with actual practice, can lead to good design. The guidelines are usually written for a specific information design product, such as information graphics, signage, or a data-driven website. In *Data Design*, for example, Mollerup describes the do's and don'ts of each chart type (2015). In the *Data Visualization Handbook*, Koponen and Hildén explain which visual variables, such as position, length, color, and area are the most effective for showing numerical values, orders, or categories in information graphics (2019, p. 58). And in *D3.js in Action*, Meeks details how to create interactive charts with the programming language D3.js (2018). Such guidelines are invaluable when it comes to the practice of information design.

On a more reflective note, we can think about which traits define a good information design product. In *A Truthful Art*, Cairo speaks about five qualities that make a visualization successful. According to them, a good visualization is truthful, functional, beautiful, insightful, and enlightening (2016). Truthfulness is accomplished by "thorough and honest research" (p. 118); functional means that the visualization is useful and useable; beauty implies that it is "attractive, intriguing, and even aesthetically pleasing for its intended audience" (p. 119); an insightful visualization allows people to yield new knowledge from engaging with it, and being enlightening implies that the visualization has the potential to truly impact people. Cairo presents this framework of qualities in the context of information graphics, but it can nonetheless be applied to other information-driven or data-driven products.

A further, slightly broader list of successful traits for information design products is Lawson et al.'s adaption of the Vitruvian virtues. The Vitruvian virtues are named after Marcus Vitruvius Pollio, a "first century architect, author, and engineer" (Pettersson, 2016, p. 69). According to him, a built structure should be solid, useful, and beautiful (Pettersson, 2016). Based on these characteristics, Lawson et al. (2012) list soundness, utility, and beauty as the defining traits of a successful

information design product. Soundness occurs when the message that the product is trying to convey is meaningful and if this message is presented in an honest, transparent way. Utility is measured by how the information design product enables the people who will use it to achieve their goals. And beauty refers to how appropriate the format and the design of the product is. The authors point out that an aesthetically pleasing product can still be designed inappropriately. According to them, beauty is where aesthetics, appropriateness, and effectiveness meet.

Richard Buchanan, an interaction design researcher and practitioner, offers a version of these three qualities for design products in general that is more matter-of-fact than the adapted Vitruvian virtues. According to him, a successful design product is useful, useable, and desirable (Buchanan, 2001). For a product to be useful, Buchanan simply states that "it must work" (2001, p. 15). In interaction design, this has traditionally been the domain of collaboration between the designer and the engineer, but Buchanan specifically points out that for information products to work, the collaboration between content specialists and designers is just as essential. Usable products take the affordances of the human body and human cognition into account. Here, Buchanan points to the potential of a fruitful collaboration between the human sciences and design in which contributions from the fields of behavioral and social sciences lead to design products that are more adept to human traits. Finally, Buchanan states that desirability is a complex phenomenon. While aesthetics play a role in how desirable a product is, he sees "identification" as a better descriptor of what defines desirability. "What is there in a product that leads someone to identify with it and want it to be part of his or her life?", Buchanan asks, before stating that "this is surely one of the most puzzling and intriguing aspects of design today" (2001, p. 15).

What is interesting in Buchanan's categories – and what differentiates them from the other traits we have summarized – is that they include the people who create and use the product. Through a collaboration between designers, engineers, and domain experts the design product becomes useful. By considering the capabilities and the abilities of the people who will

use the product – either through the collaboration with scientists or through a participatory process–, the product will become usable to them. Finally, the product is desirable because it allows the user to identify with it, through aesthetics and other factors that remain unclear for now.

How might these traits look in the case of an information design product that is created through a participatory information design process? Being useful surely still remains a collaboration between engineers, designers, and domain experts. Usability can arise through the intersection of the human science and design, but – as is the case in this thesis – it can also come from a deep understanding of the behaviors and needs of the target audiences of a product. Finally, we can argue that, desirability can be elicited through aesthetic appeal and by providing the audience with possibilities to identify with the data and the information presented in the information design product.

Returning to the field of official statistics, Malaguerra points out, the concept of relevance has to always be reconsidered in light of new technological and societal development. In looking at "what might be done further, to make the statistical product more beneficial in the democratic context", Bumpstead and Alldritt from the UK Statistics Authority list three areas of possible improvements (2011, ch. 1. *Introduction and Abstract*):

- **Utility:** as statistics only become valuable through use, it is important to understand what this use entails and what users need from the statistics.
- **Accessibility:** statistics must be accessible to citizens. This is affected by how available and how understandable the statistics are to the citizen. In order to be understandable, statistics must offer "helpful explanation from a source that can be trusted" (2011, ch. 1. Introduction and Abstract).
- **Relevance:** statistics must be relevant to the democratic debate both through their subject matter and through their accessibility

Their three points – utility, accessibility, and relevance – echo Buchanan's idea that a good design product is useful,

useable, and desirable. In fact, we might argue that relevance too, is strongly interlinked with identification. Democratic processes hinge on the idea that the participation of an individual is relevant to shaping a societal reality and such participation can only come through the identification if not with the topic than at least with the idea of democracy.

The idea that relevance and desirability is tied to identification is a fascinating one. It links a design product to the human search for identity. One account of identity is the *Narrative Criterion of Personal Identity*. This theory describes how people make their identity by the creative act of weaving their experiences into a coherent narrative. It is only through the connection of these experiences that a string of single events gains any meaning (Shoemaker, 2019). If identity is linked to narrative, we can argue that desirability is the possibility for the reader to identify with the narrative presented by the product. In fact, many researchers have explored the importance of allowing users to "find themselves" in data visualizations (Drucker et al., 2018).

Narratives Visualizations

Stories are believed to be a uniquely and deeply human way of making sense of our world. A prerequisite to our ability to tell stories was the development of language. Summarizing various theories, Harari speaks of the Cognitive Revolution that led to new ways of thinking and communicating some 30'000 to 70'000 years ago (2015). Our language abilities likely developed as a means to share practical information about the inhabited environment, to gossip about others and to create myths and legends that explained the world. According to Harari, the ability to communicate with others through a sophisticated language, led to the Homo Sapien's ability to collaborate in large numbers. Stories were therefore paramount to the development of societies. Stories were passed on first verbally, then visually and much later in written language. In fact, the medium – from songs to ancient cave paintings to books and VR games – through which stories are told has always been defined through the available technology (Riche et al., 2018). Visualization can be seen as one such technical tool to tell stories (Cai-

ro, 2013). Data visualizations – and by extension information design – are therefore tools to tell stories about data.

In his book, Harari describes gossipers as the journalists of ancient times. According to the theories described above, gossiping was an essential element in the development of human civilization (Harari, 2015). Today, journalists still fulfill their duty of informing humanity of the cheaters and liars of our society. As society becomes more and more datafied, journalists turn to data to find and tell our stories (Riche et al., 2018). Together with the new availability of visualization and publishing tools, this has led to a growing number of data-driven stories being published over the years. This undertaking is sometimes connected to aspirations toward "the democratization of data – the making of data understandable to the general public" (Riche et al., 2018, p. 3). It is therefore also in journalism that data visualization, as a narrative element, has made its biggest strides.

Research on narrative visualization rests on the shoulders of classic narrative art forms. These include literature, the performing arts, comics, radio drama, theatre, and cinema (Bach et al., 2018). Comic art, for example, uses sequencing and visualization to convey a story and research on structures in comics can therefore be used as a starting point for narrative visualization research (Kosara 2017; Amini et al. 2015). Classic journalistic writing structures such as the inverted pyramid are also being appropriated for the use in data journalism and examined critically by narrative visualization researchers (Kosara 2017, Segel and Heer 2010). Despite many parallels however, much of the knowledge on stories from other fields "is not very formalized or easily applicable to data" (Kosara 2017, para. 2; also Bach et al., 2018). This lack of applicability calls for a closer investigation of narrative visualization as a field in its own right.

Various methods have been proposed to classify different types of narrative visualizations. Segel and Heer, for example, draw a distinction between magazine style, annotated chart, partitioned poster, flow chart, comic strip, slide show, and video by looking at the number of visual scenes and analyzing the order of visual elements a visualization contains (2010).

These "genres", as they call them, can be regarded as basic components that can be combined "to produce more complex visual genres" (Segel & Heer 2010, p. 1145). Kosara and Mackinlay, on the other hand, look at the situation in which the visualization is presented to determine different types of narrative visualizations. They thus distinguish between "self-running presentations for a large audience", "live presentations", and "individual of small-group presentations" (2013, 45–46). News media pieces intended for a relatively large, anonymous audience are often "self-running presentations". The latter two categories describe a situation in which someone presents visualization to a (mostly) physically present audience. In another paper, Kosara describes yet a further way to classify types of narrative visualization: Looking at the type of argument at the start of a data story, he differentiates between narrative visualizations that provide proof, pose a question, or provide a long explanation as an entry to the story (2017). The typologies for narrative visualizations outlined by Kosara, Mackinlay, and Segel and Heer are far from exhaustive. There is still a need for further research to review, revise and ultimately formalize such genres. Nonetheless, the vocabulary and definitions they provide offer a steppingstone for new research and practical inquires.

Beyond typologies, we can consider various other aspects when it comes to analyzing and creating data stories. Hullman and Diakopoulos, for example, speak of four layers on which editorial decisions are made when creating narrative visualizations: data, visual representation, interactivity and textual annotation (2011). Bach et al. talk about narrative design patterns that serve to connect form and intent of a narrative visualization (2018). These patterns can be divided into argumentation, framing, empathy and emotion, and engagement. Argumentation, for example, includes comparing, concretizing, repeating elements in the data story. Segel and Heer also talk about visual structuring, highlighting, guiding transitions, ordering, interactivity, and messaging. While delving into all these patterns and techniques in detail would exceed the scope of this thesis, we can turn to two often mentioned topics that provide actionable input for the thesis project. These are narrative structure and – what I will term – identification.

Narrative Structure

Similar to narrative visualization genres, narrative structures too can be categorized by analyzing schemas, sequences and transitions. The narrative visualization genres and the different kinds of structures can be regarded as independent classifications; however, some structures are more suited for particular genres (Segel and Heer 2010). The most fundamental distinction to make in terms of structuring, is the difference between an open and a linear structure (Koponen & Hildén 2019). In a linear structure, the reader follows the content elements in the order intended by the author; an open structure, on the other hand, allows the reader to create their own reading sequence.

Segel and Herr claim that, while data stories can be organized sequentially, they offer new opportunities for alternative, non-linear ways of reading (2010). Consequently, they look at how narrative visualizations employ and combine open – or reader-driven – structures and linear – or author-driven – structures. In this regard, they distinguish between three prevalent schemes: The Martini Glass, the interactive slideshow and the drill-down story. In the Martini Glass structure, the reader is first guided through a predefined story sequence after which the structure allows the reader to explore the content by themselves. In the interactive slideshow, the author guides the reader through each slide, while leaving possibilities for the reader to explore the content on the slide by themselves. Finally, in the drill-down story, the reader is presented with the main topic and a selection of possibilities to explore on their own. Differentiating between these three different types of structures help place data stories on a continuum between author- and reader-driven elements. This, in turn, allows for a more conscious editorial decision as to how much engagement is expected from the side of the user.

Robert Kosara offers another interesting exploration into possible structures for narrative visualization. Instead of looking at structural elements that make the visualization more author-driven and/or more reader driven, he concentrates on the structure of the arguments that are laid out in a narrative visualization (2017). Reading prevalent news stories, he had observed how they often start with a question or a claim and then present fact after fact to support or refute this claim. He criticizes that these kind of news articles and visualizations do not have a story arch and therefore do not motivate the reader to finish the article. Therefore, he proposes an alternative structural model for data stories. This structure starts with a claim or a question. Then facts and evidence are presented and explained. A final conclusion links these facts back to the beginning claim or question. The pattern can be repeated in various ways to build a nested structure of claims and evidence.

Identification

Empathy is a concept that is often evoked when it comes to the broader aim of "making people care about a story". The general idea is that, if a story elicits empathy from the side of the reader, the content of the story will become more meaningful to them. This derivation, however, is not without problems. As Lisa Charlotte Rost pointed out in her talk at *Visualizing Knowledge 2019*, empathy does not necessarily mean that we care more about something or someone. In fact, studies show, that empathy for an individual decreases the more suffering we see.[24] Another premise of using the concept of empathy in data visualization, is that the reader remembers that there is a person behind every data point. Surely, we can feel some empathy towards human beings, however, there are many datasets that do not refer to a person directly but reference abstract measurements, systems or invisible phenomena.

Due to these problems, connecting the concept of storytelling with empathy is problematic. More fruitful is instead the idea that we construct identity through narrative. There are many ways we can help readers do so, and in practical applications of data visualization and information design, many different methods have been developed to engage the audience to allow them to identify with the story. In the talk metioned above, Rost provides different ways to categorize these techniques.

Rost makes a case for using both narratives and numbers – pathos and logos – in our data stories, but to use them at different moments of time in the process of audience engagement (2019). She proposes to elicit emotions to catch people's

24 Västfjäll, D., Slovic, P., & Mayorga, M. (2015). Pseudoinefficacy: negative feelings from children who cannot be helped reduce warm glow for children who can be helped. Frontiers in Psychology, 6. doi: 10.3389/fpsyg.2015.00616

attention. Once people are interested in a topic, it is crucial to provide more factual information, as well as options that can lead to further action. She then goes on to give a list of techniques that can be used to "speak emotions with data viz". On the visual side, she proposes to make use of color, as color has emotional and cultural connections. Size is another powerful visual means to elicit certain emotions. Finally, making use of pictographs that show a data point as what it references – a person – is another way to engage the audience on an emotional level. On the side of the data, she proposes to break the data down so that it shows what it means to a particular reader, to zoom in on one data point, or to show each data point instead of aggregating it into one number.

Nadja Popovich from The New York Times proposes a similar way of making data more human. In her work, Popovich visually translates climate change data for a broad, non-specialist audience. She focuses on making the often very global issues surrounding climate change more personal to the reader. To achieve this, she uses three different methods through which the reader can identify with a topic: *Geography*, *Demographics*, and *Engagement*. When *Geography* is used, readers are guided directly to their place of interest, either through their IP address or by entering their country or hometown into a search field. With the *Demographics* technique, readers can select the demographics to which they belong, after which they are presented with their demographic fit within the larger data set. Finally, through the *Engagement* technique, users are asked to actively participate in making the visualization. All techniques serve to humanize the data and lead the reader to a deeper understanding of the subject matter.

Government Reports as Narratives

Data-driven storytelling is no longer solely the domain of journalism. Narrative design patterns are used in presentations, business analytics – and in official statistics. Smith, for example, emphasizes how narrative elements help users "understand 'why' in addition to 'what'" (Smith, 2013, p. 178). And Ten Bosch and de Jonge stress the importance of using storytelling for both products that are meant to communicate

a message and more analytical visualization tools. The latter do not "relieve the NSI [national statistical institutes] from its duty to tell an important story with the data: just as newspapers filter and highlight the news, so NSIs should still highlight important statistical patterns themselves" (Ten Bosch & de Jonge, 2008, p. 106). Finally, the fact that one thematic session at the EU DataViz Conference in 2019 was dedicated to *Telling Stories* can also be seen as a manifestation that the concept of storytelling has slowly but surely found its way into the realms of statistical dissemination.

There is an inherent tension in the concept of using data in a narrative format; a tension that is heightened in the context of official statistics. Stories are traditionally individual and personal, while data generalizes and abstracts. As Drucker et al. explain: "The best of stories can reach a multitude through an individual, from the personal to the collective" (2018, p. 18). In government context, appearing objective and impartial is not just tied to journalistic aspirations. Striving to treat every citizen or every nation equally is a highly sensitive, political endeavour. Statistical impartiality is therefore a cornerstone in The European Statistics Code of Practice (Publications Office, 2018). Telling empathetic stories about an individual person within a data set therefore does not lie in the reach of statistical institutions.

Despite these limitations, narrative elements can still be used in government reports to give the user a sense of identification with a topic. This identification can take place on an editorial level by providing content and structures that allow people to find themselves in geographic, demographics, or through engaging elements that allow them to partake in the visualization. Identification can also be elicited through graphic means – color, size, and form. Emulating what a data variable references in the physical world – large, small, light, heavy, etc. – in graphic form also allows for an emotional identification with a topic. In addition, narrative design patterns can be applied to aid structure and flow regardless of the level of identification that is demanded from the audience.

3 DESIGN STUDY DOCUMENTATION

3.1 Overview

Knowing is not enough; we must apply. Willing is not enough; we must do.
	— **Johann Wolfgang von Goethe**

This chapter describes the practical application of the participatory information design approach and its methods – including the narrative design patterns – outlined in the previous chapter. The chapter is organized by the steps laid out in my process – *learn*, *organize*, *observe & explore*, *analyze & synthesize*, *prototype & evaluate*, *reflect*, and *write*. Following Zimmerman et al.'s call for an encompassing documentation of *research through design* projects (2007), I have attempted to describe the process in an amount of detail that should allow others to follow, evaluate and re-create it.

I worked on the whole design study for a little more than a year (Figure 18). Following the participatory information design approach, I gained extensive insights into how government publications are produced and used, and iteratively created a design proposal as a response to the challenges I had observed. The report *Key Data on Early Childhood Education and Care in Europe* (the *Key Data* report, for short) served as the main case study throughout the process. The report's data, visualizations, and texts were the starting point for my own inquiries and explorations, as were the target audiences[25] mentioned in the report – namely, policymakers (i.e., civil servants, see p. 102), researchers and parents (i.e., the broader public). Later in the process, I also added journalists to this main audience group.

In order to understand the needs of each audience group separately, I applied the information design process three times – once for each audience group (Figure 19). Each process cycle started with a collaborative workshop with representatives from one of the audience groups. The data from those workshops was then analyzed and synthesized, and these insights were translated into a design prototype. As the last step to one cycle, this prototype was discussed with the original workshop participants in a feedback session. Prototypes

25 The terms *audiences* and *users* are used interchangeably in this thesis to reference the people who use or might use government reports.

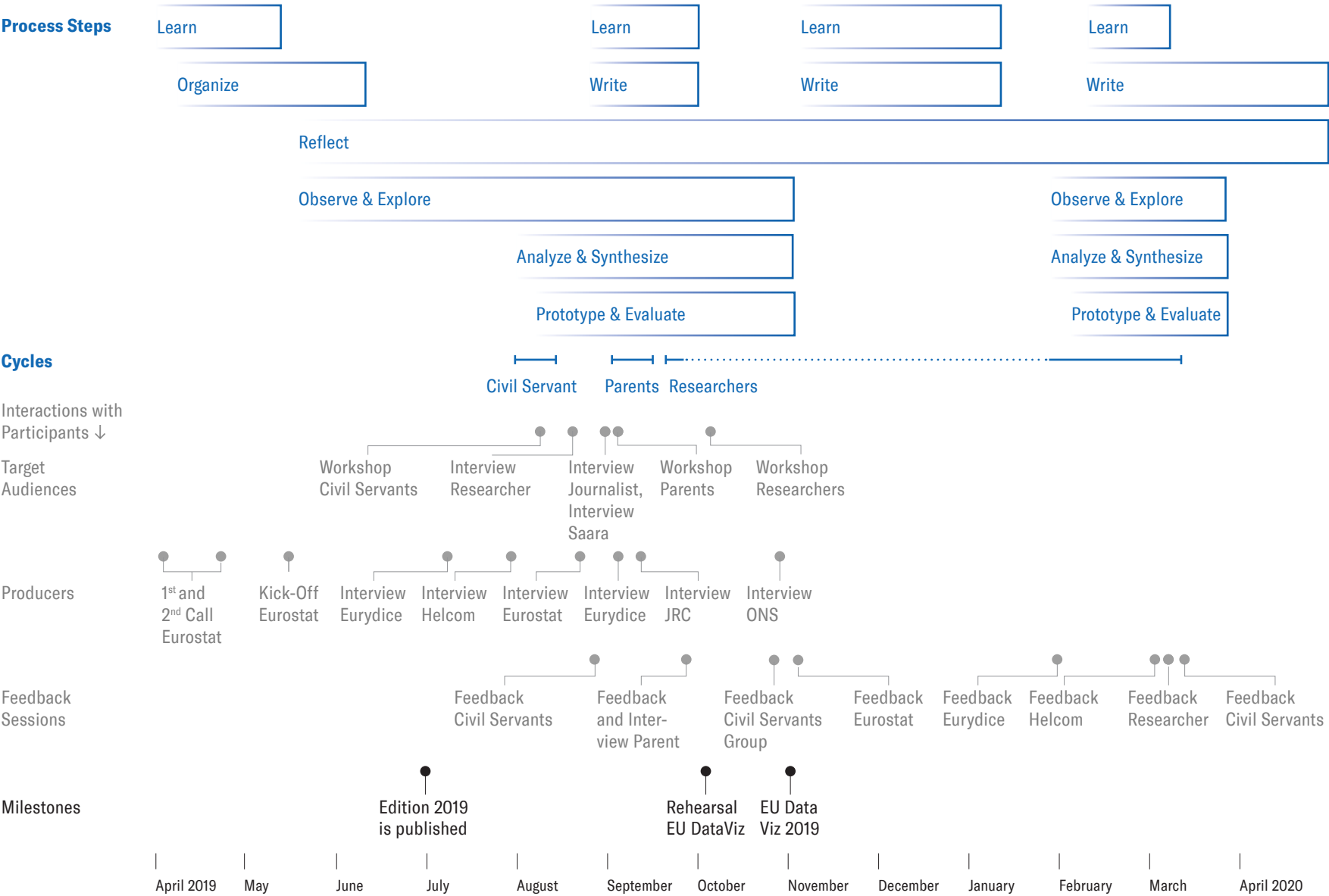were also developed for separate occasions, such as for feedback rounds with other stakeholders and for the EU DataViz 2019 conference. This event represented a special kind of feedback session as it that it gave me the opportunity to present my preliminary findings to an expert audience. Methods aimed at exploring and framing the problem space (benchmark analyses), understanding the content of the report (visual content analyses), and gaining insight into how such publications were produced (interviews) were applied alongside the three audience-focused cycles.

The entire core cycle was embedded in the *learn* and *organiz*e, and the *reflect* and *write* steps (Figure 19). These precondition and analysis phases placed the thesis into an academic context and allowed me to write the *Theoretical Background* chapter, as well as the *Reflection* and *Conclusion*.

The thesis process was anything but linear. Many steps would happen simultaneously or in such quick alternations that it is sometimes hard to identify when they took place and how they influenced each other. Especially, the activity of designing the prototypes was characterized by continuously shifting back and forth between analysis, synthesis, design, and reflection. While these smaller shifts would often occur within hours, larger modal shifts occurred between research-based and design-based activities. When I worked on writing the thesis and developing the design at the same time, I would separate the two activities, doing one in the morning and the other in the late afternoon. A big break in the design work after the EU DataViz conference (Figure 18) allowed me to concentrate fully on the writing of the thesis and return to the prototype with a fresh viewpoint.

The Design Study – Process Timeline

Process Steps

Learn Learn Learn Learn

Organize Write Write Write

Reflect

Observe & Explore Observe & Explore

Analyze & Synthesize Analyze & Synthesize

Prototype & Evaluate Prototype & Evaluate

Cycles

Civil Servant Parents Researchers

Interactions with
Participants ↓

Target
Audiences

Workshop
Civil Servants

Interview
Researcher

Interview
Journalist,
Interview
Saara

Workshop
Parents

Workshop
Researchers

Producers

1st and
2nd Call
Eurostat

Kick-Off
Eurostat

Interview
Eurydice

Interview
Helcom

Interview
Eurostat

Interview
Eurydice

Interview
JRC

Interview
ONS

Feedback
Sessions

Feedback
Civil Servants

Feedback
and Inter-
view Parent

Feedback
Civil Servants
Group

Feedback
Eurostat

Feedback
Eurydice

Feedback
Helcom

Feedback
Researcher

Feedback
Civil Servants

Milestones

Edition 2019
is published

Rehearsal
EU DataViz

EU Data
Viz 2019

April 2019 May June July August September October November December January February March April 2020

Figure 18. The steps, cycles, interviews, workshops, feedback sessions, and milestones of the participatory information design process.

The Design Study – Process, Methods, and Results

Phases

Basis

2. THEORETICAL BACKGROUND

Steps (chpt. #)

Read (described in 3.2, result in chpt. 2)

Organize (3.3)

Choice of Case Study, Set-up with Eurostat

Theoretical Background Chapter, Design Inspiration

3.4 Observe & Explore

Interviews, Benchmark Analyses, Visual Content Analyses, Surveys, Experience Maps, Collaborative Design Workshops

Research Data

Methods
Results

Sketching, Wireframes, Prototypes, Contextual Interviews, Feedback Sessions, Presentation

Design Proposals in the Form of Interactive, Visual Prototypes

3.6 Prototype & Evaluate

Core

Repeated in 3 Cycles

3. DESIGN STUDY DOCUMENTATION

3.5 Analyze & Synthezise

Qualitative Coding, Needfinding, Task Analysis, Visualization

Insights into Audience Roles, Tasks, Reading Behaviours, and Needs,

Documentation

the written thesis at hand

Write (3.8)

Reflect (described in 3.7, result in chpt. 4 & 5)

Reflections on the Prototypes, Discussion and Conclusion Chapters

4. DISCUSSION
5. CONCLUSION

Figure 19. The structure, methdos, and results of the participatory information design approach as applied in the design study project.

3.2 Learn

In the *learn* step, the researcher builds knowledge through the study of relevant information design literature (Sedlmair et al., 2012). In this thesis, the *learn* step was employed multiple times throughout the process (Figure 18): In the beginning, I used a first, broad literature review to gauge the feasibility of the thesis topic. Then, guided by what had become relevant in the design project, a narrower literature review was conducted during the mandatory *Academic Writing* course a few months later. After presenting my thesis at the EU DataViz conference in November 2019, I carried out an extensive literature review while I began to write the first draft of the thesis. A final litera-ture review accompanied the final writing phase in March and April 2020.

Reading and learning about relevant topics didn't just drive the writing phases. Instead, the papers and books I read would often directly influence my design work, opening up new pathways for discovery. Studies on narrative structure by the likes of Kosara (2013, 2017), Segel and Heer (2010), and Hullman (2011), for example, inspired different ways to struc-ture the content. Drucker's book *Graphesis* (2014) opened my eyes to a new way of considering data interfaces. And Kahn's blog post series on *Global Information Design* (2019) helped me understand information design beyond the confines of a west-ern, graphic design-oriented framework. Beyond inspirational inputs, books such as *Truthful Art* (2016) and *Functional Art* (2013) by Alberto Cairo, *Data Design* by Per Mollerup (2015), and the *Data Visualization Handbook* by Juuso Koponen and Jonatan Hildén (2019) were regularly consulted both for basic definitions in the theory part and to be able to name and understand what I was doing in the design project.

Figure 20.   Some of the books that were used extensively throughout the thesis.

3.3 Organize

In the *organize* step, the researcher lays the administrative groundwork for the thesis process. In this thesis, the *organize* step was directed towards finding a government organization that could provide a suitable case study in the form of a data-driven report. Through a previous project, I was already familiar with the report *Key Data on Early Childhood Education and Care in Europe* and knew that a new edition was going to be published in 2019 (*see 1. Introduction*). As I was very enthralled about the report's content, I decided to start looking for collaborators through this publication.

I first reached out to Eurydice, the main publishing unit of the 2014 report, to inquire about a possible collaboration. Although they responded, it seemed that their personnel resources were running low. Therefore, they could only offer to give me interviews. As the 2014 edition of the report had been a joint publication between Eurostat and Eurydice, I decided to also reach out to Eurostat. A person I know who works as an information designer in an EU Institution could direct me to Julia Urhausen, Julia Urhausen, who works as an *Information and Communication Officer* at Eurostat's *Dissemination and user support* unit. Luckily, she was very enthusiastic about providing support for the thesis in the form of interviews, meetings, and feedbacks.

In May 2019, I had multiple Skype calls with Julia Urhausen and Louise Corselli-Nordblad –team leader of *Statistics Explained* at Eurostat's *Dissemination and user support* unit. In these conversations, we defined a loose way of working together in which they would contribute insight and expertise from their vast experience in publishing and disseminating official statistics, and I would provide them with design insights and ideas from an outside perspective. Due to time limitations, it was not possible for me to work on an actual project at Eurostat that was going to be published. However, I decided to accept this limitation for the opportunity to work with a large institution with years of experience in publishing official statistics.

A further point of consideration was the choice of the case study. When the second edition of the report Key Data on Early Childhood Education and Care in Europe was published in June 2019, I realized that Eurostat was not officially named as a partner anymore, even though some of the data used in the report was still provided by them. At that point, I considered switching to a report that was created only by Eurostat. However, in the end, I felt that my interest in the topic of early childhood education and care and its relation to women's participation in the workforce would allow me to sustain my enthusiasm for the project over a longer period of time. In addition, the case studies proposed by Eurostat had either been published a few years ago or had already been produced in different formats for different audiences. The report *Key Data on Early Childhood Education and Care in Europe*, on the other hand, was based on relatively new data and published as a common PDF. As my Julia Urhausen and Louise Corselli-Nordblad also agreed with these arguments, I decided to stick with my original choice and work with the 2019 edition of the *Key Data* report.

3.4 Observe & Explore

The *observe & explore* step marks the beginning of the core phase of the study. It consists of learning about and discovering the design space in which the research project is situated. This step aims at collecting research material that can be used in the next part of the core phase – the *analyze & synthesize* step. To gather this research data, I applied a range of different qualitative methods. These included multiple benchmark analyses, contextual and classic interviews, collaborative workshops, surveys, and visual analyses. Devising and engaging in these activities allowed me to explore the problem space, learn from the producers of government reports, collaborate with the target audiences of the *Key Data* report – the civil servants, researchers, journalists, and parents – and arrive at an understanding of the report's content.

Exploring the Problem Space

The exploration of the problem space in this thesis occurred through conversations and the critical examination of existing solutions. Conversations included discussions with colleagues and semi-structured interviews with my advisors. At the very beginning of the research process, these exchanges yielded hunches about the users and the producers of government reports. Critical examinations, on the other hand, included a benchmark analysis of how different government bodies publish reports, as well as the collection of both problematic and outstanding examples of information design products from or for government bodies. Both of these examinations produced a clearer picture of the opportunities and challenges faced in the dissemination of government data.

Developing Hunches About the Users

My initial idea had been to create various formats of the same publication, each tailored to the needs of a specific group of people that uses government reports. However, the interviews with my advisors led me away from the notion that users could be categorized distinctly into different groups. Instead, I came to believe that users do not hold one static role

but inhabit a range of constantly changing needs and interests. For instance, a person might be a policymaker while also being a parent. They might be going through an intense period of change in their personal life but still have a keen interest in matters related to the European Union. The intricacy of these circumstances, and the fact that they can fluctuate and change, means that the kind of information a person finds useful or relevant can vary over time. This multiplicity stands in contrast to creating separate products that would inhibit people from seamlessly reaching information according to their current needs.

Through the interviews, I also realized that a report's figures – charts, diagrams, infographics – play a central role in reaching a diverse audience. This implies that, for one, the figures need to be designed in a way that makes them useful to experts and understandable to novices. For another, the multi-channel world in which communication takes place today means that the report's figures have to be repurposable for different media.

A further realization brought on through these initial conversations was that proposing a new report design would call for a diplomatic approach. A new report design would have to allow the expert users to continue their work with as little disruptions as possible, while also providing enough opportunities for new users to engage with the report.

The hunches I had about the report's target audiences made me curious about the nature of their needs and roles. It inspired me to go beyond conventional user-centered design methods, such as Personas and Usability Testing, and to engage with them in a collaborative manner. This process would entail working together with actual representatives of the target audiences to observe and record the variety of needs and tasks they have when using the *Key Data* report.

Developing Hunches About the Producers

In the public sector, various factors create an environment that is hard to challenge and even harder to change. The experiences my advisors shared with me shed a first light on the difficulties producers such as Eurostat and Eurydice might face when creating reports. These hurdles are heightened in

intergovernmental organizations such as the European Union, where a consensus has to be reached between multiple nations, and the political stakes involved in communication are high. Restricting factors might include: outdated style guides that are not suitable for data visualization; confined access to tools due to third-party contracts or security concerns; limited resources for communication both in terms of personnel and budget; an inability to react quickly to new media channels due to hierarchical approval structures; and an obligation to uphold the role of impartial providers of information. To some extent, information design lies at the other end of the spectrum. As an emerging field, it demands skills in a wide range of disciplines, flexible, interdisciplinary work across various areas of study; the capability to constantly adapt new tools and methods; and the capacity to explore arising possibilities.

According to my advisors, external information designers and information design consultants can support government organizations through various different kinds of project work. They can design and implement data-driven products for an organization; they can create guides or systems that enable government officials to create the products on their own; or they can educate government officials on methods and resources that also allow them to create products but also to work with designers more easily. All these services can be enhanced by taking into account the needs and organizational structures that are specific to the public sector. Methods from the field of journalism, for example, can inspire more user-friendly products but need to be appropriated accordingly.

In regards to journalism, it is interesting to consider the relationship between the media and the government. The question of where government communication ends and the work of the media begins was something I discussed with my advisors, and later with my contacts at Eurostat. Traditionally, statistical offices focus on producing and disseminating data, while the media takes on the role of communicating relevant statistical content to the public. However, dissemination efforts by statistical offices are often drowned out by the volatile nature of the news cycle, which leaves journalists with little time to engage with complex data sets. Furthermore, according to my advisor, traditionally educated journalists

often lack the skills to wrangle and process data into a news story. Some statistical offices have therefore begun to publish data stories that can either be used by journalists or consumed directly by the broad public.

Developing hunches on the producers allowed me to imagine different possibilities for how my research study could alleviate some of the challenges they face. It is through these reflections that I decided to focus the theory part of this thesis on what information design is and how it can contribute to the development of data-driven government products. The reflections on the intersection of journalism and government communication laid a focus on the application of narrative patterns for information design products.

Getting an Impression of How Government Reports Are Published Online

Another way I explored the problem space was by analyzing how government reports are being published by seven (7) intragovernmental organizations and three (3) national statistical offices. Through online research, I examined the products they offer on their websites, their publications, how those publications are organized, and their social media accounts.

This benchmark analysis was done solely on the basis of looking at information published online and was not verified with each organization. Despite being rather superficial, the examination offered a first overview of approaches to publishing statistical insight on the web. A detailed description of the analysis can be found in *Annex A*.

Making Critical Observations

Beyond systematically analyzing how reports are published, I also collected various examples of controversial, data-based visualizations from governments. While there are surely many examples of the kind of misrepresentation that leads to a false interpretation of the data, these examples focus on visual and aesthetic issues that are addressed more seldomly in information design literature. A selection of these examples is shown in Figure 21 to Figure 26. Each example illustrates a different category of issues that I have observed:
- unsuited figurative representations when it comes to the visualization of sensitive topics (Figure 21);
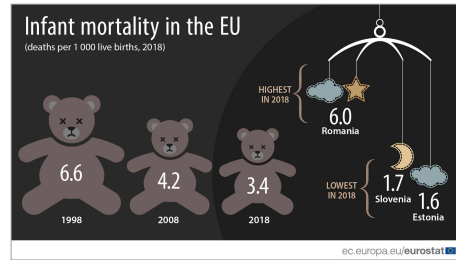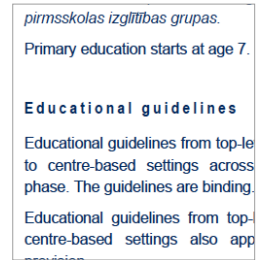
Figure 21. Infant Mortality (Eurostat, 2020).

Figure 22. Detail of *Key Data* report (Eurydice, 2019).

Figure 23. Detail of the infographic for the *Key Data* report (Eurydice, 2020).
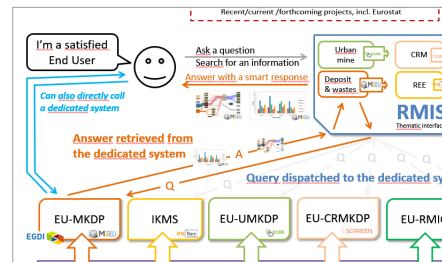

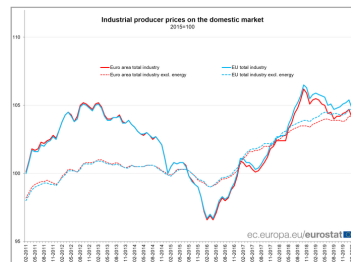**Figure 24.** Detail from a figure in the *Raw Material Information System* report (JRC, 2019)

Figure 25. Industrial producer prices on the domestic market (Eurostat, 2020).
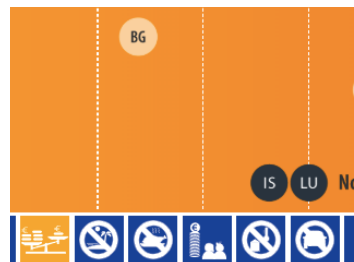

Figure 26. Detail from an interactive visualization (Eurostat, 2020)

–   typesetting that uses typographic features ways that make text harder to read (Figure 22).
–   the reinforcement of stereotypes through images (Figure 23);
–   insufficient (visual) content editing (Figure 24);
–   the missed opportunity to use simple graphs as an extension of visual identity and to extend these graphs with highlights and explanations (Figure 25);
–   user interface elements that are hard to understand as they use intricate illustrations as icons (Figure 26);

Because of the abundance of infographics and data visualizations that are published today, I confined the examples I show here to visualizations created by EU bodies. It is essential to point out that the examples illustrate typical problems and are not emblematic of these specific organizations.

Identifying Recent Inspiring Examples

In contrast to the two previous exercises aimed at identifying common problems, this exercise looks at examples of government reports and portals that stand out both for their visual and for their functional virtuosity. Most examples I found focused on the communication of data in a government context. Except for a few print examples, they were all digital, online products. To provide some context, I described and coded each example. The first set of codes describes the way the product can be updated and reused over time: some products are one-off solutions and cannot be updated, some products are one-off solutions but can be updated continuously, and some products constitute a system that allows multiple instances of the product to be created. The other set of tags describes if the website *is* the report, if it serves as an entry point to a collection of reports, if the website is a data exploration tool, or if the product is a print product. The complete collection of coded examples can be found in *Annex B*. A selection of examples is shown here in Figure 27 – Figure 29.

The collection of examples grew throughout this research study. The examples helped me identify gaps in the range of available design solutions that could be addressed in my thesis and acted as inspirations to my design process.

Learning from the Producers

In this thesis, it was important to me to first learn from other people's expertise in producing data-driven government reports before proposing my own solutions. This undertaking began with a kick-off meeting with Julia Urhausen and Louise Corselli-Nordblad from the *Dissemination and user support unit* at *Eurostat*. A few months after this meeting, I also got the chance to interview Louise on her experiences as the head of the *Statistics Explained* portal. I also interviewed the following people: the head of communications and a data analyst at *Eurydice*; a scientist and the communications secretary at *HELCOM*; a data visualization specialist at the *Office for National Statistics* in the UK; and a scientific officer at the *Joint Research Centre* of the European Union. All of these organizations produce data and publish reports that have to reach a broad, diverse audience.

The kick-off session with Eurostat took place in Luxembourg in May 2019. It consisted of an interview with Julia and two small exercises I had prepared. The first exercise was designed to help me understand the range of statistical products that Eurostat produces and maintains. Together with Julia, we assigned Eurostat's various products to the users that would most likely use them. The second exercise was focused on gaining some insight into the production workflow that is used to create Eurostat reports. For this, Julia and Louise talked about their process while I visualized it on a large piece of paper. The summary from this session can be found in *Annex C*.

All interviews I did with the producers were semi-structured and covered the following topics: the organization's mandate; workflows that are used to produce the report; roles and tasks in these workflows; the way these organizations engage with their target audiences; and challenges they face in the communication of their data. The interviews were recorded and later transcribed. These transcriptions, as well as the material from the kick-off session are summarized and analyzed in the *analyze and synthesize* step.

Figure 27. The Planning the Bothnian Sea report (Helcom, 2013, photo by Besserwisser)
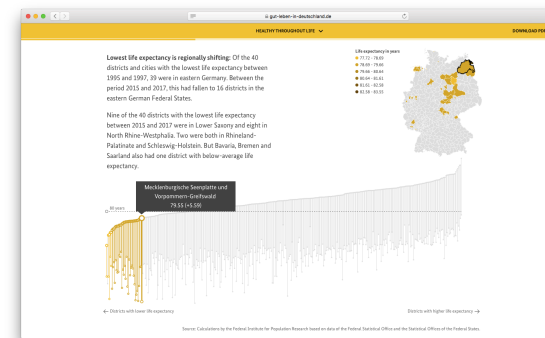
Figure 28. Screenshot of *Wellbeing in Germany* website (Federal Government, 2016).
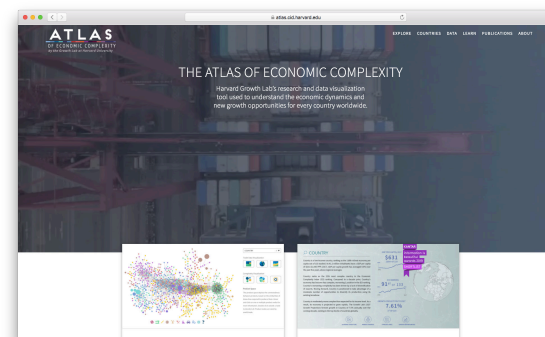
Figure 29. Screenshot of the *Atlas of Economic Complexity* (Harvard, 2018).
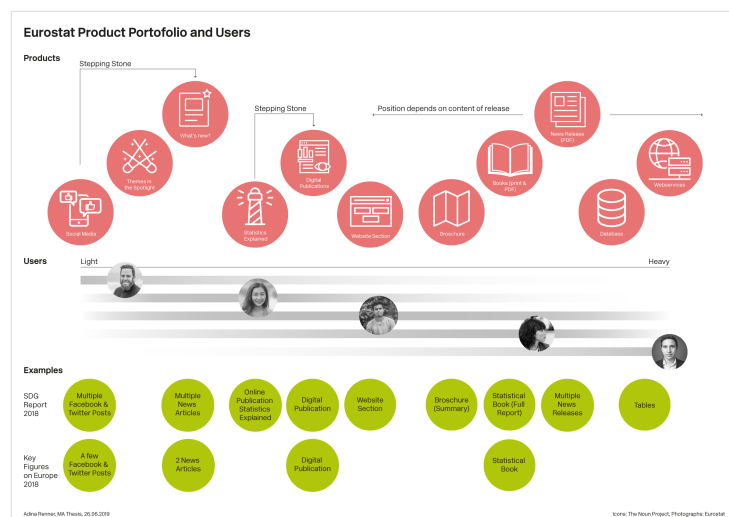
Figure 30.　Eurostat's product portfolio. The pink circles are different product types, the green circles represent examples of these product types. The photos of peope are taken from the Personas that Eurostat uses. They are ordered from light to heavy users and the product types are assigned to them.
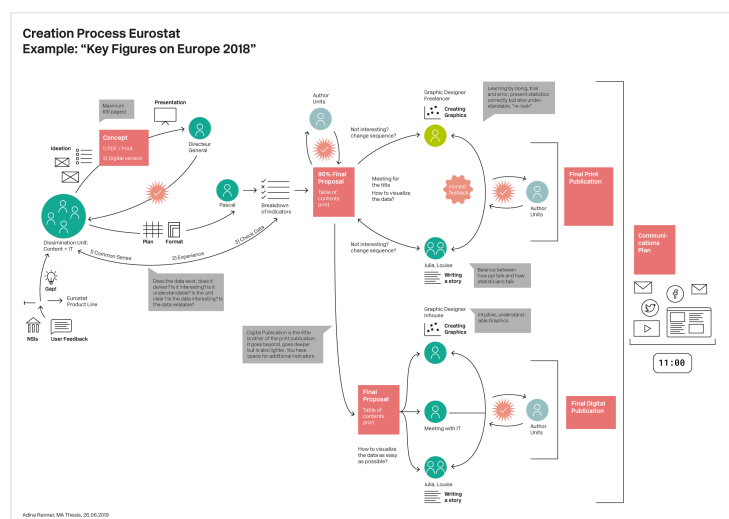
Figure 31.　Eurostat's workflow that used to create the both the digital and the print version of the report *Key Figures on Europe 2019.*

Collaborating with the Audiences

As this thesis focuses on developing a solution for the various needs of a report's target audiences, this step is one of the central pieces of the process. It consisted of exploring how the report is used by the alleged target audience – researchers, policymakers, parents, and journalists. To understand their needs, I conducted surveys and collaborative workshops with one to two representatives from each audience group. Additional interviews with further audience representatives complemented the workshops.

The following sections describe how I found and organized the study participation, the survey, the workshops and workshop activities, and the learnings from these workshops.

Considerations in Organizing Study Participants

Mindful of the limited time at my disposal and anticipating the organizational efforts that go into finding study participants, I limited myself to finding two representatives from each target audience. I focused on finding the people for whom this report would be relevant rather than finding a higher number of more-or-less fitting candidates. I also decided that these representatives should live in Finland. For one, this decision was a practical one: It allowed me to conduct in-person workshops and to interpret the findings in the context of a shared, national reality. For another, this decision was based on the fact that Finland is a very advanced country when it comes to digital transformation in government institutions[26] and to early childhood education and care policies (as indicated in the *Key Data* report). The goal of this thesis is to explore new solutions for the future format of reports, rather than find solutions that deal with the larger question of digital transformation that many institutions face. Therefore, I felt that setting the entire research in Finland would be more likely to inspire new formats and ideas. Last but not least, the thesis topic presented me with the opportunity to learn more about the country that had been such a good host to me during my studies at Aalto University.

26　For example, the share of individuals using the Internet to interact with public authorities lies at 78.3% in Finland (goingdigital.oecd. org/en/indicator/23).

Finding Study Participants

As anticipated, finding suitable and available participants was a time-consuming effort. As a first step towards identifying potential participants, I researched each audience group and wrote a short profile piece about them. Through this research it became clear that within the *policymakers*[27] audience group, it is the civil servants who use the *Key Data* report most actively – at least in Finland. In this thesis, the term *civil servant* is used interchangeably with the term *policymaker*.

After my research, I tried to find individual people who could act as representatives to those audience groups. This was done through online research and by reaching out to friends that could spread the word. After I had identified different individuals, I would usually send them an email with a call for participation and a participant information sheet (Figure 32).

All in all, I sent out about forty emails to potential participants, each tailored to a specific person and audience group. To make sure that I was reaching out to the right people, I would ask the researchers and civil servants if they work with the report and the journalists if they write about education- or data-related topics. The representatives of the "parents" audience group were asked if they are interested in childcare-related topics. Beyond that, the criteria for participation were that the person had time for both a short, twenty-minute survey and a two-and-half-hour workshop. Participants were also encouraged to participate in feedback sessions after the workshop.

As civil servants in Finland publish their phone numbers and email addresses online, it was easy to contact them. They were also the most willing to participate, seemingly because the report represented an essential tool in their job. For them it was also possible to participate during their work hours. The researchers and journalists were the hardest participants to find. I reached out to all universities in Finland that offer an education in early childhood education and care as well as to all national media outlets. Researchers generally seemed less available due to limited resources.

The considerable time investment a participation would entail also deterred journalists. People in the "parents"

27 *Policymaker* is often used as an umbrella term for anyone that is involved in defining policies. This can include policy advisors, civil servants, members of parliament and other decision-makers working in national and local government.
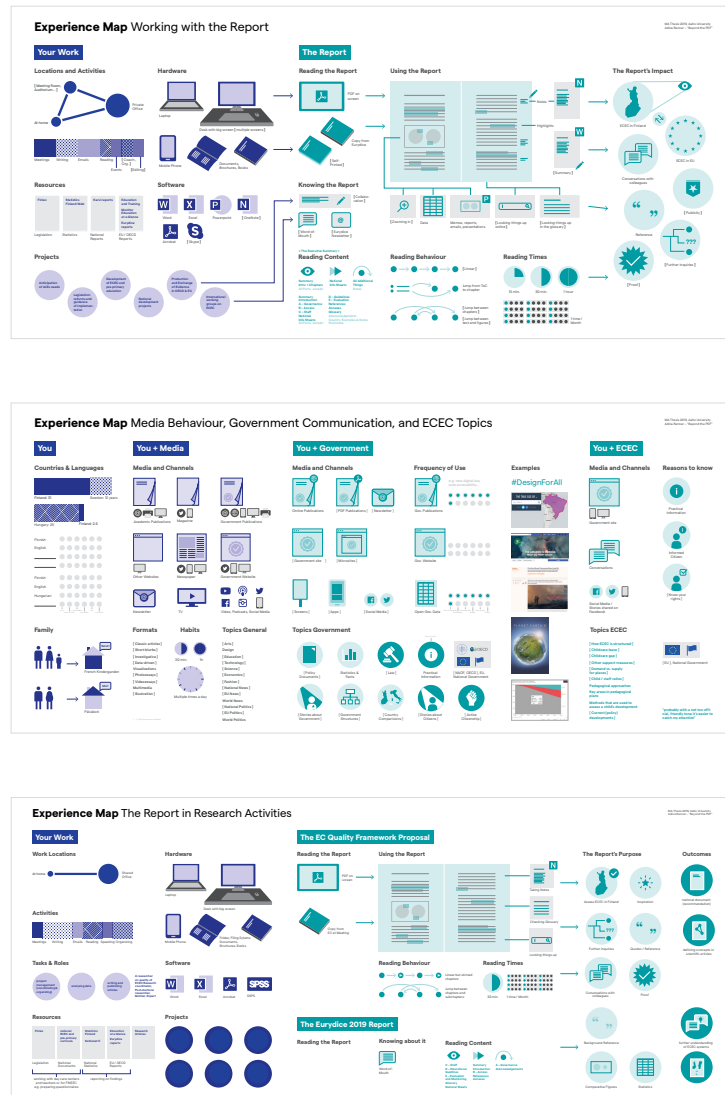

Figure 32. *Call for Participants*. Information Sheet I created to find study participants.
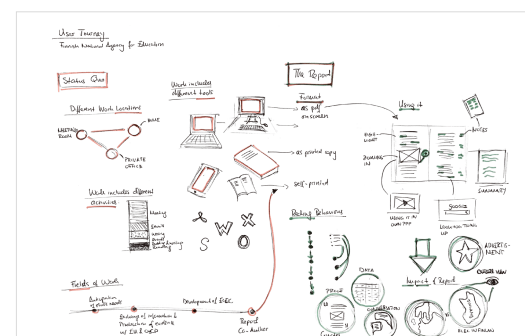
Figure 33. A first sketch of the civil servants' *Experience Map*.

Figure 34. A sketch of the workshop structure.

Figure 35. Final Experience Map for the workshops with the civil servants (top), the parents (middle), and the researchers (bottom).

audience group were usually enthusiastic about the topic, but it proved hard to find people who would commit to the study. If the time that was required for the survey and the workshop was out of question, I would offer a simple one-hour interview. Although the process was very time-intensive, it allowed me to find participants who were enthusiastic and committed to the project. In the end, the following people participated:

In the survey and workshops:
– A civil servant from the national agency of education
– A civil servant from the ministry of education and culture
– A post-doc researcher in early childhood education and care from a Finnish University
– A Finnish parent with an 8-year old child
– A Hungarian parent-to-be who has been living in Finland for a few years

In the interviews:
– A journalist from a national, Finnish newspaper
– A former kindergarten teacher
– A post-doc researcher in early childhood education and care from another Finnish University
– A Finnish policy advisor who works for the European Parliament in Brussels and is also a parent to a newborn.

The participants were between 27 and 59 years old. Of the nine participants, only one was a man, and all except one were of Finnish nationality.

The Surveys

About a week before the workshop, each participant was asked to fill out a 20-minute survey. The survey was aimed at helping me gain a general understanding of how the workshop participants use the report. Part one of the survey asked them about their personal life and their work and work environment. Part two contained questions about how they had used the 2014 edition of the report *Key Data on Early Childhood Education and Care* and how they were planning to use the 2019 edition. The survey purposefully avoided questions that asked them to make a judgment call on the report and was

designed to reflect the "is-situation". Although the structure was the same in all surveys, I tailored each survey to the audience group's specific characteristics. As an example, the civil servant's survey can be reviewed in *Annex D*.

Once the participants had answered the questions, I visualized and printed their answers on a two-and-a-half-by-one-meter piece of paper (Figure 33 & Figure 35). The visualization was a kind of *Experience Map*[28] that showed how the report was used by each audience group.

The Collaborative Workshops

The aim of the workshop was to help me understand in as much depth as possible how the report is being used. Each workshop followed the same structure but was flexible enough to accommodate the specific research needs I had at the time. I also adapted the workshop activities to the participants' experience with the report: While researchers and civil servants use the report as a work tool, regular citizens, although officially one of the target audiences, might have never heard about it. This called for different approaches in the workshops.

I devised the workshop activities after the co-creation framework by Liz Sanders. As Sanders explains, "the point of the framework is that you are iteratively making and enacting and telling and that the participatory activity is a practice" (2012). Furthermore, workshop activities should be successively linked to the past, the present, and the future, allowing participants to recall situations, reflect on challenges, and then come up with possible solutions (Figure 34). Following this framework, I worked out the three following activities:

1. "You Be Me" (enacting the past)

For this activity, I asked one of the participants to be the "director" while I was the "actor". A second participant played the "script supervisor". The director would direct me to play him or her, while the script supervisor would make amendments to our "script" – the large plot showing the survey answers. In the workshop with the researchers and civil servants, we enacted scenarios in which they were reading and using the report. In the workshop with the parents, we reenacted scenarios in which they had shared something that had moved them on social media (Figure 38 & Figure 39).

28 An experience map "focuses on a general high level understanding of human behavior" (Morales, 2020). It looks at the users' experiences without focusing on a specific design solution.

Figure 36.   I on my way to one of the workshops.

Figure 37.   My workshop material.

2. "From Journey to Experience" (narrating the present)
In this activity, I asked participants to add their "experiences" to the Experience Map. Because the visualization I had made was still a more factual representation of the as-is state, the idea of this exercise was to turn this representation into an actual experience map that included emotional aspects. The participants first wrote down challenging and frustrating but also pleasant and helpful elements of the report on sticky notes. Then, we stood around the plot and added the sticky notes to the specific place in the visualization that showed the situation in which these emotions surfaced (Figure 40).

"Data Detectives" (alternative activity)
For the parents, exercise two was a little different: I had asked them in the survey which topics from the report might interest them. I then brought printouts of the charts from those topics to the workshop and asked them to discuss what they saw and what struck them as interesting or odd (Figure 42).

3. "Make and Tell" (making for the future)
For the final activity, I asked participants to sketch out a solution to their needs on a piece of paper. The civil servants were asked to choose the most annoying or frustrating aspect of using the report and make a little sketch of what a report could look like that solved that challenge. The parents were asked to choose one of the graphs we had looked at and imagine how such a topic might appear in their social media feed. Due to time reasons, I didn't do this exercise in the workshop with the researcher (Figure 43).

My Network (additional activity)
With the civil servants and the researchers, I also did an additional activity: To allow me to understand the professional network in which the report was used, I asked them to draw a network of the stakeholders with whom they interact. To facilitate this exercise, I provided sticky notes with the names of various possible stakeholders. I then asked them to organize the post-its as a network diagram on a whiteboard. Together, we would detail the relationships between the civil servant or the researcher and the stakeholders through connecting lines and additional notes (Figure 44). In a second step, we discussed if and how the report was used in each relationship.
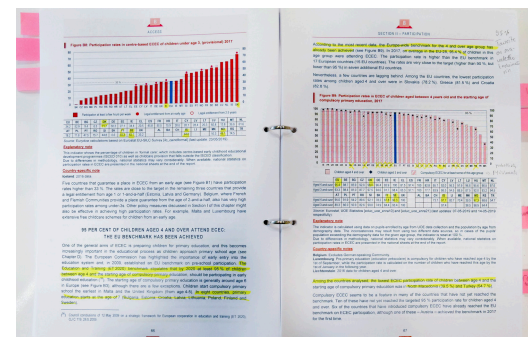
Figure 38. A civil servant's personal report copy that as used as a prop in the *You Be Me* activity.
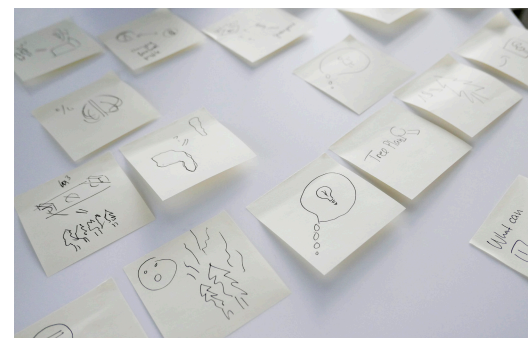
Figure 39. Notes made by the "script supervisor" in the workshop with the parents.
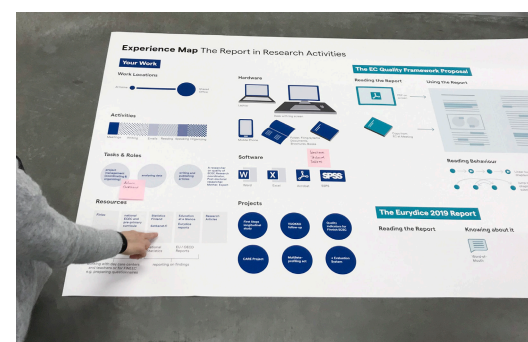
Figure 40. Talking with one of the researchers about frustrating and joyous experiences with the help of the experience map.

Learnings from the Collaborative Workshops

Of the three activities, "You be me" was the most successful one. Participants would forget themselves and delve into descriptions of how use the report. The activity often revealed rich details about situations, behaviors, and feelings that did not become apparent in the survey. It also provoked a lot of laughter because my acting skills are quite limited.

The printed *Experience Map* formed another excellent basis for the workshop. Because it already established a factual foundation on how the participants used the report, it allowed us to concentrate on the more emotional side of using the report – the challenges, frustrations, and joys. The plot also served another unexpected purpose: It established that I was a professional designer and that I was motivated to truly engage with the participants.

The "Make and Tell" activity was probably the most challenging one. Participants often felt slightly overwhelmed by the idea that they would have to produce something themselves. Clearer instructions and a larger workshop group would have probably allowed people to feel more at ease with having to create something on the spot. "My network" was maybe the most interesting activity for the participants themselves, as it allowed them to reflect on the vast network of people with whom they collaborate.

The Interviews

The interviews were semi-structured and lasted for about one hour. The list of questions was more or less the same for all interviews. I asked the interviewees about their background, about how they use the report, how they use the data and the visualizations from the report, and which challenges they encounter when using the report.

Some of the interviewees also filled out the same survey I had sent to the workshop participants. In that case, I would go through the topics of the survey and verify the information they had provided. The interviews offered an additional perspective on the information I had retrieved in the workshops.

Figure 42.   The participants in the parents' workshop talking about one of the charts from the report.

Figure 43.   A participant in the parent-workshop creating a visualization that they would like to encounter on social media.
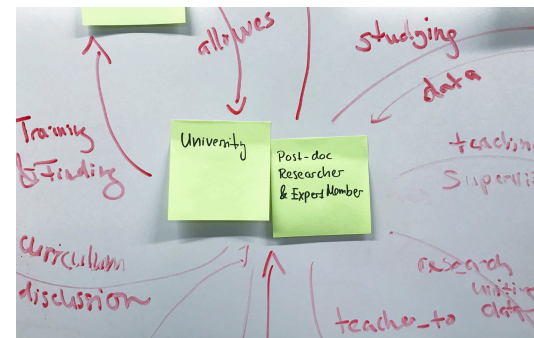
Figure 44.   A detail of the network of people the researcher works with.

Understanding the Subject Matter

In this thesis, it was important to become familiar with both the content and the design and structure of the report. Similar to when I explored the problem space, I employed a variety of different research methods ranging from evaluative methods to visual content analyses. These activities took place mainly at the beginning of the study process.

The first two sections in this subchapter describe the policy context of the report and the 2019 edition in detail. The subsequent sections describe the methods that I used to analyze the content design, the visual design, and the structure of the report.

Understanding the policy context

Policies that enhance the quality of early childhood education and care have become a growing priority across the European Union (EU) as high quality early education is seen as a means to level the playing field for socio-economic disadvantages as well as for equal participation of men and women in the labor market. In 2002, for example, the Presidency Conclusion of the *Barcelona Summit* asked EU member states to:

remove disincentives to female labour force participation and strive, taking into account the demand for childcare facilities and in line with national patterns of provision, to provide childcare by 2010 to at least 90% of children between 3 years old and the mandatory school age and at least 33% of children under 3 years of age. (Council of the European Union, 2002)

In 2006, the European Commission adopted the communication *Efficiency and Equity in European Education and Training Systems*, which points out that "high-quality pre-primary education has long-lasting benefits in terms of achievement and socialisation" (European Commission, 2006). The first Eurydice report on early childhood education and care was created as a follow-up to this communication. (European Commission/EACEA/Eurydice, 2009). In the same year of the report's publication, the *strategic framework for European cooperation in education and training* (ET2020) stated that

lifelong learning covers all learning contexts at all levels and raised the participation benchmark for children over four to 95% (Council of the European Union, 2009).

In 2011, the European Commission issued the communication *Early Childhood Education and Care: Providing all our children with the best start for the world of tomorrow*, which provides the basis for a European agenda for early childhood education and care (European Commission, 2011). Five years after the first Eurydice report on the topic, Eurydice created the first of the *Key Data* reports (European Commission/ EACEA/Eurydice/Eurostat, 2014). Shortly after, the European Commission published the *Proposal for Key Principles of a Quality Framework for Early Childhood Education and Care* (European Commission, 2014) and in 2017, the *European Pillars of Social Rights* listed early childhood education and care as one of its core principles (European Union). Finally, in May 2019, EU member states adopted a council recommendation that endorses the 2014 *Quality Framework Proposal* (Council of the European Union, 2019).
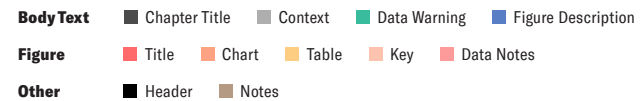
The 2019 Report

The 2019 edition of the report *Key Data on Early Childhood Education and Care in Europe* was published in July 2019, a few months into my master's thesis (Figure 47). While the 2014 edition had looked at 61 indicators across 37 different education systems, the 2019 edition compares 46 national systems across 5 key areas. The 2019 edition organizes the indicators into 5 key areas – access; staff; curriculum; monitoring and evaluation; as well as governance and funding. These areas are aligned with the dimensions that define quality in early childhood education and care as outlined in *Proposal for Key Principles of a Quality Framework for Early Childhood Education and Care* published by the Directorate-General for Education and Culture of the European Union in 2014. Next to five main chapters, the 2019 report contains an executive summary, a glossary, contact information for each national unit, and national sheets that describe each unit's early childhood education and care system. The summary is also published as a slightly modified, separate brief. Furthermore, a sheet with infographics that summarizes the main findings of the report is also available.
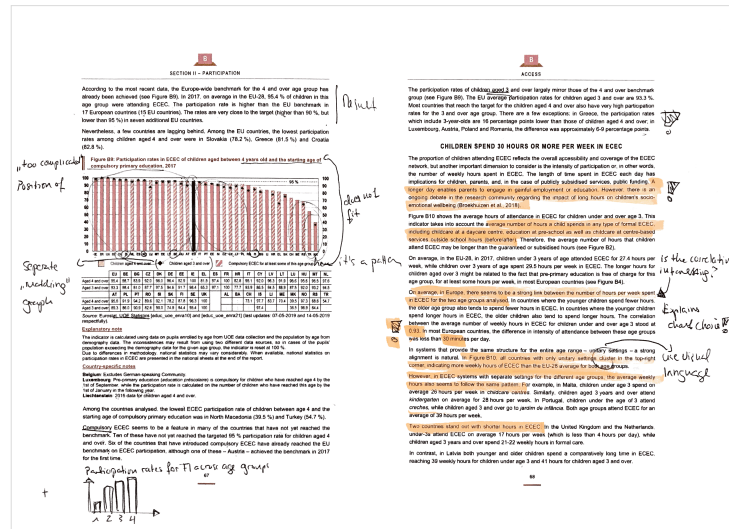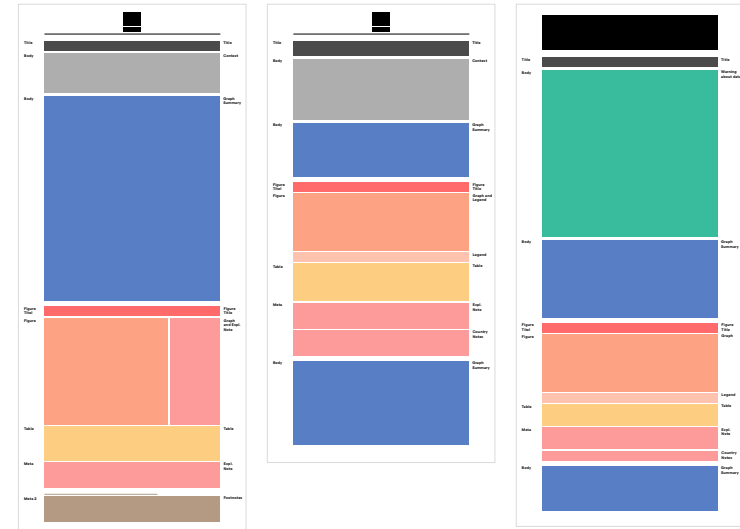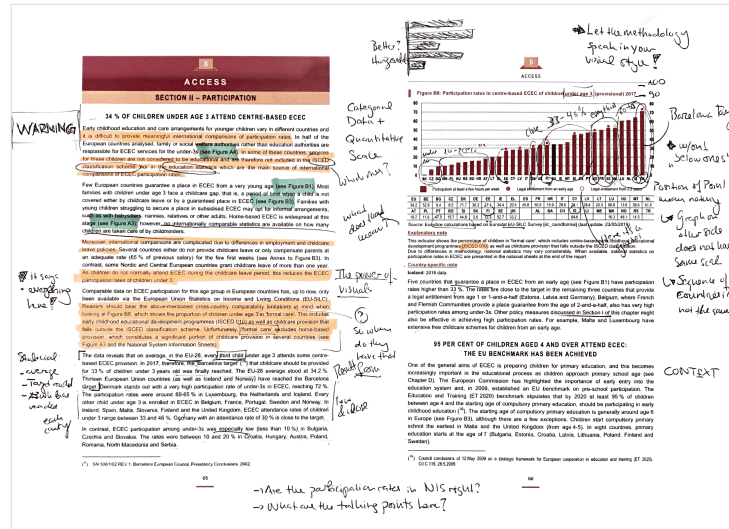
Figure 45. Two pages of the report with my notes.

Figure 46. Three sections of the report with each section categorized by content type.

Besides the topics of the chapters, the target audiences mentioned in the report also shift from the 2014 to the 2019 edition: While the 2014 edition targets teachers, journalists, researchers and parents, the 2019 report targets policymakers, researchers and parents as the audiences of the report.

Reading the Report

In order to properly understand the content, I rigorously read the report multiple times (Figure 45). I read it printed out on paper at 50% size. As I have very good eyes, this helped me understand where a person with weaker eyesight might struggle to read the text. While reading, I would note down any emotional reactions to the text and to the figures that showed the data, for example if something felt frustratingly complex or if something sparked joy or interest. I would also make notes to summarize paragraphs in my own words. Finally, if the graph was based on Eurostat data, I would look at the metadata online to understand the limitations of the data set.

Analyzing the Content Structure

In order to put the structure and content of the *Key Data* report in context, I selected some reports from the organizations I had analyzed in *3.4 Observe & Explore* and compared their table of contents (Figure 48). I paid attention to including both reports that were more technical and reports that seemed to have been created with a broader audience in mind.

From this exercise I could judge more clearly what kind of content is the same to all reports and would therefore be useful to include in a solution that might also work for other reports.

Analyzing the Content Types

To understand what kind of content the report contained, I created a typology of different content types and applied these categories to paragraphs on selected pages of the report (Figure 46). This helped me gain an understanding of the amount of text and space that was used for each different content types.

Figure 47. Selected pages from the PDF of Eurydice's 2019 *Key Data* report.

Table of Content Comparison between different reports

– does not apply   ■ yes   ■ no

	Publication Name	Imprint	Abstract	Acks.	ToC	Figures Codes, Abbr.	Fore-word / Editorial	Syn-opsis, Summary	Intro-duction	Main Content	Conclu-sion	Refer-ences	Glossary	Annex / Country Sheets	Contacts
Eurydice	Key Data Report 2019	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes
	Key Data Report 2014	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes
	Digital Education at School in Europe	yes	no	yes	no	yes	no	yes	yes	yes	no	yes	yes	yes	yes
	Mobility Scoreboard	yes	no	yes	yes	no	no	no	yes	yes	yes	yes	no	no	no
	Structural Indicators for Monitoring Education…	yes	no	no	yes	yes	no	no	yes	yes	no	no	no	no	no
	Compulsory Education in Europe	yes	no	yes	no	no	no	no	no	yes	no	no	no	no	yes
	The Teaching of Regional or Minority Languages…	yes	no	yes	yes	no	no	no	yes	yes	no	yes	no	no	yes
Eurostat	Living Conditions in Europe	yes	yes	no	yes	no	no	no	yes	yes	no	yes	no	yes	no
	Sustainable development in the European Union	yes	no	yes	yes	no	yes	yes	yes	yes	no	no	no	yes	no
	Agriculture, forestry and fishery statistics	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes
	Aeging in Europe	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	no
	Eurostatistics – 01/2020	yes	no	no	yes	yes	no	yes	no	yes	no	no	no	yes	no
Helcom	Planning the Bothnian Sea	yes	no	yes	yes	no	no	no	yes	yes	no	no	no	yes	no
	State of the Baltic Sea	yes	no	no	no	no	yes	no	no	yes	no	yes	no	no	no
	Maritime Activities in the Baltic Sea	no	no	no	yes	no	yes	no	yes	yes	no	no	no	yes	no
OECD	Starting Strong IV	yes	no	no	yes	yes	yes	yes	no	yes	no	yes	no	no	no

Figure 48.   A spread of the report with the categorized paragraphs.

3.5 Analyze & Synthesize

The previous *observe & explore* step is sometimes described as a diverging activity. It opens up possibilities and is aimed at collecting a rich assortment of research materials. In the *analyze & synthesize* step, the research activities are convergent. The objective of this step is to synthesize the material collected in the previous step into a consolidated input for the next step of the core phase – the *prototype & evaluate* step. For the *analyze & synthesize* step, I employed visual content analysis and visualization to analyze and interpret the collection of examples, interviews, workshops. The result of these activities is a problem statement, the visualization of workflows used by the producers, the visualization of audience needs, roles, tasks, and behaviors, and a summary of what I learned from the subject matter analysis.

Problem Statement

The following problem statement was derived from hunches on the producers and users, the benchmark analysis of how government bodies publish reports, the collection of problematic government visualizations and the analysis of inspiring examples. It summarizes the main issues discovered through this process and concludes with a statement of the objectives of this design research study.

Government reports combine text and visualization to provide context that helps the reader interpret official data, offering an ideal way for governments to communicate data to both experts and the broad public. Despite this potential, government publications are often hard to access and use. Multiple factors can contribute to this issue: for one, the website on which these reports are published might be hard to navigate. They might use an ambiguous information architecture that makes the reports hard to find or they might organize the reports by a typology that follows an inconsistent logic.

Only two (2) of the analyzed organizations explained the typology they are using and all except one (1) had a typology that resulted in a confusing organization of the reports. For another, reports are mostly published as PDFs – a format that was originally developed to allow people to convert a printed document into an electronic document and share it with others independent of software, hardware, or operating system[29]. From the ten (10) organizations I looked at, only three (3) regularly publish reports in the form of a website and only one (1) of those organizations, the Office for National Statistics (ONS) UK, consistently uses native web technologies to publish their reports. Apart from an executive summary, organizations usually provide only the full version of the report. Generally speaking, this version is directed more towards expert audiences than towards the broader public. The organizations that publish reports using web-formats tend to create different versions of a report for different audiences. Even if multiple different report versions are published, however, they can end up in silos that make it hard for audiences to progress from one version to the next.

Looking at the types of visualizations and the visual language that is used by government organizations to communicate data, we can observe a gap between the highly illustrative infographics and common chart formats that are published. The infographics are not very dense in information content. They might seem more approachable but run the risk of distorting the data through the use of figurative shapes. They might also lack an awareness to the impact of visual depictions and metaphors. This can result in visualizations that cause emotional distress, propel stereotypes or spread false information. Charts, on the other hand, are often presented with minimal style and explanation. They often lack annotations that would explain the data and fail to communicate the organization's brand through visual cues such as typography, color, and the style of the graphic elements that make up a chart.

All this is not to say that there are no well-design infographics and highly informative charts produced by government organizations. Nonetheless, there seems to be potential to use the possibilities of design and visual language more

29 See acrobat.adobe.com/mena/en/acrobat/about-adobe-pdf.html

extensively and more consciously to produce charts that are engaging both on a content and an aesthetic level.

Looking at inspiring examples we can discern that there are only very view instances in which the product is a sustainable system that can be used for multiple reports. It is much more common that government organizations choose a particular report that they deem interesting to a larger audience and that this report is then published as a highly customized design product.

In summary, we can identify four interconnected problems: For one, the online access to the reports is impeded by websites that are difficult to navigate. Secondly, many government organizations seem not to have made the transition from printed to web-based reports. Instead, they are stuck in limbo with a format – the PDF – that emulates the characteristics of a printed document. Thirdly, there is relatively little experimentation in terms of trying to create reports that cater to audiences with different needs. Finally, there seems to be a potential for more awareness as to how different visualization types and styles can be properly used to communicate a range of different topics – from abstract concepts such as GDP per Capita to more immediate statistics about child mortality – to different kinds of audiences.

The design project in the core phase of this study addresses three of the problems outlined above. Firstly, it aims to explore different design options to the content, structure, and style of a fully digital online data-driven government report. Secondly, it seeks to explore how this portal can offer different, interconnected versions of the report that allows the audience to engage with the content on different levels. Thirdly, it aims fill the gap between sweet infographics and boring charts by proposing charts that are interactive, have a high attention to detail, purporte a certain style and are attentive to the emotionality of the topic they represent.

Report Production Workflows

The kick-off meeting and the interviews with Eurostat, Eurydice, Helcom, and the Office for National Statistics (ONS) in the UK uncovered many possible research areas that lie beyond the focus of this thesis. The data collected from these encounters invite an in-depth analysis of the workflows, structures, hierarchies, challenges, and solutions that are applied in these organizations. However, the aim of this thesis is not to propose a design solution that fits the needs of such organizations but to explore solutions that serve the users of government reports. Therefore, I focused the analysis of the interviews on understanding different production workflows that are used in government organizations to produce reports.

The workflows were analyzed by listening to interviewees' descriptions of the production process on the audio recordings while simultaneously sketching this process on paper. These sketches were then scanned and redrawn in Adobe Illustrator (Figure 49 – Figure 51). At the time, I was strongly inspired by Sabine Junginger's inquiries into how design is practiced in organizations (2009). Her model outlines four different relationships between design and the organization. Design can either be an external resource, a part of the organization, at the core of the organization or an integral part of the organization. This simple framework motivated me to reflect on how (information) design is used in the workflows I was analyzing. This, in turn, helped me understand where my thesis could contribute both in terms of providing knowledge on information design and in terms of the solution I would propose.

The following workflow models from Eurostat, Eurydice, Helcom, and the ONS are to be understood as first sketches of what could still be developed into a more in-depth analysis.

Production Workflow at Eurostat

At Eurostat, the publication production workflow depends very much on the intended audience of the report. The reports that are aimed mainly at an expert audience and come in a traditional paper format are edited by the Eurostat *Dissemination and user support* unit (Figure 56, top). They propose a table of contents (ToC) to the statisticians in the statistical production units. When the table of contents has been approved, they brief an external firm that writes the texts and produces the tables and graphics based on the data provided by the statisticians. Once the report is finalized, the communications officers disseminate it through the Eurostat website and social media channels.

If the publication is aimed at a broader public, however, the communication officers are in charge of selecting the topic, editing, and producing the report (Figure 56, below). For some of the print publications, the communication specialists might work together with an external publishing company for certain components of the report. For every new product, the people working at the *Dissemination and user support* unit reconsider previously used publication formats. After that, a collaborative, creative, and iterative process ensues. In each iteration, the relevancy and understandability of the statistics for the intended users are re-examined and reconsidered. Throughout this process, the communication specialists work in close collaboration with the statisticians to make sure that the data is represented correctly. For the charts and illustrations, they often work together with an in-house graphic designer. Digital reports are designed and implemented directly with the web developers from Dissemination and user support unit.

Traditional Paper / PDF Publications

EDITORS

National Statistical Production Units	Eurostat Statistical Production Units	Eurostat Dissemination Unit	External Publishing Firm
– produce data – send data	– collect & check data – produce EU aggregates – give input & approve ToC – check final version of text & figures	– propose ToC – provide input – advise & check chapters & content – approve final version – disseminate publication	– write texts – produces tables & graphics

"Visual Publications" / More User-Friendly Publications

EDITORS

National Statistical Production Units	Eurostat Statistical Production Units	Eurostat Dissemination Unit	External Publishing Firm
– produce data – send data	– collect & check data – produce EU aggregates – approve ToC & give input on selection of indicators – check final version of text & figures	– choose topic – propose ToC & indicators – provide input – write text – develop & produce graphics & visualization tools – if online, produce HTML version – disseminate publication	– if print, might support the production of the publication

(EU) graphic designer

– create graphics & visual elements
– if print, layout

Key

◉ Design Steps

- - - - Only used for some publications

Figure 49. Eurostat's two production workflow models.

Production Workflow at Office for National Statistics UK (ONS)

Similar to Eurostat, the ONS has different processes depending on the kind of publication that is being produced. Articles, a publication type that is aimed at a more general audience, are produced by the *Digital Content Team (*Figure 50, bottom). This team consists of data journalists, data visualization specialists, graphic designers, and social media specialists. Mostly either a data visualization specialist or a data journalists will come up with an article idea. This idea is then discussed with statisticians and data owners with an expertise in a particular topic area. If the idea is feasible, the person from the *Digital Content Team* writes a proposal for the article and enters this proposal into a commissioning process. As the their work often cuts across multiple ONS units, this procedure ensures that work is not duplicated within the organization. Furthermore, in an environment that tends to see citizen content as an afterthought, the procedure solidifies the work of the *Digital Content Team*. Once the proposal is approved by the *Editorial and Communications Group*, the article is produced through a close collaboration between the data visualization specialist and the journalist. Statistical analysts are consulted throughout the process to ensure the validity of the article's messages; graphic designers are asked for input on the visual style of the charts; and social media specialists are in charge of the dissemination of the article.

The production of statistical bulletins, on the other hand, is led by the statisticians (Figure 50, top). They collect, process, and analyze the data. A content design team may advise on bulletin structure. A separate central publishing team produces and edits the bulletins. They input the text into the *Content Management System* including metadata and recreate graphics using the in-house charting system. This allows the charts to take advantage of responsive design and accessibility considerations. The publishing system allows the publishing team to produce the entire bulletin on their own. Sometimes however, they might consult a data visualization specialist or a journalist on the graphics and texts. They also collaborate with the social media specialists on the dissemination of the bulletin.

Statistical Bulletins

EDITORS

Statistical Units
– deliver data
– collect, check, and normalize data
– analyze data

Central Publishing team
– create text and graphics
– publish bulletin

Digital Content Team
– provide expertise
– disseminate bulletin

Articles

EDITORS

Statistical Units
– deliver data
– provide expertise

Digital Content Team
– commission an idea
– select indicators
– write text and design data visualizations
– implement article
– disseminate article

Commisioner
– check and approve idea

Key

⬤ Design Steps

Figure 50. The ONS' two production workflow models.

Production Workflow at HELCOM

At HELCOM, the report production process is led by scientists from the HELCOM member states, the so-called contracting parties (Figure 51, top). Working together in dedi¬cated Projects, they collect and analyze data and edit the report. The report is first approved through a corresponding thematic Working Group and later through the Heads of Dele-gation – the representatives of the contracting parties. Once the report is fully approved it is handed over to the communi-cation secretary. They either simply publish the report by creating a PDF from the Word document or copy the content into InDesign to apply some styling and formatting. If the report topic has the potential to reach a wider audience, the communication secretary might collaborate with external design agencies to create a report that is suited for a broader dissemination.

Production Workflow at Eurydice

At Eurydice, the statistical analysts are the main editors of the publications (Figure 51, bottom). They first collect the data from the national Eurydice units and analyze it. Based on their analysis they then produce the report. This includes writing the texts and creating the charts in Excel. If none of the al-ready existing chart templates in Excel fit their data needs, a new chart type is developed together with the in-house graph-ic designer. The designer then creates an excel template for that new chart. Another designer is in charge of designing the report's cover page. The report itself is written in Word and undergoes multiple feedback rounds with the national units. Communications officers are only involved once the report is fully approved. The person I spoke to in the Eurydice Sector, Planning and Dissemination Unit emphasized that it is im-portant to maintain this division to avoid influencing the work of the analysts. Thus, once the report is finalized, the responsi-ble communication officer creates additional materials, such as press releases and infographics, and disseminates the report through the Eurydice website and through newsletters. The release of a publication might also be accompanied by a press conference.

Thematic Reports by HELCOM

EDITORS

Project / Expert Groups	Working Groups	Heads of Delegation	Communication Secretary
– collect data – check and normalize data – analyze data – write text and produce graphics	– check and approve report	– check and approve report	– publish report
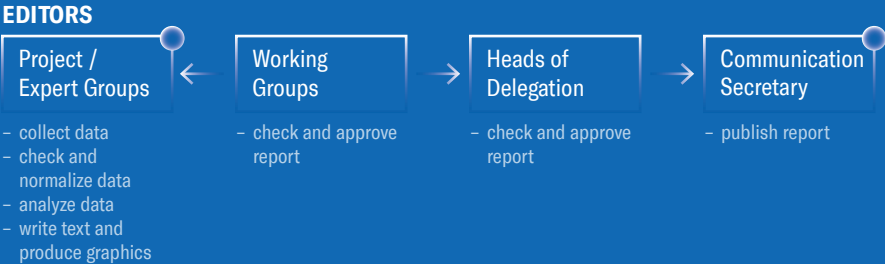
Comparative Reports by Eurydice

EDITORS

National Eurydice Units	Eurydice Analysts	Eurydice Designer	Eurydice Dissemination
– deliver data via survey – provide expertise	– collect, check, and normalize data – analyze data – write text and produce graphics	– provides excel templates – does a few of the graphs in InDesign	– disseminate report

Key
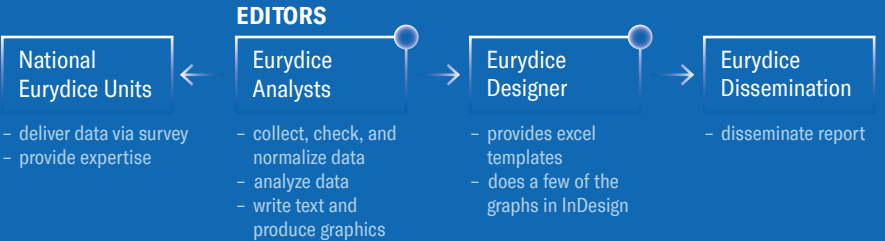
◉ Design Steps

Figure 51. HELCOM's production workflow model and Eurydice's production workflow model.

Although each organization has its unique processes when it comes to producing reports, the analysis reveals two different types of workflows: workflows that are led by scientists and statistical analysts, and workflows that are led by the communication units. In the former workflow model, the analysist are the editors of the report. During the process, they might consult communication specialists or designers for the visualizations and texts. In general, however, communication is seen as something that happens after the content has been created. Often, this process is based on the belief that including communicative perspective alongside the statistical analysis might taint said analysis. This workflow can be observed in all organizations that I analyzed.

In the latter workflow model, the communication specialists are the editors of the report. This workflow is found in the organizations that create separate products for the broader public, in this case Eurostat and the ONS. Communication specialists will often collaborate with the statisticians throughout the process of creating these products. At the ONS, the communication specialists consist of data journalists, data visualization specialists, and social media specialists who both edit and produce the publications. In contrast, the communication specialists at Eurostat have a background in communications and marketing. This entails that communication specialists will collaborate with graphic designers and web developers from other teams as well as external publishing firms to produce the report.

Another reason that Eurostat relies on external publishing companies is the sheer volume of statistics and reports they produce. HELCOM also collaborates with external agencies but for exactly the opposite reason. Working with a very limited communication resources they do not have the means to have the production of more elaborate reports in-house. Eurostat, Eurydice, and HELCOM all produce comparative statistics are delivered from single units across Europe. This makes the process much more complex.

Roles, Tasks, and Behaviors of the Target Audiences

To analyse the material from the workshops with the target audiences, I used the same visualization method I had used to analyse the interviews with the producers. After each workshop, I would listen to the audio recordings and summarize what was being said in sketches (Figure 55 & Figure 56). The process yielded a collection of sketches that showed the roles, tasks, and reading behaviors of each audience group.

Through this visual analysis, it quickly became clear that the audiences were not just passive consumers but that they also played a role in distributing and, sometimes even in producing content for the report. The differentiation between these roles is important, as each role comes with a range of different tasks. These tasks are, in effect, various activities in which a person from a particular target audience uses the report in a certain way to solve a problem. For example, the target audience *civil servants* might have as a task "to create a presentation on early childhood education and care for an international delegation". To complete this task, the civil servants use graphics and content from the report and repurpose it for the presentation.

Different tasks might cause different reading behavior. However, I found that both target audiences that use the report at work – the civil servants and the researchers – familiarize themselves with the report first before they come back to it for specific tasks. Journalists and the broad public, on the other hand are more focused on a specific topic from the report and seldomly read and come back to the full edition.

The sketches were later digitized and turned into informative, visual summaries of the roles, tasks and reading behaviors of the civil servants, the researchers, and the parents.[30] The following pages (Figure 52 – Figure 54) contain this visual summary as well as a short textual description.

30 As I didn't conduct a workshop with the journalists, there is no analysis of their roles, tasks, and reading behaviors.

Civil Servants

Civil servants are at once creators, distributors and consumers: As one of Euridyce's national unit, civil servants at the Finnish National Agency for Education actively collaborate with Eurydice on the production of the report's content and are responsible for distributing the report in Finland. Civil servants might also write a summary in Finnish and announce the report through their communication channels. They also use the report for their own work, for example in memos and reports for the ministries and in presentations to national or international stakeholders. In those memos, reports and presentations, they often use screenshots of the report's charts. Ideally, the civil servants would like to only show a selection of countries or annotate the chart with their own notes. The charts' static format is not really suitable for this use.

Apart from using the digital version to take screenshots of the figures, the civil servants use a printed copy of the report. This can either be an officially printed version or a self-printed version. The report is read thoroughly from start to end. Sentences and parts of the graphics are highlighted and annotated. Important pages are bookmarked with sticky notes. The outcome of this reading process is a personal hard copy of the report that civil servant will come back to time and time again. One civil servant described how they simulateously make notes on the paper copy and summarize parts of the report on their iPad. The reading process is thus supported by a mix of analogue and digital tools.

Although civil servants still rely on the printed report this might soon change. During this thesis, one of the civil servants was preparing to move into an open space office in which there will be no room for a personal bookshelf. The civil servant noted that this makes it all the more important to have useful, digital reports at their disposal.

Roles

Creators
deliver data;
give feedback,
and edit drafts

Distributors
circulate the report to
trade unions, ministries,
the media and local and
regional government

Consumers
use the report as a
reference in
memos, reports, and
presentations

Tasks

edit drafts of the report and
collect national data and send it
to Eurydice

write national summary;
communicate with various
stakeholders (e.g. Trade
Unions, Media)

write memos and reports; give
presentations with information
and graphics from the report

Reading Behaviors

Digital Copy   Printed Copy

**Screenshot of
Graphics**

Note

Highlight

**Digital Document
for Notes**

Print   Download   Personal Copy

Post-it as
Bookmark
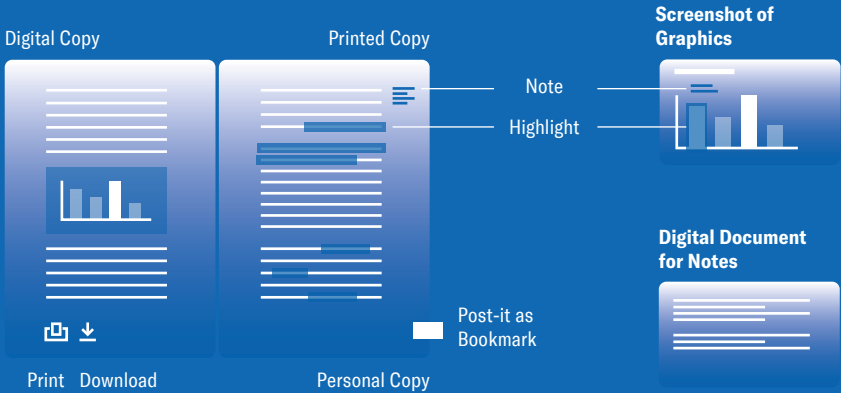
Figure 52.   Role, tasks, and reading behaviors of the civil servants

Researchers

Researchers are distributors and consumers of the Key Data report. They might recommend the report to their students or suggest it to other researchers. When they teach, they summarize parts of the report as an input to their lecture. Finally, they use the report as a source for background information, facts, and definitions in own research and in reports they write for other governmental organizations. The researchers I talked to do not necessarily use the data sets or the figures from the report for their own research papers.

Researchers often learn about the report from colleagues or at conferences. When they encounter the report for the first time, they flip through it, skimming its contents to check if it is relevant to their work. Later on, when they read the report more precisely, they summarize parts of it by making notes in the report and/or in a separate document. Relevant paragraphs and figures are scrutinized to ensure their validity. Surprises and inconsistencies that are encountered in this process are treated as open questions that drive further research. The researchers might, for example, compare the report's content with the content of the report's sources.

Challenges the researchers face when using the report are, for one, related to their work environment. Researchers are often assumed to have the time to read and research topics in depth, when in reality their schedule is packed with administrative tasks. Other challenges they encounter are finding very specific answers that are relevant to their research.

The researchers I talked to did not have a preference for reading a digital or a printed version of the report. However, they pointed out that digital, interactive figures would allow them to customize these figures to better fit their lecture material. Also, just as with the civil servants, printed copies have to often be left behind when research teams move to new offices. The researchers did mention the importance to be able to print out certain parts of the report. One use case for this was that they handed out a graphic from the report that shows the structure of the Finnish system to exchange students as a first introduction to the Finnish education system.

Roles

Distributors
circulate the report to students, government officials, and other researchers.

Consumers
use the report for own research and expert member or consulting writer for other reports

Tasks

recommend to students; give students a part of the report as handout

write report / research paper; give lectures with information and graphics from the report

21%

look up facts, search for specific concepts and definitions, and use country examples

Reading Behaviors

Printed or Digital Copy

Note → Write Summaries

Highlight →

Print   Download

Compare ← → Read Source Documents
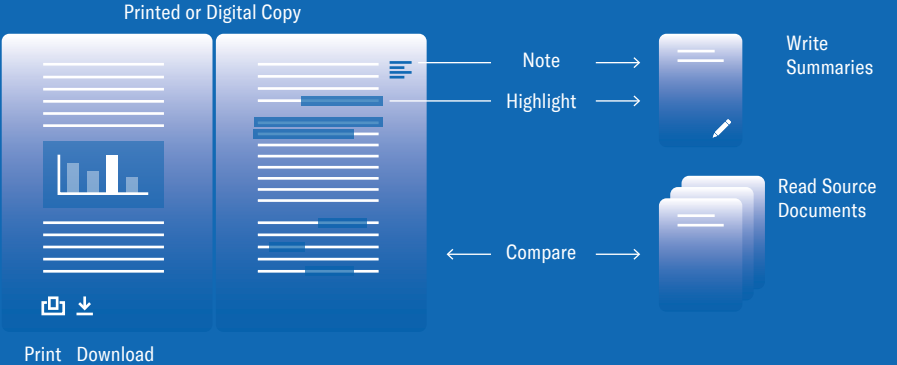
Figure 53. Role, tasks, and reading behaviors of the researchers.

Parents

The *Key Data* report is not a document that ordinary citizens would normally read. For that reason, I examined how the study participants had consumed recent, moving media topics. Both described an aha-moment when they read interactive articles that allowed them to compare the extent of the Amazon wildfire devastation with familiar measurements such as the size of a football field. In our discussions, it became apparent that there is a lot of half knowledge surrounding such issues, seemingly from reading conflicting, mostly superficial information (e.g. is the Amazon the lung of the earth?). Finally, the participants also expressed that they felt a certain pressure to be conceived as genuine and authentic on social media.

When observing how the parents read charts from the *Key Data* report, a sequence of activities emerged: They would first try to understand the chart, looking for the meaning behind abbreviations, terms, and design decisions. Finding something interesting in the chart led to an aha-moment. This was followed by an attempt to relate what they had found to experiences in their own life. As a last step, they proceeded to set their own experience into the context of the whole chart again.

Four points are important in the process described above: Firstly, the misinterpretation of the chart happens easily and quickly. Secondly, the experience is seen as rewarding when new, surprising knowledge is gained. Difficult terms and confusing design discourage meaning-making, while explanations and being abel to locate a personal experience in the topic act as encouraging factors. The sharing of newfound insight is another potentially rewarding activity. Expectations also play a large role: If the audience is used to interactive charts, a static chart might seem unworthwhile. Finally, aesthetics can act as a powerful catalyst for a reason to engage with the chart.

Both participants were not quite sure what benefits the report would bring them. They felt that the report is less important to them because early childhood education and care in Finland is very good. They mentioned that one purpose for reading the charts could be to verify facts they had heard about. Finally, they felt that they were more in need of practical information than abstract, international comparisons.

Roles

Consumer
consume various information through both traditional and social media

Tasks (generalized)

understand · find own country · compare · share · action · get useful information

Reading Behaviors

Social Media Post
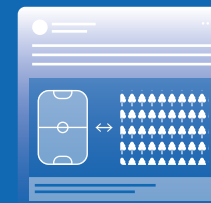
Understanding through comparison with familiar dimensions

Reading Charts

Aha!
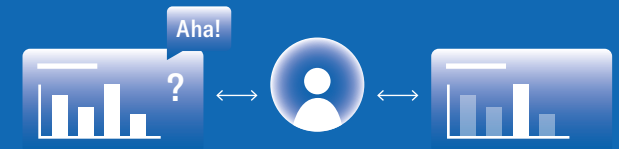
understand ⟷ compare to self ⟷ put into context

Figure 54. Role, tasks, and reading behaviors of the broader public.

The Audiences' Needs

While roles and tasks represent functional findings, needs try to capture behavior and attitudes that are more ephemeral and are therefore harder to address. I began formulating these audience needs after the three workshops, when I felt that I needed a broader picture of the audience groups than my initial task and roles analysis could offer. This analysis also allowed me to include the material I had gathered from the short interview with a journalist.

The needs were elaborated both through visualizing the written summary of the workshops (Figure 57) and by coding transcriptions of the audio recording to find statements that support my findings. Through continuously reorganizing these quotes and the visualization, three main categories of needs emerged: **Scope** describes the volume and depth that an audience needs in regard to the report's content; **intertextuality** describes audience needs in terms of being able to compare and connect either different parts of the report or the report with other, additional material; and **affect** describes how the audience sees themselves in the report.

The first *needs visualizations* allowed me to review my underlying assumptions about the audiences and inspired new ways of thinking about the design project. The following pages contain the visualizations as well as short elaborations to each need category (Figure 58 – Figure 60).

Stakeholder Landscape

As the workshops and interviews progressed, an interconnected network of people that use the report revealed itself. This network was visualized and iteratively refined through feedback with the participants. The network shows relationship between the main audience groups and between these audiences and others in which the report is used. This provides a connected way of looking at the roles and tasks of each audience group. As these are already described in great detail in the sections above, the diagram is not explained again (Figure 61).
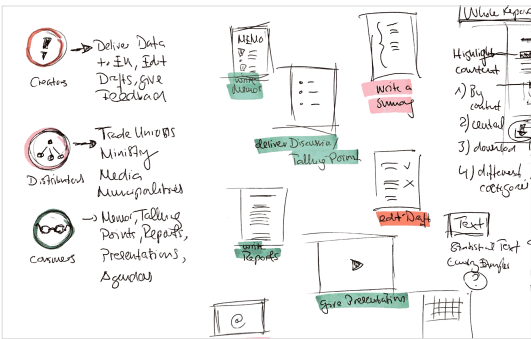
Figure 55. A detail of a sketch of the civil servants' roles, tasks, and reading behaviors made while listening to the audio recordings.
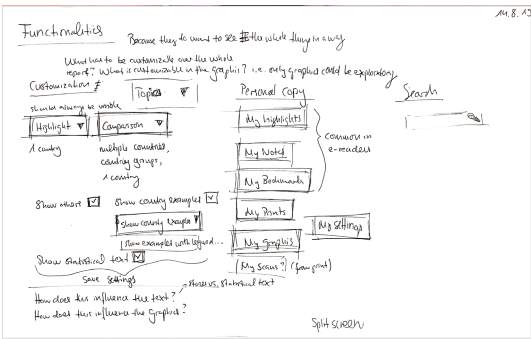
Figure 56. A sketch of user interfaces made directly after the sketch above.
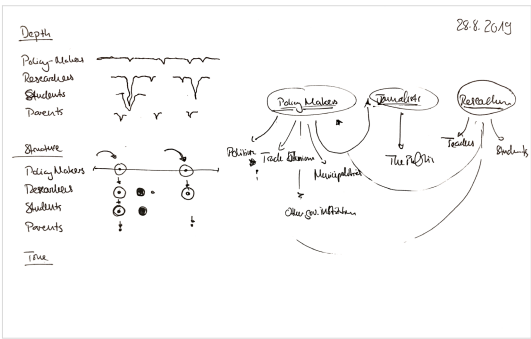
Figure 57. A first sketch of the audience needs and the stakeholder landscape.

Scope

Civil servants use the whole report for their work. Their general aim is to understand the report's content well enough to be able to communicate insights from it to others. Therefore, they need to be able to read the report thoroughly without having to go into great details in order to grasp the main messages.

The researchers also read a large portion of the report but use different parts of it for different purposes: They might skim the report for useful information, read parts of it thoroughly to be able to talk about a certain topic with students and faculty, or analyze sections of it in great depth to drive further inquiries into their own research. Thus, their needs are similar to the needs of the civil servants in terms of scope. In terms of depth, however, they require a wider range of different options.

The journalists are more goal-oriented than the researchers and the civil servants. They usually read only a certain part of the report. If they use this part as a source, they will read it in great depth, even cross-verifying it with other sources. Therefore, journalists need to firstly be able to find the part that is relevant to their story quickly. Secondly, they need to able to ensure the validity of that part without having to read the whole report.

The parents do not normally encounter the full report. Instead, they might read something about a single, focused topic. In general, the encounter with that topic might happen in a rather fast, superficial way. Nonetheless, providing the possibility for them to continue to engage with the topic in more detail is still necessary.

Civil Servants

"That topic is very high on our political agenda. That's why I read it first and made some notes. Well, actually nearly all the content is important, as we are constantly working with those issues."

Researchers

"Sometimes you have time and you can devote yourself to dig into something... but due to the administrative overload there are also times in which you can only rarely sit down and read."

Journalists

"Even if there is a good press release or nice graphics, I need the numbers."

Parents

"I mostly just look at the headlines quickly. But when I see something on Facebook – I don't know what is happening to me – then I click..."

Figure 58. The civil servants', researchers', journalists', and parent's needs in terms of scope.

Intertextuality

Civil servants usually focus on the topics that are a priority under the current political agenda for which they work. In order to gain a full understanding of a particular topic, connections are made from that topic to other related issues. Civil servants usually don't just focus on early childhood education and care but might also have other areas of responsibility, such as future skills or higher education. Therefore, it is important for them to quickly gain as much of an understanding of that topic and potentially connected challenges as possible.

Researchers, on the other hand, are generally more focused on trying to "read in-between the lines". They make multiple connections between topics within the report as well as between topics in the report and topics from other sources. Their goal is not just to understand the current state of a subject but to synthesize various perspectives to arrive at an indication of how the issue could develop in the future.

Journalists will always try to connect the content to something that is currently happening in the country or town they report on. They are interested in showing cause and effect, and in uncovering disparities.

Parents like to understand the relationship between themselves and the topic presented to them. Therefore, they try to compare the topic to experiences they've made, people they know or have heard of, or measures that are familiar to them. They also see the content in comparison to other content in newspapers and on social media feeds.

Civil Servants
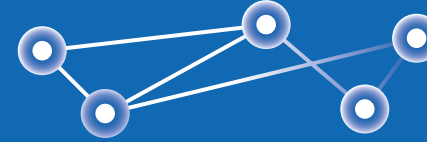
"And the enrollment rates are actually linked to parental and family leave..."

Researchers

"So when we talk about quality, what does the quality encompass? What are the subcomponents of quality and how does that relate to what I'm studying?"

Journalists

"One approach is to to find issues from the root up, to localize them. A report can serve as a jumping point for new ideas or it can be used as background material for facts."

Parents

"And then I saw that the Amazon is the size of Europe... I'm this kind of person that needs comparisions like that; then I really start to feel something... like wow."

Figure 59.   The civil servants', researchers', journalists', and parent's needs in terms of scope.

Affect

Civil servants are concerned with how well the nation for which they work is represented in the report. They identify with the national characteristics. Politically they compare their country to countries in the same region and then to EU countries. Countries outside of the EU do not have any bearing on their work.

Researchers see their home country more as one part of a larger construct. They attempt to compare the country they study with other countries on an objective level. They understand their research as one part of a larger, pan-European undertaking.

Journalists look at the information in the report through the eyes of the people they produce content for. A journalistic sense is described as understanding what is interesting to the people. The journalists stand in the service of their readers and try to see what might be interesting to them.

Parents look for things that are relevant to their own world. They want to know how they and their loved ones are affected and where they can place themselves in relation to the content and to others.

Civil Servants

We as a country...

"Finland is special in that regards. It's something very typical and an interesting feature in our system."

Researchers

In the EU, our country...

"The EU is a strong entity, and because there are so many different countries in the EU, we can look towards the other countries. We have a kind of European culture."

Journalists

They, the people...

"In an analysis piece, we try explain why things are as they are. So there we might use these numbers."

Parents

I, my family, my country...

"So in my home country, there is a parental leave and then compulsory kindergarten. And inbetween, there is a gap... that means that... Ahhh, yea, that's what my sister is suffering with: The state doesn't provide a place for her child."

Figure 60.   The civil servants', researchers', journalists', and parent's needs in terms of scope.

The Report in the Stakeholder Landscape

work together on report

Eurydice

Civil Servant
at Gov. Agency or Ministry

Researcher
Post-Doc at University

other organisations and associations

Parliament

use as material for
Teacher Trainings

distribute to
Trade Unions

Local Government

use as material for
University Courses

use in presentations for
International Delegations

use as material for
National Government

use in work with
Fellow researchers

share with

Journalist
at National Newspaper

inform

Parents

Key

—— Report is actively used or shared in this relationship.

- - - - Report might be referenced but is not actively promoted in this relationship.

Figure 61.   How the report is used throughout between the various stakeholders.

General Reflections on the Report

The various exercises I did to understand the content of the report and familiarize myself with how it had been designed did not yield any tangible outcomes in the *analyze & synthesize phase*. Rather, the knowledge I gained from analyzing the report were incorporated directly into the design of the prototype. For the sake of the project documentation however, I have summarized the ideas and insights I gained through this step in the sections below.

Understanding the content of the report

Reading up on the policy context of the report proved highly important as the interpretation of the data often hinges on an understanding of this context. Although the report contains a glossary, there are naturally also many concepts that are not explained and that presume political knowledge on the side of the reader. For example, there are various EU Benchmarks for the participation rates of children in early childhood education and care. While the single benchmarks might be explained in the report, the reader still has to know the concept behind EU Benchmarks. This background information is not contained in the report. In the workshops it became clear that researchers have an in-depth knowledge of these concepts while civil servants might know many of them only superficially. For parents even seemingly simple terms such as "civic and democratic competences" can cause misunderstandings as the concepts behind those terms are so ambivalent. Therefore, if the report is made available and accessible to a larger public, it is important to communicate these basic concepts or at least link to further resources.

Understanding the metadata is almost equally important. Personally, I found that knowing how the data had been collected – for example, through surveys, national registries, or statistical models – provided me with a frame to interpret this data. Again, the researchers seemed largely familiar with the methodologies behind the data, while the civil servants, in general had more of an overall understanding of them. Methodology was not a topic that was discussed with the parents. The importance of having an understanding of the data methodology and other concepts from the metadata depends, of

course, strongly on what purpose the report serves. While it is not pertinent to understanding the charts, it should be made easily available to those who make their own interpretation of the report's data and communicate this interpretation to others.

Another important aspect of understanding the subject matter, was understanding the comparative nature of the data in the report. With comparative data, paying attention definition of each metric is pertinent to understanding and interpreting the data. This became clear in the conversations I had with the civil servants and the researchers. For example, participation rates for children under three in Finland is relatively low (34%). An extensive parental leave policy – as is in place in Finland – means that young children stay at home longer and start early childhood education and care later. This in turn negatively impacts the participation rate and something that is a positive feature in a system suddenly makes a country look bad. The fact that reading a chart warrants careful scrutiny is true to any chart, however the nature of comparative data should always heighten this scrutiny. It is important to remember that to a large portion of people, a bar chart always encourages the same trustworthiness regardless of the kind of data it represents.

Understanding the structure and design of the report

The analysis of the content structure of multiple reports showed that most government reports that communicate data mostly follow a similar structure. The examples I looked at all contain an imprint and a table of content. Some also include acknowledgements, a forward, or an editorial. Most have an introduction before the main content follows and many also include an annex. A very small number of reports have an abstract, references, a glossary, or contacts. Only two of the reports had a conclusion. The researchers I talked to use the OECD report series called "Starting Strong" more often than the Key Data report. When asked why, they both cited as one reason that this report includes a sort of conclusion in the form of policy pointers. Given how popular summaries and guidelines seem to be, for example in conference presentations, it is surprising to see that most reports don't even have a conclusion.

Texts that described the statistics in the chart were the most used content type in the chapter in which I analyzed the different content types. This was followed by the content type "country examples" which describes in more detail the policies of selected countries. How useful these content types are to the different target audience depends, of course, on what purpose the report serves but also on personal preference. Some people felt that they didn't really need additional text describing the statistics unless this text revealed something that was not instantly recognizable in the chart. Other felt that the statistical text provided a good introduction to the chart.

While these differences were not necessarily related to the audience group, the preference for the country examples was clearly allocable to the different groups. The researchers felt that country examples were helpful steppingstones in their research while the civil servants didn't see that much use in them. Single countries are, in fact, not just mentioned in the country examples, but also in the statistical text and country notes below each chart. Personally, I felt that this was confusing at times because it didn't allow the reader to get a full picture of the situation in one country.

Surprisingly a lot of the text also warns about pitfalls when interpreting the data. Nonetheless, from my own experience reading the report and from feedback I got from the workshop participants, it seems that once you start reading the chart or the statistical text about the chart, these warnings are quickly forgotten.

Paying attention to feelings of frustration and confusion when reading the report also offered some interesting insights. For example, one of the most irritating things to me was the fact that, through the flow of the content on the pages, a chart and the statistical description to that chart were often on different pages. Flipping back and forth I would often loose the context and have to start reading anew. Another point that made me lose track were the length of statistical descriptions. Often, I spent a considerable amount of time trying to find the different countries that interested me in the chart and had to look up the country abbreviations. In the workshop with the parents, I could observe how others struggled with both of these issues pertaining to the country codes and their position in the charts as well.

3.6 Prototype & Evaluate

In the *prototype & evaluate* step, insights gained from analyzing the research material is translated into a design artefact that is iteratively evaluated and refined. The aim of this step is to develop a solution that solves a particular problem and meets the audience and subject matter requirements. In this thesis, the goal of the *prototype & evaluate* step was to design a proposal for how data-driven government reports could be published to meet the needs of a broad audience. The final outcome is a prototype of an online publication portal that provides these audiences with a variety of tools and content formats to work with, examine, explore, and consume a data-driven publication.

Using the *Key Data* report as an example, I iteratively developed multiple visual, interactive prototypes – user interface designs that look and feel like the finished online portal but are not implemented on a technical level. In this process, the overall structure and content from the *Key Data* report remained the same. My contribution lay in: devising new features for working with the report online; designing different ways to engage with the data; providing various navigational concepts; and proposing new content formats. Using the example of one chapter, I also rewrote and restructured the content and proposed additional data visualizations.

To develop the prototypes, I used three overarching approaches as well as a variety of design methods. The following sections describe first the approaches and the design methods, and then the final prototype.

Approaches

Three underlying approaches guided the development of the prototypes. They consisted of translating insights about the audiences into design outputs, exploring design solutions through iteration and variation, and applying theoretical frameworks to the conceptual development of the portal.

Translations of User Inputs

Translating is what I termed converting insights I gained from the audiences into an actual design artefact. This happened in three ways:

Firstly, the audiences' **roles, tasks and reading behaviors** that had been found in the previous steps were translated directly into **features**. This boiled down to devising and designing different kinds of user interface elements, such as, for example, buttons and input fields that allowed users to download the charts in different sizes and formats.

Secondly, the translation of the **scope, intertextuality, and affect needs** supported the **editorial, structural, and emotional** aspects of the prototype development:

Scope translates to the volume and the complexity of the content – the breadth and depth of charts, the length of texts, and the amount of additional description. On an **editorial level**, this means defining how much text and how many charts there are, how complex they are, and how they are organized. Visually, scope can be translated into hierarchy and layout.

Intertextuality defines the **structure** of the online portal – how parts of the content are connected and how content can be invoked by the users. For the design, this translates into deciding on how interactivity is used on the protal and how transitions between two screens or screen elements take place.

Affect defines the **emotions** invoked by the portal – how the audience should feel when they visit it. This translates to the visual style of the portal, colors, fonts, and the density of the content. It also translates to the editorial decisions on how to present the content in a way that allows users to identify with it.

Thirdly, collecting feedback on my designs offered a new, additional way to gain user input. **Feedback sessions** were held in various formats: They could include large groups of people or individuals; would last anything between 15 minutes and multiple hours; and took place in person or on a video conferencing call. The feedback session was structured depending on the participants: In the feedback sessions with members of the **target audience** groups, I first observes how they experienced the prototype in general. Then, I asked specific questions about that part of the prototype that was relevant to the audience's tasks and needs. In particular, I tried to evaluate if my design proposal seemed meaningful to the parents, useable to the researchers, and useful to the civil servants. Notes were also made on people's emotional reactions towards parts of the prototype. The feedback sessions were summarized into a list of ideas that could be incorporated into the next prototype. I did two feedback sessions with each of the civil servants, two with one of the researchers, and one with an ordinary citizen.[32]

Feedback sessions were also held with the **producers**. These sessions were more focused on gaining an understanding how such a portal might fit into their workflow in the future. The presentation of my thesis at the EU DataViz Conference in November 2019 constituted another way to gain feedback from producers (Figure 62 – Figure 64). The majority of the attendees were from the public sector and therefore presented a kind of expert audience to judge my thesis concepts.

The feedback session with the producer and audiences, as well as my presentation and the feedback I got at the EU DataViz Conference are documented in detail in *Annex E*, alongside a description of each prototype.

Exploration through variations and iteration

The basis for all work that was done in the *prototype & evaluate* step was the concept of variations and iterations. Variations are focused on producing a large variety of different alternative solutions (Figure 65) while iterations are aimed at refining a solution. Variations and iterations were applied to the development of all components of the prototypes – from color palettes, to the design of user interface elements, and the

32 Further feedback sessions had been planned with representatives from the "parents" workshop but had to be cancelled due to the Coronavirus pandemic.
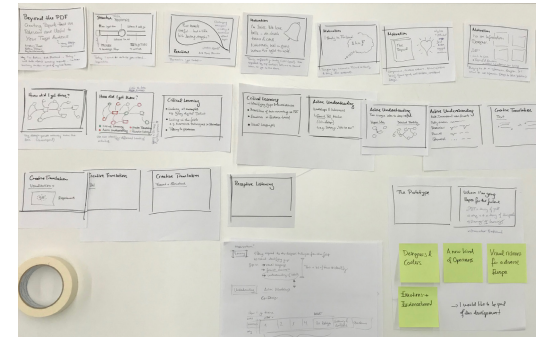
Figure 62. A storyboard for the presentation at the EU Data Viz Conference 2019 in Luxembourg.

Figure 63. The conference programme and my badge.
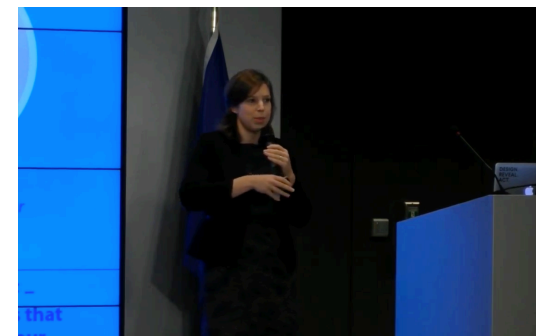
Figure 64. A screenshot of the video recording of my 12-minute talk I gave in the thematic session "New Ways to Present Reports".

Figure 65. Variations for an example of a new content format I propose for the broader public called *Data Essays*.

visual style of the whole portal. I used this approach both for the translation of user inputs and – independent of insights gained from the audiences – as way to generate concepts and designs.

Conceptualization through Theoretical Frameworks

In this thesis, I found that frameworks outlined by information design researchers could serve as an additional input to the design process. As with the exploration through variation and iteration, this input sometimes supported the translation of audience needs directly but could also be used as an approach in its own right. Information design theory inspired me and pushed me to see my work under a different perspective. It also helped me justify design decisions, giving me a vocabulary to think about the design solution in a conceptual manner.

One of the main theoretical concepts that influenced my work were narrative data visualization. Storytelling is mentioned repeatedly in literature on the dissemination of data (c.f. Smith, 2013; ten Bosch & de Jonge, 2008) but related concepts are not elaborated in great depth. Storytelling was also mentioned by the people at Eurostat as a concept that they use and would like to apply more extensively. In this thesis, my aim was not to define and evaluate the efficiency of storytelling per se but to explore their application as designerly methods. In chapter *2.2.*, I looked at narrative structure and identification through narrative. In the *prototype & evaluate step*, I mainly applied narrative structure as a design method.

A further theoretical framework that influenced me in this step, is the idea of micro visualizations – a concept that is elaborated by Jonas Parnow on his master's thesis (2015). Finally, theories around the visualization of large cultural collections (Whitelaw, 2015; Windhage et al., 2019), as well as the concept of humanist data visualization after Drucker (2014) influenced how I thought about visualization as a means to navigate complex collections of text and data. The elaboration of those theoretical frameworks is beyond the scope of this thesis. However, traces of their concepts can be found in the design methods.

Design Methods

Various design methods were used on top of the three approaches described above. These methods were a mix of visual design activities – such as sketching – and strategic design activities – such as defining design statements.

Sketching

A sketching process always proceeded designing in digital applications. Sketches ranged from very rough sketches focused on idea generation (Figure 66) to more elaborate sketches that where used to work out the ideas visually (Figure 67 & Figure 68).

Design Statements

While I was analysing the material from the workshops and working on the prototypes, I would write down editorial conceptual ideas on sticky notes and put these on the wall behind me desk. These statements served as a reminder me of the overarching concepts that guided the project. They were iteratively refined during each cycle (Figure 69).

Wireframes

Wireframes are simple renderings of the website that use placeholder elements to denote different content. Wireframes were created in multiple stages of the process. In the beginning, they served as stand-ins for unfinished pages while I focused on designing the core elements of the portal. Later, when I was working on all the pages, I would sometimes replace the already fully styled elements with grey boxes (Figure 71). These page designs would then be put together in a click-dummy. This helped me to evaluate the navigation without being distracted by the visual style of the portal.

Information Architecture

The *Information Architecture* represents the structural organization of the website (Chandler, & Munday, 2020). The Information Architecture was tackled from multiple perspectives: For one, a simple text document was used to explore different structuring options and names for the navigation points (Figure 72). For another, diagrams of the structure were sketched out to gain a clearer understanding of the
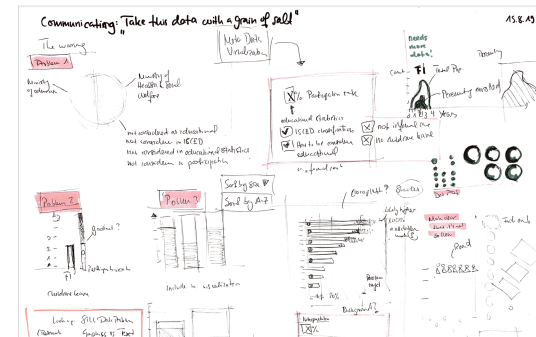
Figure 66.   A rough sketch that explores how to visualize what is included and what is excluded in a particular data set. The color was added as a second editoral layer to mark promising ideas.
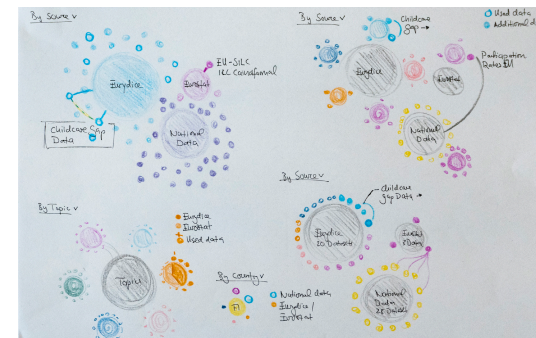
Figure 67.   A sketch that explores how a visualization that depicts the report's data sources could look.
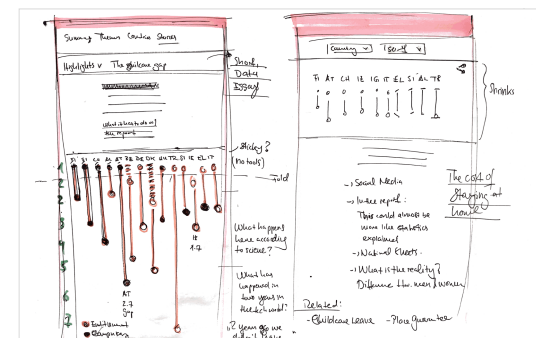
Figure 68.   Sketch that preceeded the variations of the *Data Essay* shown in Figure 65.

positive radical
transparency

TLDR;
to long didn't read

TDDF;
to deep didn't
follow

leave room
to breath
i.e. make it light
and simple

trust the
figures

be bold
i.e. be clear and
courageous

explanation
first, exploration
on demand

Figure 69. The final design statements I used to guide the
development of the prototypes.
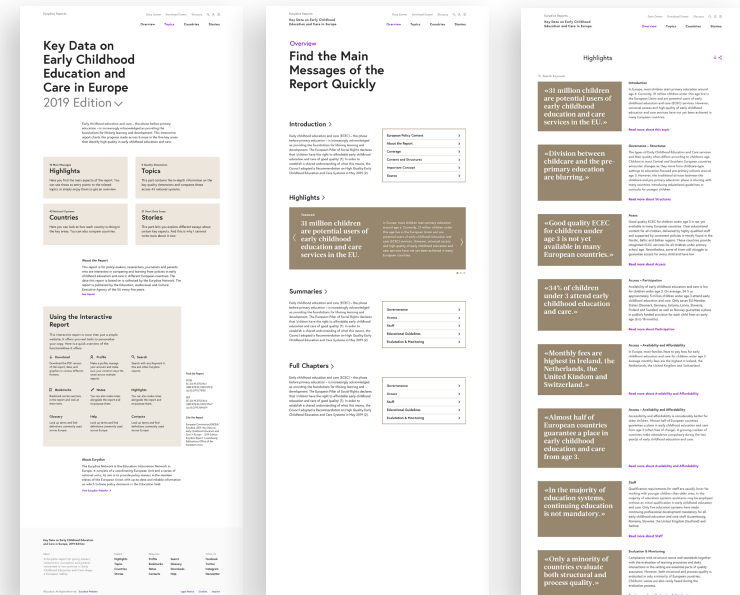
Figure 71. Wireframes created from a prototype that was
already fully develped visually.
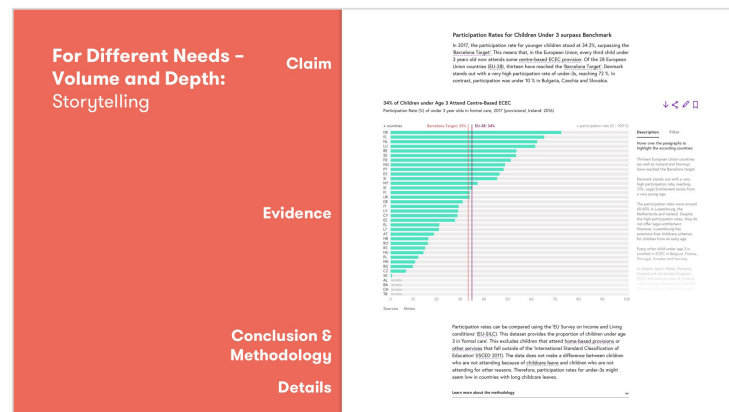
Figure 70. A slide from my presentation at EU DataViz 2019 that
explains how I applied Kosara's narrative argument structure.
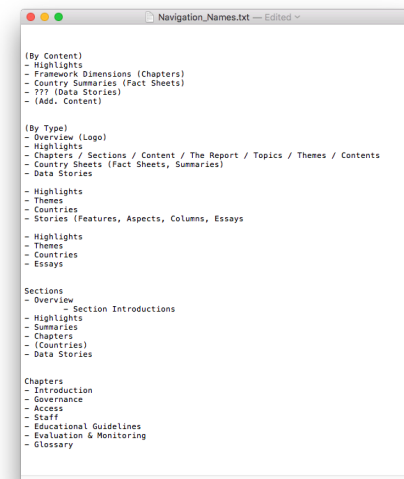
Figure 72. A text file that explores different typologies that
could be used to structure the report's content and the navigation.
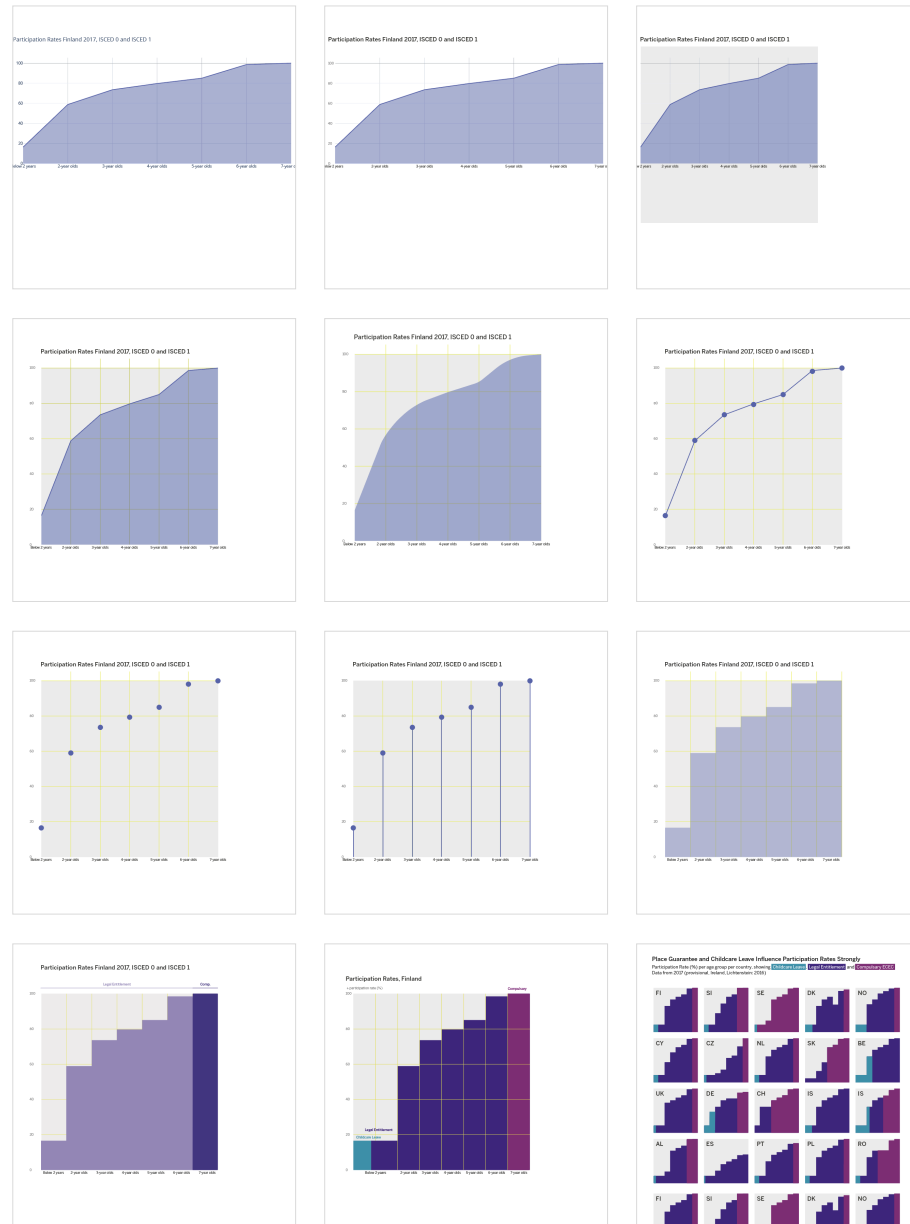
Figure 73. Iterations (and one variation) on a chart that shows the participation rate of children in early childhood education and care per age group and per country.

interrelationships of different pages and parts across the site. In addition, iteratively designing various versions of the navigation itself helped to test the assumptions made on paper.

Combining texts and charts

Beyond the overall architecture of the portal and the functional and visual structure of the portal's pages, I would often use Kosara's argument structure's for data stories (2017) to define how text and charts worked together. For this structure to work, I often had to re-edited the text and defined what was shown in the graphics anew.

Chart Design

To work on the design of the charts, I would copy the data from the tables in the PDF report into a CSV-file. I would then use a plotting library called plot.ly to generate a first simple chart of the data. This would allow me to explore the data. After that step, I would sketch different ideas for the visualization on paper. Finally, I would export the chart from plot.ly as an SVG, open it in Adobe Illustrator and use that chart as a basis for translating the sketches into a digital form. In Illustrator, multiple iterations were made in terms of the detail design of the charts (Figure 73).

Inspired by the concept of micro visualizations (Parnow, 2015) and data visualization for large online collections of cultural objects (Windhage et al., 2019), I also created visualizations on the report's text, charts, data, and data sources that doubled as navigational elements.

User Interfaces

A lot of work went into creating a clear, simple user interface that included powerful features but seemed easy, light, and – to a certain degree – intuitive to use. This included consideration of the layout, the style of interface elements, and the interaction design of functionalities. Similar to the overall user interface, I created a lot of variations of the user interface around the charts (Figure 74). This included filter options as well as the design of the a *story layer* that made detailed information on each country available to the user. In defining the way that users would be able to interact with the charts, I would often recall Segel and Heer's narrative schemes
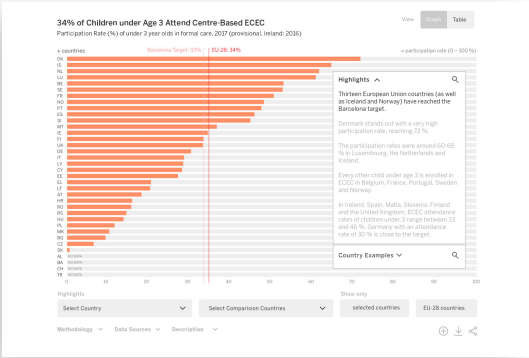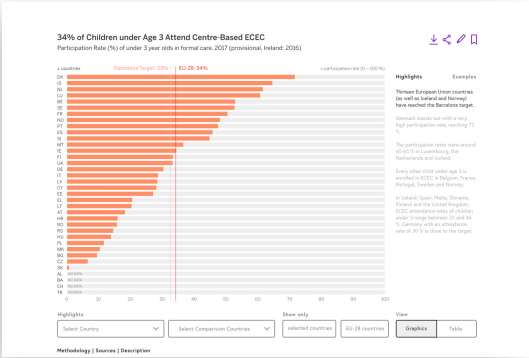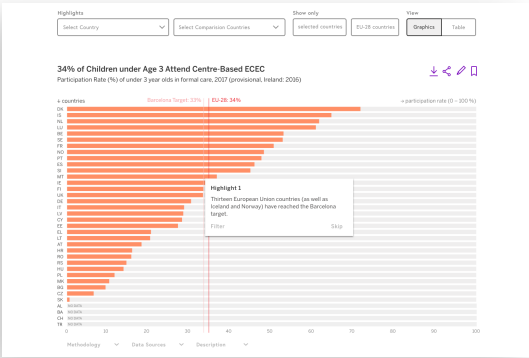
Figure 74. Iterations of the interface design of the charts. It includes filters, view options and a story layer that reveals interesting aspect about each country's data.
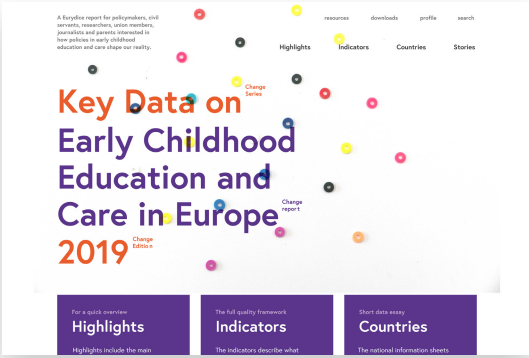
Figure 75. A selection of the designs I made to explore the style of the platform using graphic elements (top), drawings (middle), or photography (bottom).

that define the interplay between data-driven and author-driven elements in data stories (2010).

Visual Style

The development of a visual style was supported through the creation of a moodboard, as well as the development of a color palette. The color palette was developed to provide enough colors for the data visualizations used in the report and enough shades of those colors to reflect different interactive states (Figure 79). In the beginning of the process, the colors were consistently checked for accesibilty using tools such as color.review and leonardcolor.io. Towards the end this became hard to maintain. Currently, the colorpalette is designed in a way that using only the two darker shades and combining either only the colors from an even row or the colors from an odd row will result in a color palette that should conform to accessiblity guidelines.

Later, I explored various visual styles using different media, such as photography, drawings, and graphic elements (Figure 75).

Interactive Visual Prototypes

From the design I created, I would create interactive prototypes using the prototyping application *Invision* (Figure 76). This online app supports the creation of click-dummies that allow users to click through a protype in a browser.

HTML Prototypes

In later stages of the process, some parts of the prototype were developed as online prototypes to test different functionalities more interactively (Figure 77 & Figure 78).
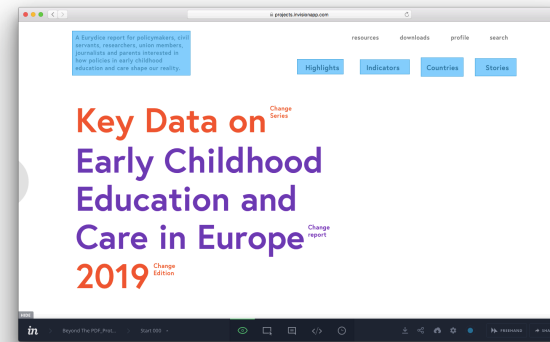
Figure 76. The interactive prototype as seen in the prototyping application Invision. The blue highlight mark clickable elements.
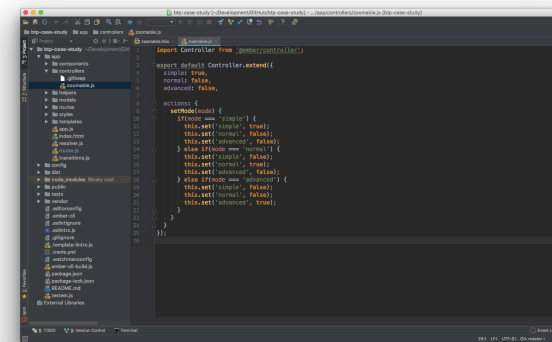
Figure 77. Screenshot of the code that was used to create the HTML prototype below.
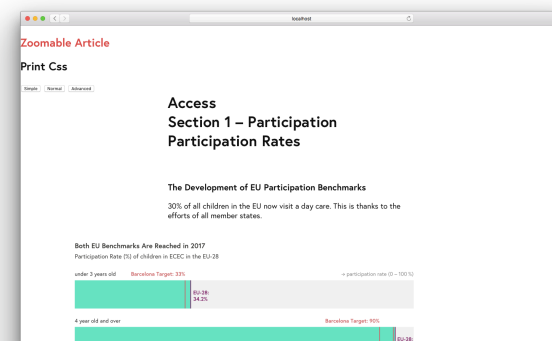
Figure 78. An HTML prototype that explores the concept of being able to change the amount of text on the page.

Figure 79.   The final color palette used in the prototype.
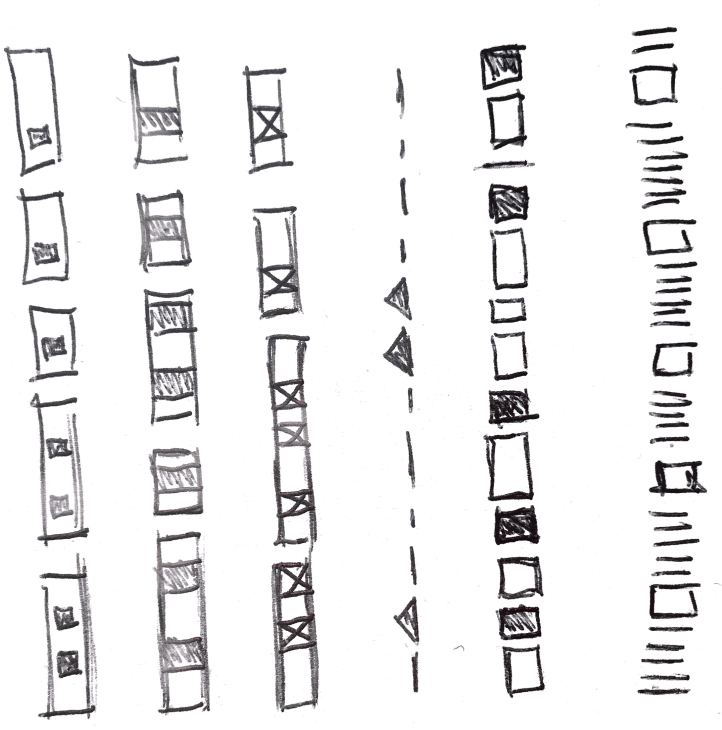
Figure 80.   Sketch of different variations for the visualization on of the pages in the report that serves to support the user navigate to different sections.

The Final Prototype

The online portal provides various different ways of accessing the report's content: A collection of short texts and summaries offer a fast way to grasp the main messages of the report. The summaries and texts are also linked to the main chapters of the report. These provide the possibility to read through the report linearly but also to explore the data and the stories in the data in more detail. The reading experience is supported through various functionalities such as the possibility to write notes, highlight text, and bookmark certain chapters and charts. Furthermore, the user can choose between a chapter layout that shows only the charts and a chapter layout that displays both texts and charts. Another layer of functionalities gives the users the possibility to learn more about the data sources and the definitions of certain terms. This layer – called connectors – provides new ways to explore the report though various visualizations of the report's content. Finally, short essays grant a first introduction to the report through playful, emotive visualizations.

The Main Pages

The main pages of the report are the *Start* page, *In Brief*, *Topics*, and *Countries*. These pages are found in the main navigation in the top right corner of the portal.

Start: The start page introduces the report and the whole portal (Figure 81). It contains short texts about the topic of the report, the report's target audiences, and its authors. It also lists the portal's main pages – *In Brief*, *Topics*, *Countries*, and *Stories* – and explains what content the user can expect on each of these pages. And it describes the various different features of the portal, giving the user an introduction on how to use the online report.

In Brief: The *In Brief* page is meant to give users a quick, brief overview of the report (Figure 82). It contains a slider with the report's key messages, the abstract, a definition of the term early *childhood education and care*, the executive summary, and quick links to the further pages of the portal.

Figure 81. The start page of the final prototype.
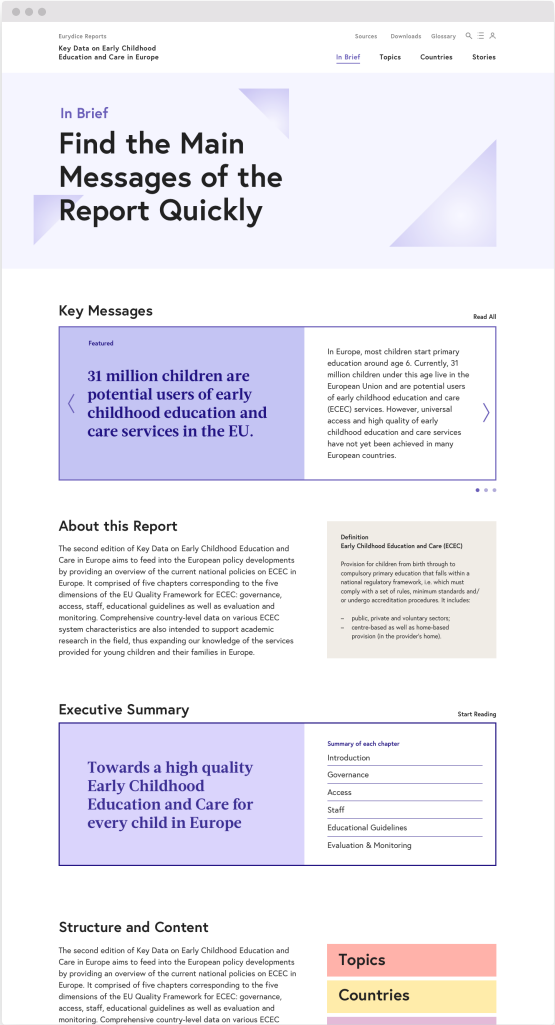
Figure 82. (left) The *In Brief* page.
Figure 83. (middle) The *Topics* page.
Figure 84. (right) The *Stories* page..
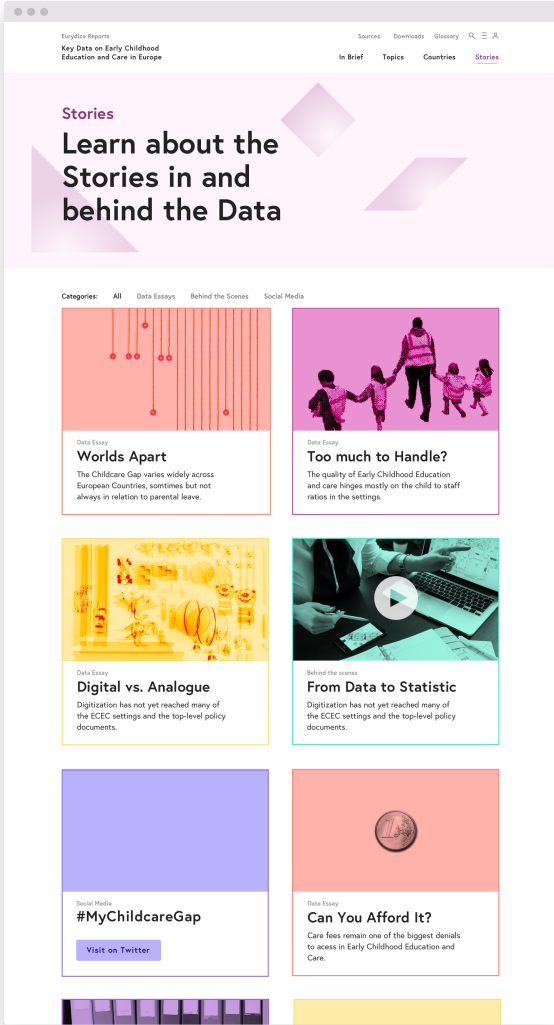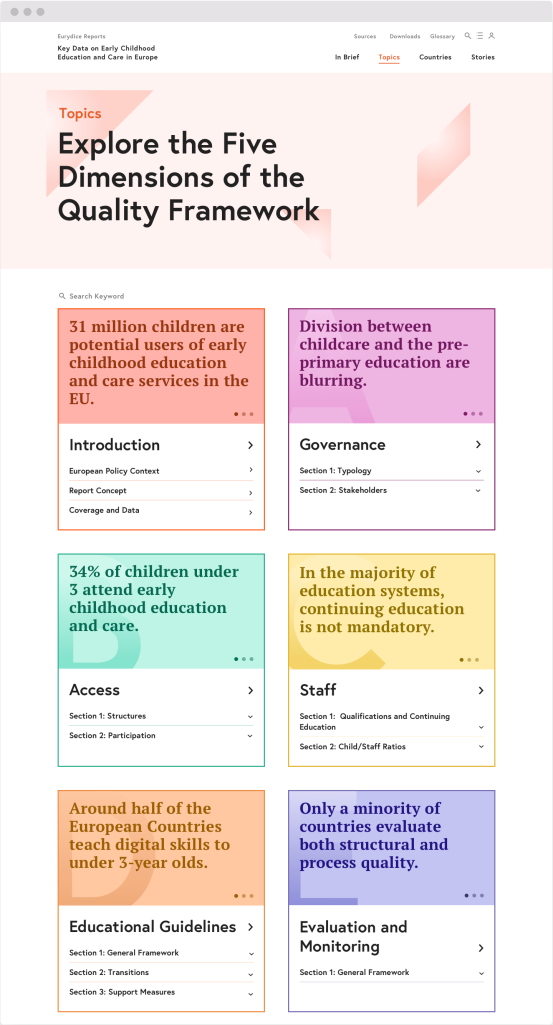
Topics: This page provides an overview over and an access to the full chapters of the report (Figure 83). It shows each topic as tiles with multiple sections and chapters. Each tile contains a slider that gives the users a little preview of the topic. The user can either click on the whole tile or on one of the chapters. Clicking on the whole tile brings the user to the topic introduction.

Countries: The *Countries* page provides an access to each country page. This consists of a simple list of the countries that is ordered alphabetically.

Stories: The *Stories* page contains different kinds of stories about and from the report (Figure 84). The page consists of a list of tiles that can be sorted by the different types of stories: *Data Essays*, *Behind-the-Scenes*, and *Social Media*. Data essays take one topic from the report and use more playful means to communicate it. The Behind the scene category consists of videos in which civil servants who have worked on the report explain how the collected and analysed the data, wrote the text and created the graphics. And social media tiles simply link to different social media campaigns or channels.

Subpages

All main pages except the start page contain further subpages. These subpages contain the main content of the report.

Chapter: The *Chapter* pages can be accessed via *Topics*. They consists of a header, a sidebar and the main content body (Figure 85). The header contains the chapter's title and a very short introductory text. It also provides users with a breadcrumb that leads back to the topic and a direct link to the next chapter. Further features include the possibility to download the chapter, cite and share it, and bookmark it. Finally, the settings button allows the user to control if only the figures or the figures and the text are displayed on the page (Figure 86). In a dropdown, user can also select countries that are then highlighted throughout the page.

To the left of the main column of the page, there is graphic element that shows the layout of the page as simple rectangles. The length of a rectangle represents the length of one section of the page. This element remains at the left edge of the
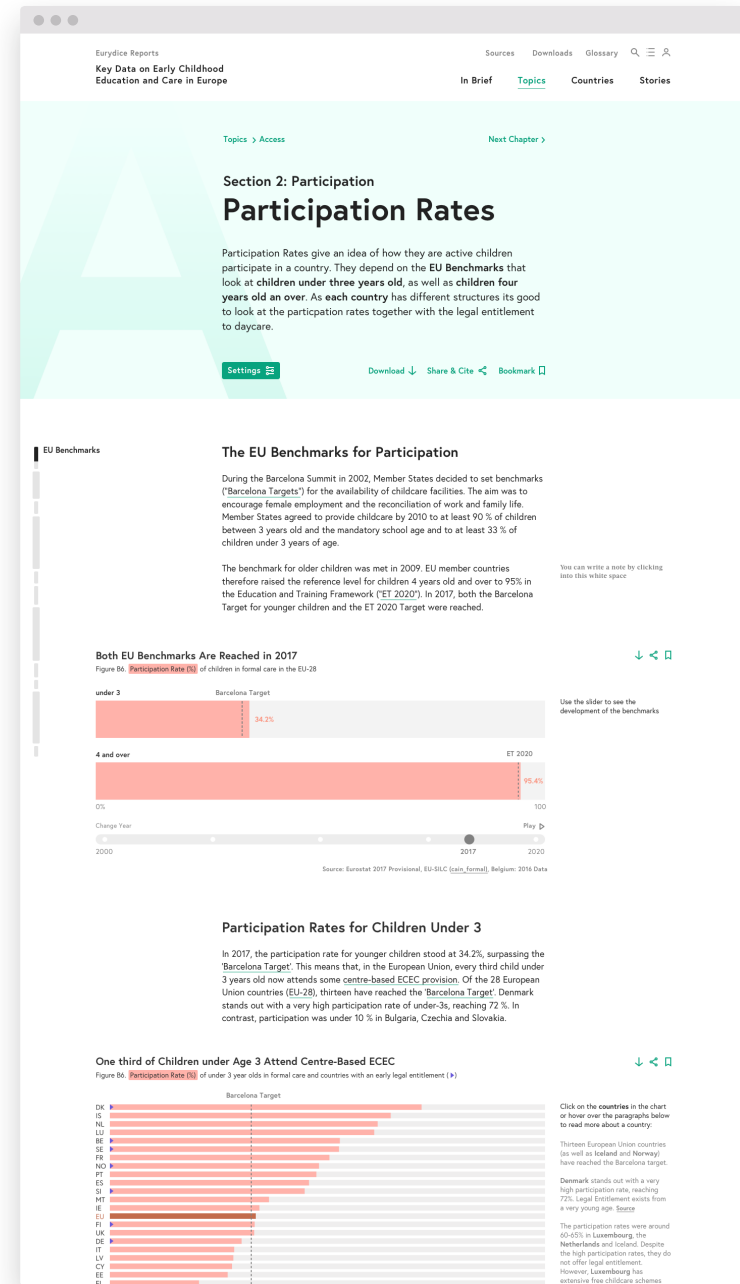
Figure 85. The start page of the final prototype.
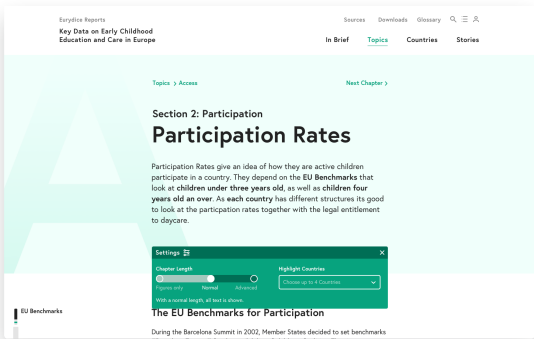
Figure 86. The page settings panel (box in dark green) on the chapter page.
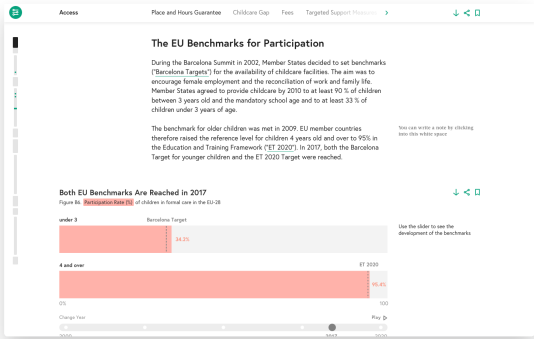
Figure 87. The minified version of the navigation that "sticks" to the top of the page as the user scrolls.
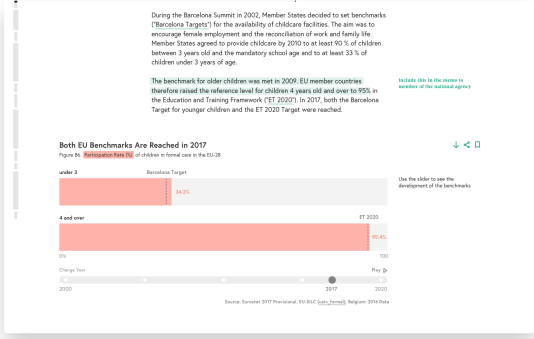
Figure 88. Highlighted text and a note (in green) by the user.
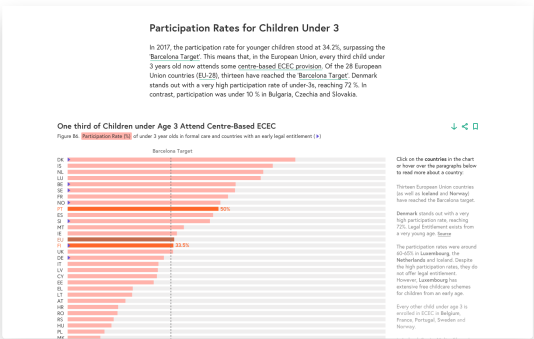
Figure 89. The chart title summarizes the main message of the chart, while the chart subtitle contains the key.
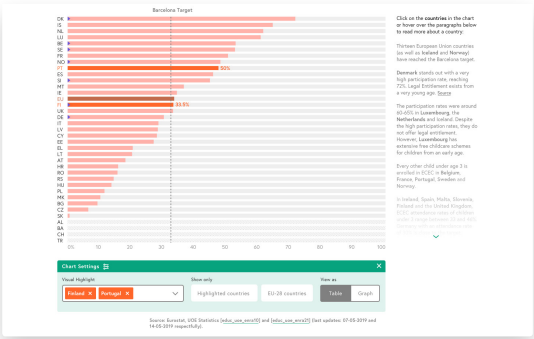
Figure 90. The chart settings that – in the case of this chart – can be used to highlight certain countries.
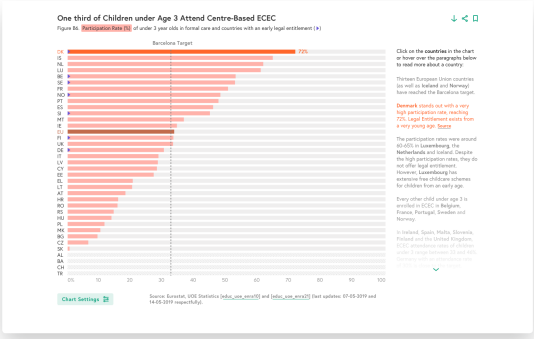
Figure 91. View of when the user hovers over a bar in the chart to read about that particular country in the column on the right.

window while the user scrolls. As the user reads, it visually shows them where they are in relation to the whole page. This element also serves as an anchor navigation: Hovering over a rectangle shows the title of the corresponding section or graphic. By clicking on one of those rectangles, the user can scroll down to that particular section.

The navigation is minimized and also sticks to the top of the viewport when the user scrolls down (Figure 87). That way, these features remain available as the user continues to read.

The main body of this page contains text and interactive graphics. Graphics and text flow one after each other. The text is kept to a minimum. The user can highlight text by selecting it with the computer mouse (Figure 88). Clicking on the white space to the right of the text columns gives the user a curser that allows them to write a note. The charts are wider than the text column. They consist of a descriptive title, a technical secondary title that – if necessary – embeds the chart's key – and the chart itself (Figure 89). Below the chart, users can filter, select, and change certain variables in the chart settings (Figure 90). An indication of the data source is placed under the chart. A column on the rights side of the chart contains texts that explain the figure and highlight interesting stories in the data (Figure 91). Hovering over an element in the chart will highlight the corresponding text in the column and vice versa.

Country: The country page describes and structure of early childhood education and care and summarizes the content of the report from the viewpoint of a specific country. It is structured in the same way as the *Chapter* page. The only difference lies in the settings: Instead of providing the possibility to highlight countries across the page, it allows the user to choose a second country that is shown alongside the originally selected country.

Story: The example *Data Essay* I created for this thesis, is about the childcare gap (Figure 92). The data essay page has many of the same features as the *Chapter* page. It allows the user to download the story as a PDF, share and cite it, and bookmark it. The main content consists of a short introductory text and a chart. The chart uses interactive elements that
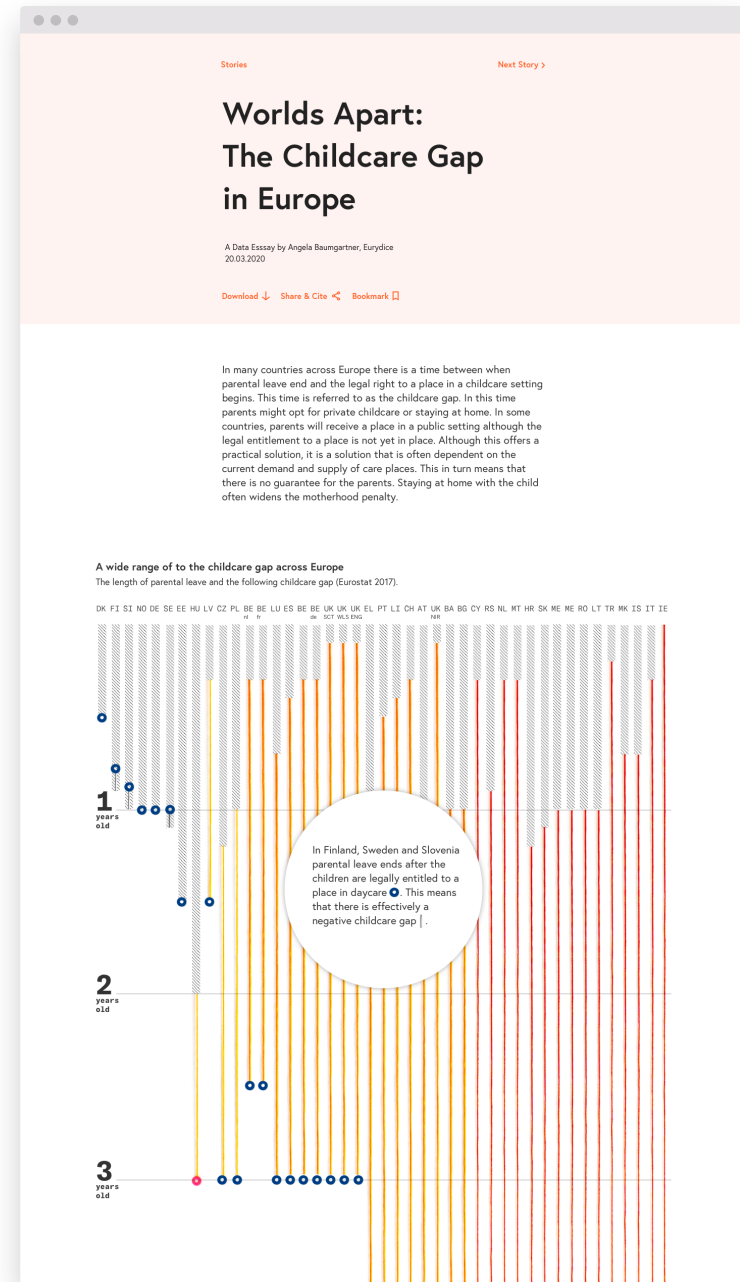
Figure 92. *Data Essay* on the Childcare Gap in Europe.

appear as the user scrolls down to explain and highlight stories in the chart. The chart is designed to be emotive. This means that if, for example, the data references length, the visual elements that show that data in an adequate visual length. Furthermore, the act of scrolling is treated as time variable. If time is a data property in the chart, as is the case with the length of the childcare gap, then the time it takes to scroll through the chart references the time that is accounted for in the data.

The Utility Navigation

The utility navigation is placed on the top right of the page; right above the main navigation. The utility navigation pages – *Your Content*, *Search*, and *Profile* – contain the main functionalities needed to use the platform.

Your Content: This page contains all the notes, bookmarks, and highlights that the user has created (Figure 91). It displays this user-generated content through an abstracted visual representation of the report. As with the visual anchor navigation on the *Chapter* pages, each section and figure of the report are presented as rectangles. Notes are shown as small dots, highlights as lines, and bookmarks are represented with small bookmark icons. By hovering over these visual representations, the user can see the highlight or note and edit it. The tooltip also provides the user with a direct link to that particular highlight or note in the report.

Search: On this page, the user can search for any term in the report. Results are shown as a network diagram by default but can also be displayed as a list. The network diagram reveals how search terms are related to each other. It shows the search result as connected tiles. The tiles contain the term that was searched in context. For example, a search for "Norway" displays parts of a chart in which Norway is shown as well as sentences and paragraphs that mention Norway. The tiles also provide a direct link to that content in the report.

Profile: On the *Profile* page the user can log in and out and change their account information and account settings. As this is a common feature for many online platforms the profile page has not been prototyped for this thesis.
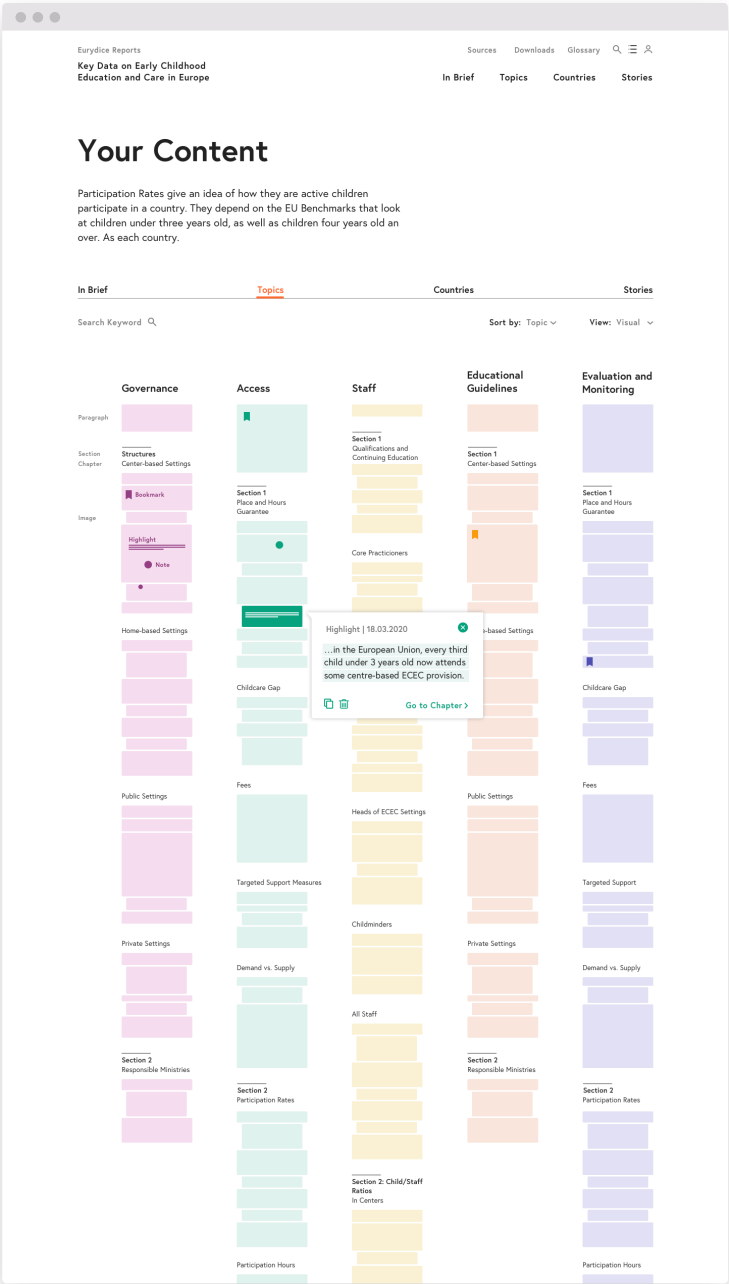
Figure 93. The *Your Content* page.
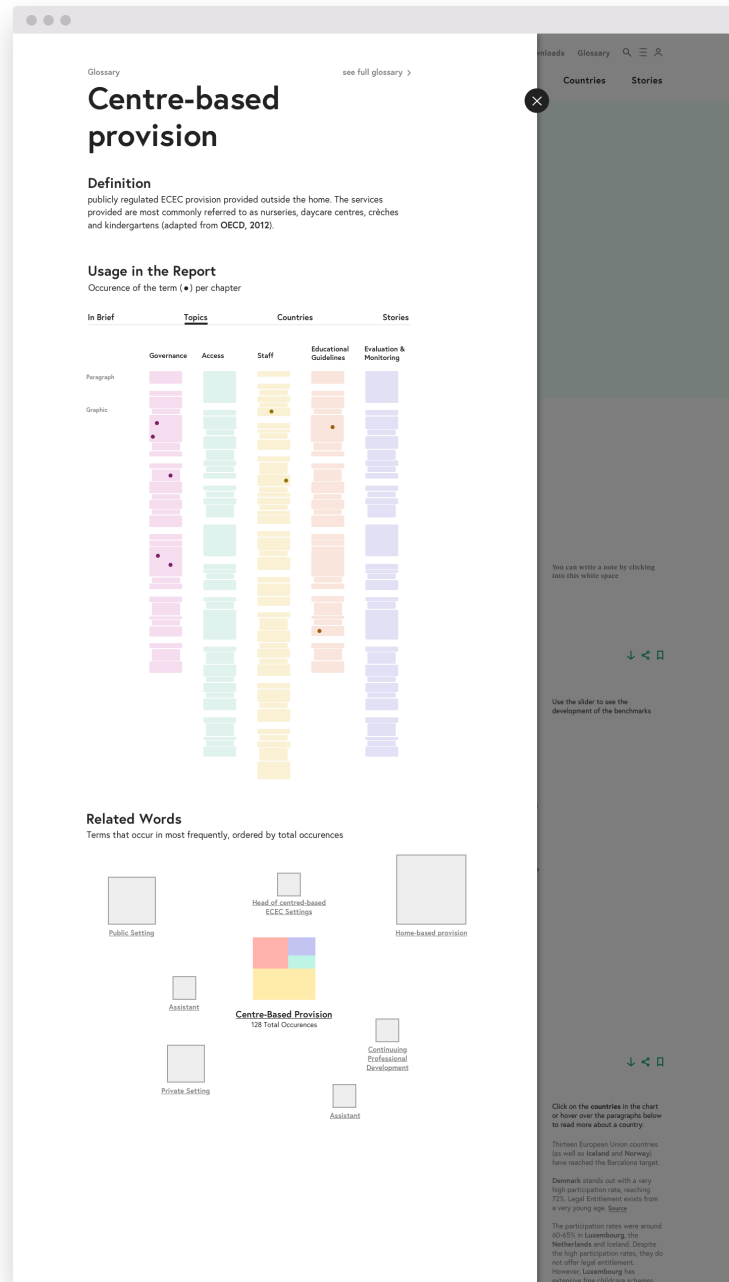
Figure 94. A glossary entry as an overlay to a chapter.
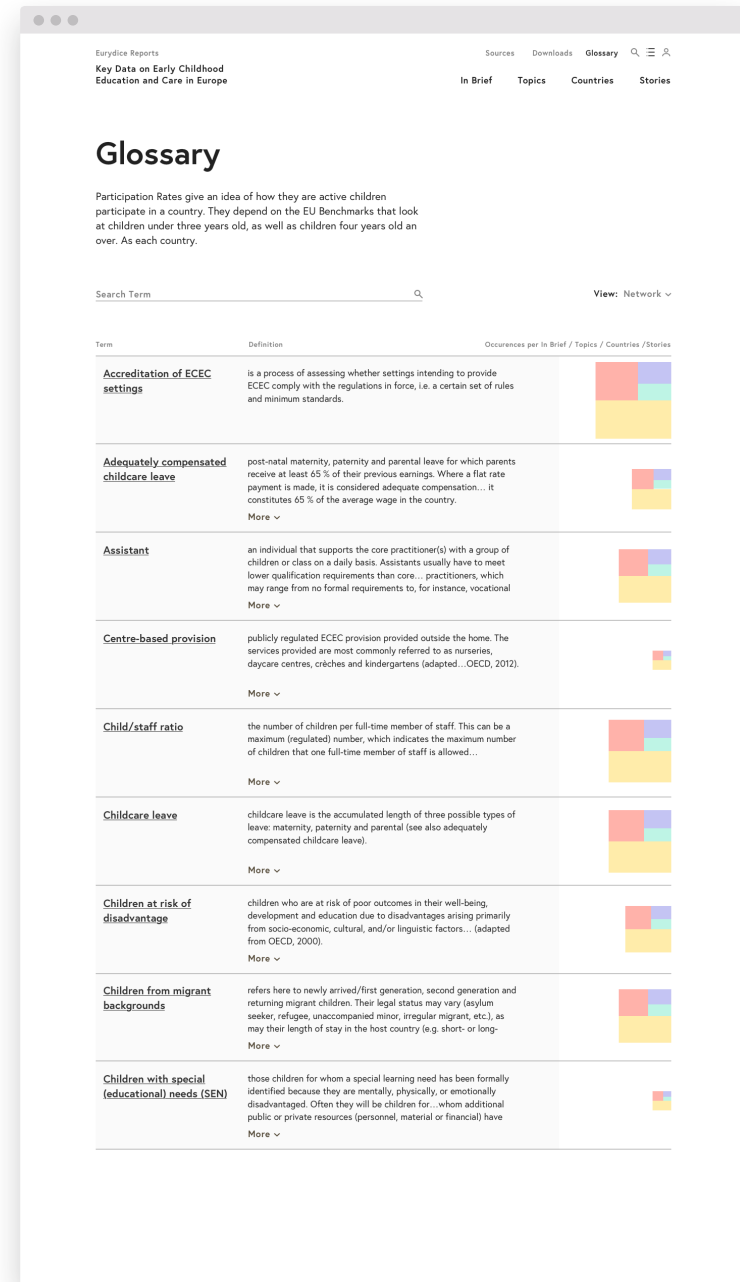
Figure 95. The page that contains all glossary entries.

Connectors

Connectors are interface elements that can be invoked as overlays on any page of the platform. In addition, all elements are collected on a dedicated page that can be found next to the utility navigation. For example, the definitions for individual terms can be viewed while reading the report's text but can also be found via the *Glossary* page. The connectors act as a meta layer to the content. This relates not only in the way they function, but also to how they display the properties of the report as data visualizations that provide further insight. The *Glossary*, *Downloads* and the *Sources* are constructed as connectors.

Glossary: The *Glossary* contains terms that have been manually defined by the authors (Figure 95). On the chapter pages of the report, words that are defined in the glossary are underlined. When clicked on, the *Glossary Connector* appears as an overlay to the page (Figure 94). This overlay contains the definition of the term. Using the same abstracted representation that can be found on the *Your Content* page, it also reveals which chapters and sections contain that word. In addition, the glossary overlay provides a network visualization of the terms that are related to the selected term. The visualization shows how often these further terms appear in the same paragraph or section as the selected term.

Downloads: The *Downloads* page allows the user to download the whole report as a PDF, as well as all the figures and data. Users can also select parts of the report, and single figures and data sets. Again, the abstracted representation of the report serves as a navigational element that allows the users to select want to download. Through this method it is also possible for the user to create a custom-made PDF. Within the report's chapters, the download overlay appears when the user clicks on the download chapter or download figure button.

Sources: The *Source Overlay* is shown when the user clicks on the data source that is listed below the graph (Figure 96). Similar to the glossary, the source overlay contains a description of the data source as well as a visualization that reveals how that particular data set is related to other data sets in the report. On the *Sources* page, the user can browse through the different data sets using the same visualization.

Figure 96. *The Sources Overlay.*

3.7 Reflect

In the *design study methodology*, the reflect step is described as the phase in which existing design guidelines are confirmed, refined, rejected and new guidelines are proposed. This kind of reflection is certainly present in this thesis as well. It mostly occurred at the very end of the whole process and is documented in the *Discussion* and of this thesis. However, it is important to point out that this is not the only situation in which reflection is paramount to the project. In fact, reflection is a constant companion to a design process. Reflecting resembles the act of consciously pausing, of stepping further away to see more – more context, different ways, new connections. Doing this is almost omnipresent in design and at the same time, easy to forgo.

While I design, there are an uncountable amount of small moments in which I pause to look at my work, comparing what I actually perceive with how I imagine it to be. In fact, reflection often happens through comparison: comparing my methods with methodologies described in design literature, comparing two prototypes or various design alternatives, and comparing how I write about my design and my process with the actual outcome. Sometimes when I was working towards a deadline, I realized how I would rush over these moments of reflection, trying to force a solution into being. This behavior usually led to sloppy design that I had to rework again later on. A good balance between forgetting myself in the forms and shapes of the design and stepping back to reflect on what I had done, was usually more successful.

3.8 Write

Because reflection is almost ubiquitous, it is very difficult to pinpoint the moments in the process in which it occurred. Writing on the other hand, is easier to track as it renders a creative outcome. Writing was started relatively late in the process and was always accompanied by a literature review. At the beginning, some attempts were undertaken to create a public, online diary of the process that would describe my steps in more detail. However, the writing together with organizing, planning and conducting the workshops proved to be too time consuming overall. I therefore dropped this idea and decided instead to alternate between writing and design phases. All in all, I went through four design and three writing phases.

Writing this thesis was done with the goal in mind to allow people to jump to different parts and chapters without having to read the whole thesis. Balancing this approach with not being too repetitive for the people who would read the thesis linearly proved to be challenge. As was the goal to make the thesis interesting to people beyond the field of design, namely to the collaborators and participants of this thesis. The outcome of my writing process is the thesis at hand.

4 DISCUSSION

4.1 Discussion of the Results

The thesis at hand seeks answers on a methodological level and on a level of an applied design outcome. Methodology-wise the thesis: 1) Examines a participatory information design process, and 2) Explores narrative design patterns. On an applied design outcome level, the thesis: 1) Gathers and documents the needs of audience groups that are commonly addressed in statistical dissemination and 2) Proposes a portal for data-driven government reports that addresses these needs. The following section reflects on the two methodological inquires of the thesis as well as the two design outcomes.

The Participatory Information Design Process

In the first research question, the thesis set out to answer the issue: "How can a participatory information design approach capture the diverse needs of a broad audience and address those needs in the design of a data-driven government report?" The participatory information design approach that was used in this thesis is inspired by Pontis' information design process (2019) and Seldmair et. al.s' design study methodology (2012). It is based on a constructive-interpretative paradigm, outlines a process, and includes various methods. It considers user participation, designerly ways of working, and the characteristics of the subject matter in the context of a research study. The following paragraphs reflect on the participation, design, information, and research components of the process.

Matters of Participation

The application of a constructive-interpretative paradigm as postulated by Pontis was paramount to the concept of participation in this thesis. Seeing people as complex human beings allowed me to observe the contradictions between what people think, say, do, and wish. I asked the study participants how they use the report *Key Data on Early Childhood Education and Care* in a variety of ways – through surveys, through the visualization of the surveys, and through collaborative enacting, doing, and making. This blend of activities led to a more complete, in-depth understanding of the multifaceted tasks and needs of the users. *Doing*, *making* and *enacting* with participants in order to understand various kinds of user experiences is the core idea of co-design after Liz Sanders (2016). This approach proved to be a valuable framework for applying the constructive-interpretative paradigm in the collaborative workshops.

In the feedback sessions, the constructive-interpretative paradigm also supported the detection of tacit knowledge – not through the observation of contradictions, but through the observation of body language and the expression of emotions. Listening for small interjections like "aha" and "hmmm" and looking out for expressions of confusion or joy on the participants' faces allowed me to discern steps in the meaning-making process that often remain unexpressed. The possibility to detect if understanding is taking place, makes the participatory approach as applied in this thesis uniquely suited to design products that aim at making information understandable.

Matters of Information

Engaging with the *Key Data* report and its contents in the *observe & explore* step helped me gain in-depth knowledge on the subject matter. This knowledge, supported the development of a design solution that strived to be true to the content. The activities, however, did not help me organize the data I would need in the following steps, namely the report's text and the data from the charts. The process I followed lacked a step for these organizational activities. In Sedlmair et al.'s Design Study Methodology, the *winnow & cast* step – which I call the organize step – includes checking if data for the project is available. This step could be extended to include the material organization – namely, the collection and processing of data.

Matters of Design

The overall designerly approach in this thesis included: 1) Translating user inputs into a design artefact; 2) Exploring different solutions through variation and iteration; and 2)

Applying information design theory. In a participatory process, user inputs are gathered and documented in each step. Visual explorations and theoretical frameworks, on the other hands are only applied in the *prototype & evaluate* phase. Visual exploration is a crucial part to arrive at a design artefact that engages the user and that treating it as secondary approach can result in products that do not adequately fit users' needs. The lack of visual exploration steps in participatory processes might also account for many of the difficulties designers face when using a participatory information design process to produce an actual design artefact (c.f. Pontis, 2019; Sanders & Stappers, 2018).

For these reason, I would propose that visual exploration and the experimentation with theoretical frameworks should start already in the *observe & explore* step. In that step, the design researcher would start to sketch and prototype potential solutions and would begin to explore the application of theoretical frameworks in the design. Then, in the *analyze & synthesize* step, the researcher could synthesize these preliminary visual explorations with audience inputs. This would provide the designer with a more "designerly" input to the design process beyond the abstract list of audience needs and requirements.

Matters of Research

Balancing flexibility with academic rigor is a tension that is well documented in design theory (Stolterman, 2008). Describing the creative, non-linear process practiced in this thesis proved a challenge. It was difficult to maintain a constant writing process parallel to my process, which already included designing, working with the audiences and producers, organizing, and analyzing research material. Writing about my findings later, however, meant that many of the processes had to be reconstructed. Writing also brought many questions on how extensively, precisely, and linearly the process should be described. In that sense, I believe that the "write" step in the participatory information design approach would benefit from additional methods that would support the design researcher in the endeavor of documenting a process.

Narrative Patterns as Design Methods in a Participatory Process

The use of theoretical frameworks both support the translation of user inputs and can be regarded as separate strategies that encourage new explorations. In this thesis, narrative design patterns were one such theoretical framework. These narrative patterns are the focus of the second research question: "How can narrative design patterns enhance this approach to create data-driven government reports that are not just useful and useable, but also meaningful to that audience?" The following paragraphs reflect on the use of narrative design patterns in the process and in the proposed report portal.

Narrative Patterns for the Translation of User Needs

Narrative patterns proved most helpful in translating the more tacit audience needs into an actual design input. Needs that regarded the **scope** of the report were translated using the concept of narrative structures (Kosara, 2017, Segel & Heer, 2010). These patterns helped redefine the content structure and how the audience engages with it. In the *Chapter* pages (Figure 85) these patterns seemed to make the report more useable. Feedback showed that audiences welcomed the short texts and the possibilities to either just read the chart, delve into its stories, or explore the data in more depth.

Needs that regarded how the audiences see themselves in the report (**affect**) can be translated through the use of narrative patterns that support identification. In this thesis, I experimented using graphic means to convey specific qualities of the data (Rost, 2019). This method was applied in the example of a data essay about the childcare gap (Figure 92). Reactions to the essay from parents, producers, and civil servants were audibly emotional: When people had scrolled down to the longest childcare gap, they would often gasp.

Needs pertaining to the possibility to compare and connect content (**intertextuality**) were mostly translated using concepts from interaction design. However, narrative patterns from research into the transition between narrative frames

(c.f. Hullman & Diakopoulos, 2011) could be explored as a means to address intertextuality in future research.

Narrative Patterns as Design Inspiration

In the design process, narrative design patterns acted as powerful means to conceptualize my design decisions and to communicate these decisions to others. Not all judgements can be extracted from user inputs, and the narrative patterns often guided me in assessing, for example, if the audience should be moved, informed, and/or encouraged to take further action on the portal. This finding is consistent with Drucker et al.'s argument that narrative design patterns can be used to elicit audience needs that we do not anticipate (2014).

Narrative Patterns in Government Context

The results from this design study suggest that government reports can improve from the use of narrative patterns. Narrative patterns are not readily applicable to government products. Due to the fact that they have to appear impartial to the topics in the data, their possibilities to provide interpretation of said data is limited. However, at the end of the day, data needs to be meaningful to people in order to be impactful. If data cannot be made meaningful through contextualization and interpretation, it can be made meaningful by 1) applying narrative structures that lead the user through the data but also allow them to explore it, and 2) emphasizing inherent, interesting properties of the data through visual means. The range of different patterns that can be applied and combined support the creation of a product that offers multiple pathways to its content.

A Rich Picture of the Report's Audiences

Adressing the applied challenge of the first research question, this thesis found that there are a variety of aspects that can be observed in terms of how audiences use government reports. Firstly, looking at roles and tasks of each audience group reveals how manifold the activities are that define the use of the report. Secondly, an examination of the reading behaviors exposes the methods that are applied by the audiences to make meaning from the report's content. And thirdly, an analysis of more tacit needs shows how the target audiences differ in terms of the scope, intertextuality, and affect.

The most striking aspect of the these findings, is the high number of activities in which these audiences engage. The civil servants work with a variety of stakeholders, the researchers teach, study, write, and collaborate, and the citizens engage in a complex process of meaning-making. Therefore, roles, tasks, behaviors, and needs are fluid. They vary change over time, and depend on momentary situations. Each audience group inhabits a range of these characteristics and the groups' ranges overlap in certain areas. This means that a researcher might sometimes read the report like a civil servant – in just enough depth to be able to relay the most important message to others; a civil servant might be moved to action by a simple, more emotive representation of the report's data; and a citizen might take more interest in the metadata than in the playful, journalistic piece. Therefore, it is not just important to *know* one's audiences – it's important to *know the range of their tasks, needs, behaviors, and emotions* of one's audiences.

A Useful, Useable, and Meaningful Data-Driven Government Report

The findings on the audiences imply that a consolidated product might be more successful in accommodating their diverse and fluid needs than creating separate product versions which is the current trend in statistical dissemination. The proposed report portal addresses the applied challenge of the second research question. It suggests that allowing users to seamlessly move between simpler, less dense representations of information and an in-depth engagement with that information encourages a more comprehensive meaning-making process. Users are supported in various ways in using this multi-faceted portal:

Supporting Navigation and Sense-Making: The portal uses an abstracted, visual representation of the content to support the users in navigating and analyzing the content. The

design of this element and the different ways it is used on the portal demonstrate an interesting design option to enhance the usability of an online report.

Providing Practical Tools: In contrast, the practical tools that the portal offers are more common to digital reading applications. They include the possibility to make notes, high-light text and visualizations, and bookmark chapters and figures. They also allow the user to download content in various formats.

Giving Context: Connectors is what I termed overlays that provide further, more in-depth information on a subject through a combination of text and data visualization. Connectors help users make connections between different concepts of the report and to organize content across the whole portal. While overlays are a common interface element, the concept of using them as layered connectors provides a new perspective on how they can be used to provide varying levels of depth to different audiences across a portal.

Offering different types of content: In terms of scope, the proposed portal offers different lengths of content – *Main Messages*, *Summaries, Chapters* and *Stories*. The *Chapters* content type provides the user with the options to only read the charts or to read both the charts and the text. And *Stories* is an additional content type that I created which offers lighter, more emotive content to the user.

Encouraging different ways to engage: The portal follows an *explanation first, exploration later approach.* As such, it allows users to simply follow the predetermined route through the content or to explore content in more depth at certain points along this route.

The portal should be useful, useable, and meaningful for all audiences. My proposal is useful in that it offers work tools, useable in that it provides different types of content formats for different needs, and meaningful in that it engages the audiences through narrative strategies. In the process, it appeared that special attention should be paid to making the report useful to policymakers – an audience for which the

report must simply function –, useable for researchers – an audience that needs a high level of usability for the various different tasks they have to complete, and meaningful for the broad public – a group of users for whom the content and the product must be relevant and desirable in order for them to engage with it.

Overall, findings from the collaborative workshops, the feedback sessions, and the interviews with the producers indicated that there is a large demand for digital solutions when it comes to data-driven government reports. For the civil servants and the researchers, such reports as the *Key Data* report represent essential tools that need to fit into their increasingly paperless, online working environment. In regard to the citizens and journalists, there is still a lot of potential in finding ways to make government data useful and meaningful to them in their daily life.

4.2 Contributions

This thesis, both in theory and in practice, examines different approaches to demonstrate how Information Design can be applied to further the communication of insights from government data to a diverse audience. In doing so, it contributes both to information design research and to practical applications at the intersection of government and design.

Research Contributions

The purpose of the present design study was to 1) address the gap between exclusively strategic research and highly applied case studies on the dissemination of official data and 2) to extend the narrow range of government-focused information design research. The thesis responds to this gap through inquiries into theory and practice of information design. The contributions come in the form of two nascent theories – preliminary outlines of what could become fully developed theories through further research.

Firstly, the thesis articulates how information design methodologies and participatory design methodologies can be consolidated into a coherent participatory infromation design approach. In chapter *2.2 A Participatory Information Design Approach*, the thesis summarizes historical and current research on the qualities of design, describes design methodologies that involve the user in the design process, and examines different kinds of information design processes. The chapter ends with a proposal of a participatory information design approach after Pontis (2019) and Sedlmair et al. (2012). Following this information design approach, the applied thesis project then uses and documents various methods that bridge user participation and the creation of an information design product. One of these methods is the extensive use of visualization as a means to record and analyze audience needs and to translate these needs into a design solution. Another method proposed in this thesis to bridge user inputs and design is the use of theoretical frameworks – such as narrative patterns – that support the designer in the translation of tacit audience needs.

Secondly, the thesis demonstrates how narrative design patterns can support meaning-making. In chapter *2.3 The Information Design Product*, the thesis provides an overview of information design products in official statistics and draws a connection between the qualities of information design products and narrative design patterns. In the applied design project, Kosara's argument structure for data stories (2017), as well as Rost's proposal for using visual means as a way to further identification with the content (2019) are applied.

Practical Contributions

The *participatory information design approach* offers people working at the intersection of design and government a practical approach that is especially suited for the development of information design products in a government context. The participatory research methods provide the possibility for a genuine engagement with the often diverse and broad target audience. By focusing workshops and feedback sessions on the understanding of information and visualization, it is furthermore possible to combine an aspiration to be true to the content with the needs of the audience.

The *participatory information design approach* led to an important finding that a consolidated platform which allows users to move seamlessly between documents is better than creating separate products. This contributes to a new perspective on insights gathered through a participatory method and led to a comprehensive proposal for the design project.

The insights gained from the audiences are also of value for further use. As policymakers, researchers, journalists, and the broad public are typical target audiences for any data-driven product in the public sector, the comprehensive documentation of their tasks and needs in this thesis can be used as a starting point for further design projects.

4.3 Limitations

The limitations of this thesis are related to the study setup, as well as to the general approach that was taken. In terms of the study setup, limitations are mostly due to limited time and resources while the limitations in terms of the approach are the result of a lack of critical reflection in some areas of the thesis topic.

One limitation of the study setup was the homogeneity of the group of study participants. Although it was a conscious decision to limit the pool of participants to people residing in Finland, the study would have benefited from including perspectives from other countries as well. Inputs from people who live in places that do not have the high level of technical infrastructure that Finland provides would have added a variety of different challenges but also new solutions to the design space. The group of participants was also limited in terms of gender, age, and ability. Due to the high prevalence of women working in the field of early childhood education and care, most participants were women between 28 and 60 years old. Minor impairments, for example a weaker eyesight or an unfamiliarity with interactive websites, that were observed during the feedback session already impacted subsequent design decisions noticeably. It is therefore feasible that a different composition of the participant group would yield more diverse results.

The study was also limited by the fact that the design process was constructed and followed by only one person (myself) who assumed the roles of designer, researcher, writer, and project manager. In reality, participatory design and information design projects are multidisciplinary efforts that call for a collaboration among people from many different fields. These collaborations add complexities to the design process that are not considered in this thesis. It is therefore debatable how the proposed participatory information design approach would perform when applied by an interdisciplinary team of people.

Finally, the design research study omitted a crucial step that is outlined in the design study methodology but could not be included in this thesis due to time reasons – the *deploy* step (Sedlmair et al. 2012). In this step, the project is published and made available for use "in the wild". This deployment of the project provides essential feedback on the validity of the design solution, that cannot be gathered through a prototype. According to Sedlmair et al., not publishing the tool, portal, or visualization that was developed is therefore one of the potential pitfalls of a study.

In terms of the overall approach, this study was limited by the absence of a critical stance towards the collection and communication of data through government institutions. As a growing number of authors point out, it is essential to critically assess the motives behind the data collection, what and who is left out in a dataset, and what stereotypes the dataset imparts on the reader (Criado-Perez, 2019; Drucker, 2014). Statistics offices in the European Union are guided by the principle of impartiality and objectivity described in the European Statistics Code of Practice. This code prescribes that member states strive to compile statistics on "an objective basis determined by statistical considerations" (Publications Office, 2018, p. 12). Drucker points out that with the increasing datafication of society it becomes more and more important that the idea behind this "objective basis" – the decisions of who and what to count – find its way into the visualizations of data. Such a critical stance could have brought to light interesting controversies in respect to tensions between narrative, truthful and effective communication

4.4 Future Research and Development

This study introduces various possibilities for further academic research and practical applications. For one, future investigations are necessary to validate conclusions that can be drawn from this study. For another, the study lays the groundwork for new questions and investigations into the intersection of information design and the communication of official government data.

In general, the field of information design and the field of statistical dissemination would benefit from a shared literature that covers historic backgrounds, methodologies, frameworks, and concepts that are relevant to the application of information design in a government context. Such a comprehensive literature review could extend on the theory outlined in this thesis to include topics such as the history of statistical dissemination, additional design concepts for designing information design products for regular citizens, and related interaction design concepts.

Further research into the use and reception of government reports could expand the study to include audiences from other countries. Researchers and civil servants will likely have similar needs independent of their nationality as they all use the report for work-related tasks and operate in the same international environment. The major difference for these two audience groups might lie in how new technologies, such as an online report portal, are adopted in different government institutions. Further research could be conducted on how such a new way of reading reports is adapted in technologically less developed environments.

To study the reception of data-driven, governmental communication by the broader public in more depth, it would furthermore be interesting to gather a more diverse group of people in terms of age, nationality, and educational attainment. Extended experiments on how they perceive official data visualizations would benefit statistical offices and citizens alike. Here, future work could focus on understanding the role of aesthetics in the meaning-making process and exploring individual differences in the perception of data visualization. Another potential area of further work could examine and evaluate the impact of different narrative design patterns on the memory and understanding of official statistics.

The use of the participatory information design process "in the wild" is another area of potential further research. Here, a natural progression would be to analyze the adoption of the process for use in a multi-disciplinary team that operates under budgetary restraints. The question of how the balance between participatory, content, and design aspects of the process can be retained in such a setting, would merit further investigation.

For the design solution proposed in this thesis to become a fully-fledged application, there is a need for further research into the roles and needs of the producers. Such research could expand on the interviews and analysis of different production workflows that were conducted in this thesis. The further development of the portal also calls for more applied design work. This would entail exploring different options for how the portal fits into these varying production workflows that are in place in government institutions. It would also include extensive technical development work. Feedback from study participants and collaborators has revealed a large need for digital solutions for government reports. All in all, the design solution presented here can serve as a proof-of-concept for the development of a product that provides government institutions with the possibility to publish more useful, useable and meaningful reports for their audiences.

5   CONCLUSION

The increasing datafication of all fields of human activity implies that the communication of insight from data is becoming a key factor in the governance of a society. Today, government bodies that produce and disseminate data have the unique opportunity to become reliable authorities that further the democratic debate through the provision of data and the interpretation of that data. In providing the interpretation of their data as a service to a broad target audience, these bodies face multiple challenges ranging from resource limitations, to changing user expectations, to divergent user needs. In information design research – a field concerned with the communication of information through visual means to a particular audience –, studies at the intersection of data, design, and government are rare, as are inquiries into the application of participatory design methods for information design practice. The aim of this thesis was therefore to contribute to the challenge of communicating insight to a broad audience with an exploration of how information design can contribute to the dissemination of government data.

The thesis explores how a participatory information design approach can be applied to make data-driven government reports more useful, useable, and meaningful to policy-makers, researchers, journalists and the broad public. It constructs such an approach in theory by building and reflecting on Pontis' constructive-interpretative information design process (2019), Sedlmair et al.'s design study methodology (2012), Koponen and Hildén's information design process (2019), and designerly approaches (e.g., Cross, 2006a; Stolterman, 2008). It also outlines narrative design patterns after Rost (2019) and Popovich (2019) as one possible method within this approach.

The design study then applies the participatory information design approach in a project that uses the report Key Data on Early Childhood Education and Care as a case study. In applying the approach, the design project makes use of a variety of qualitative, design research methods. The study also identifies narrative design patterns as a means to document and translate tacit audience needs into a design solution.

The outcome of the design project is both the documentation of the audiences' dynamic roles, tasks, reading behaviors and needs and a prototype of an online report portal that provides these audiences with content formats and work tools that are tailored to their needs. Special elements that I designed and embedded in the portal included: visual navigation capabilities; layered connectors; and data stories.

The findings from the study suggest that working with participatory methods that are adapted to the use in information design projects can yield radically different results than working with non-participatory or evaluative user-centered design methods. Through the participatory information design approach proposed in this thesis, the creator of a government report can observe, document, and consolidate the multifaceted characteristics of the report's audience. They can also address their tasks, behaviors, and needs through the development of a concrete design solution that is both true to the data and aesthetically engaging.

Limitations to the study are present in the study scope and in the perspective that was taken throughout the study. A rather homogenous participant group makes findings related to the audiences' needs less generalizable. Especially the findings on the needs and behaviors of the broad public (the "parents") would have benefited from further studies that examine their diverse needs. Finally, the study lacks a critical perspective of the role of government communication when it comes to the visualization and dissemination of statistics.

Despite these limitations, the design study demonstrates how information design in general and a participatory information design approach in particular can contribute to the creation of information design products that are truly relevant to its target audiences. As such, the thesis provides a starting point for further inquiries into applying information design concepts to the communication of government data.

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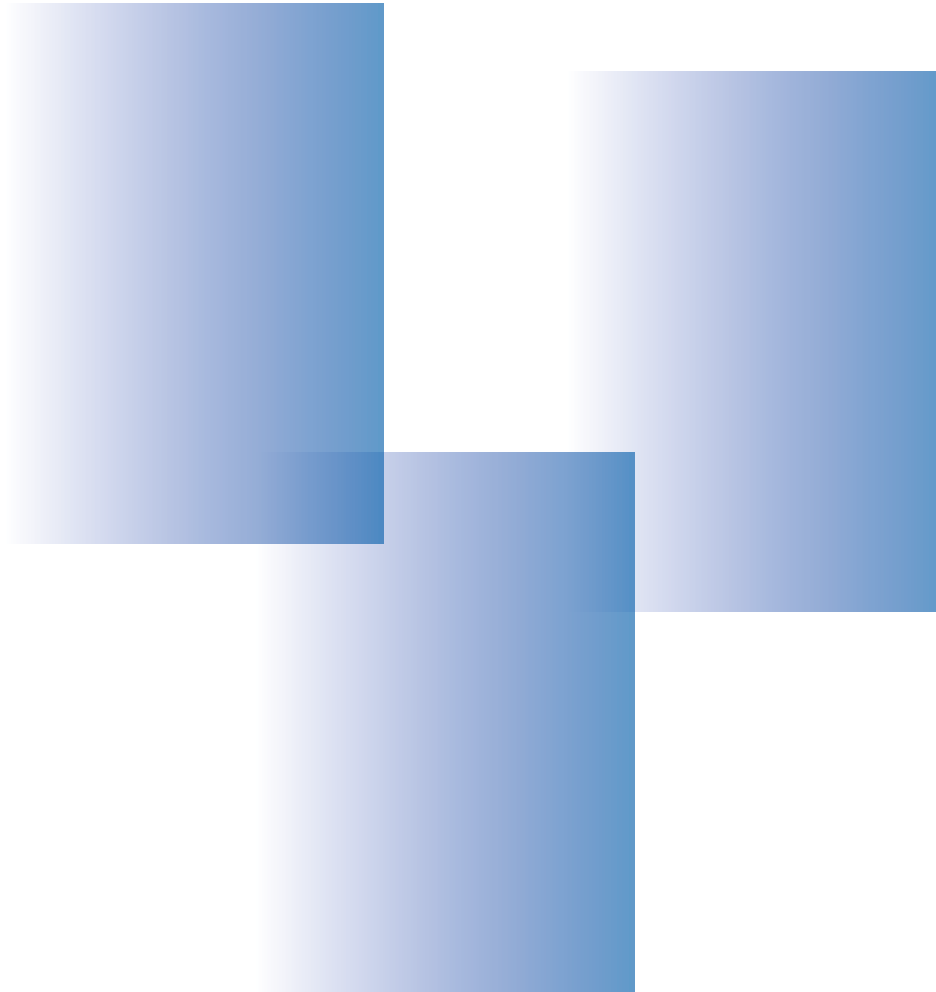
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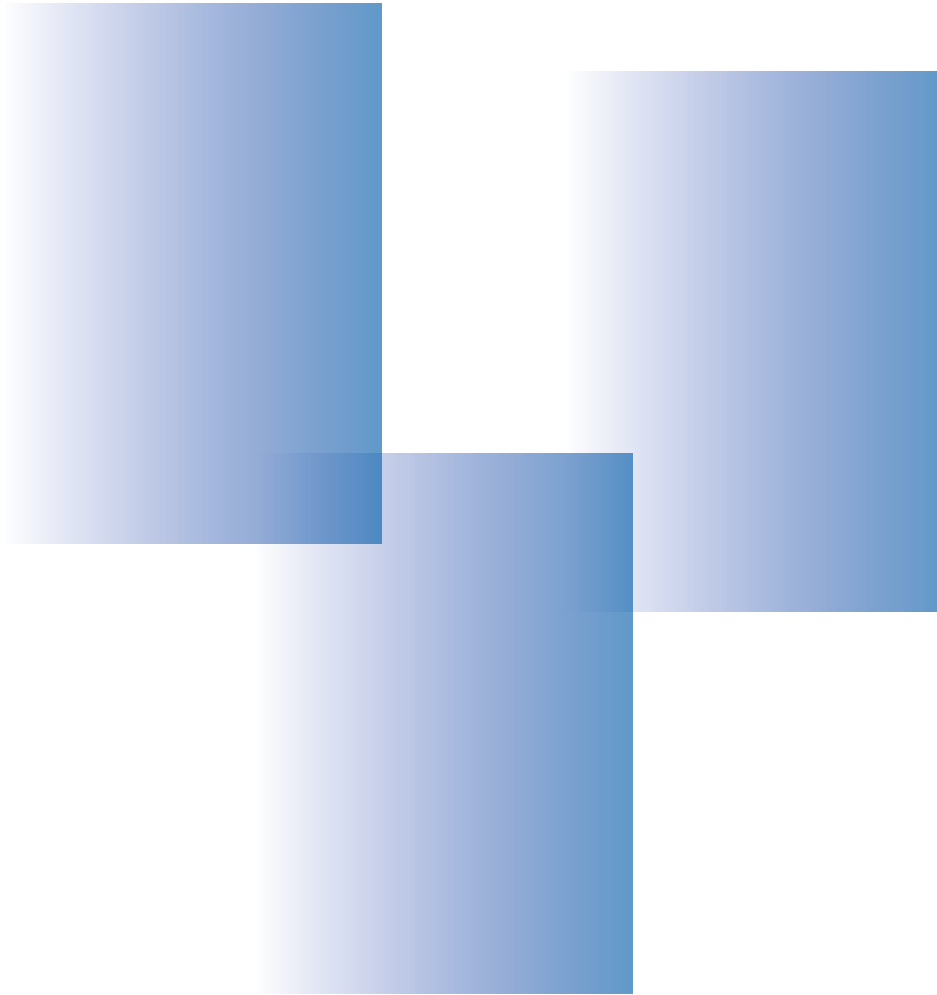
Figures that are not referenced here are my own material. In the case of screenshots, the designer and client of the captured website are referenced directly under the image.

Figure 4.   Playfair, W. (1801). Exports and Imports to and from Denmark & Norway from 1700 to 1780. In *The Commercial and Political Atlas, 1786 (3th ed. edition 1801)*. Retrieved February 4, 2020, from https://commons.wikimedia.org/wiki/File:1786_Playfair_-_12_Exports_and_imports_to_and_from_Denmark_%26_Norway_from_1700_to_1780.jpg

Figure 5.   Stabe, M., Tilford, C., & Burn-Murdoch, J. (2019, December 12). *UK general election poll tracker*. Retrieved February 4, 2020, from https://www.ft.com/content/263615ca-d873-11e9-8f9b-77216ebe1f17

Figure 6.   Sutnar, L. (1946). Taylor Instruments. In *Fortune*. Retrieved February 4, 2020, from http://www.fulltable.com/VTS/aoi/s/sutnar/x.htm

Figure 8.   Kinneir, J. (1978). *The practical and graphic problems of road sign design.* Nato Conference (p. 6). Retrieved February 4, 2020, from https://jockkinneirlibrary.org/1978-nato-conference-visual-presentation-of-information

Figure 9.   Applied Wayfinding. (2009). *Legible London*. Retrieved February 4, 2020, from http://appliedwayfinding.com/projects/legible-london

Figure 10.   Neurath, M. (1947). Reuter's transmission of the news. In *Future Magazine*. Retrieved February 4, 2020, from https://medium.com/nightingale/the-missing-legacy-of-marie-neurath-f9800733d1fc

Figure 11.   Morelli, A. & Johansen, B. (2018). Global emission pathway characteristics (Figure SPM.3A). In *IPCC Special Report Global Warming of 1.5 °C*. Retrieved March 6, 2020, from https://www.ipcc.ch/sr15/graphics

Figure 21.   Eurostat. (2020). *Infant mortality in the EU*. Retrieved April 9, 2020. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200309-1

Figure 22.   See *European Commission/EACEA/Eurydice, 2019* in the References

Figure 23.   Eurydice. (2020). Inforgraphic for the Key Data report Retrieved April 9, 2020, from https://eacea.ec.europa.eu/national-policies/eurydice/content/key-data-early-childhood-education-and-care-europe---2019-edition_en

Figure 24.   JRC. (2019). *Raw Materials Information System (RMIS): 2019 Roadmap & Progress Report – Context, Content & Foreseen Priorities*. JRC Technical Reports. https://ec.europa.eu/jrc/en/publication/raw-materials-information-system-rmis-2019-roadmap-progress-report-context-content-foreseen

Figure 25.   Eurostat. (2020). Industrial producer prices on the domestic market. Retrieved April 9, 2020, from https://twitter.com/EU_Eurostat/status/1245637093654556675

Figure 26.   Eurostat. (2019). Material deprivation rate. In *Key figures on Europe — Statistics visualised — 2019 edition*. Retrieved April 9, 2020, from https://ec.europa.eu/eurostat/cache/digpub/keyfigures

Figure 27. & Figure 98.
Besserwisser. (2013). The Planning the Bothnian Sea report.

ANNEX
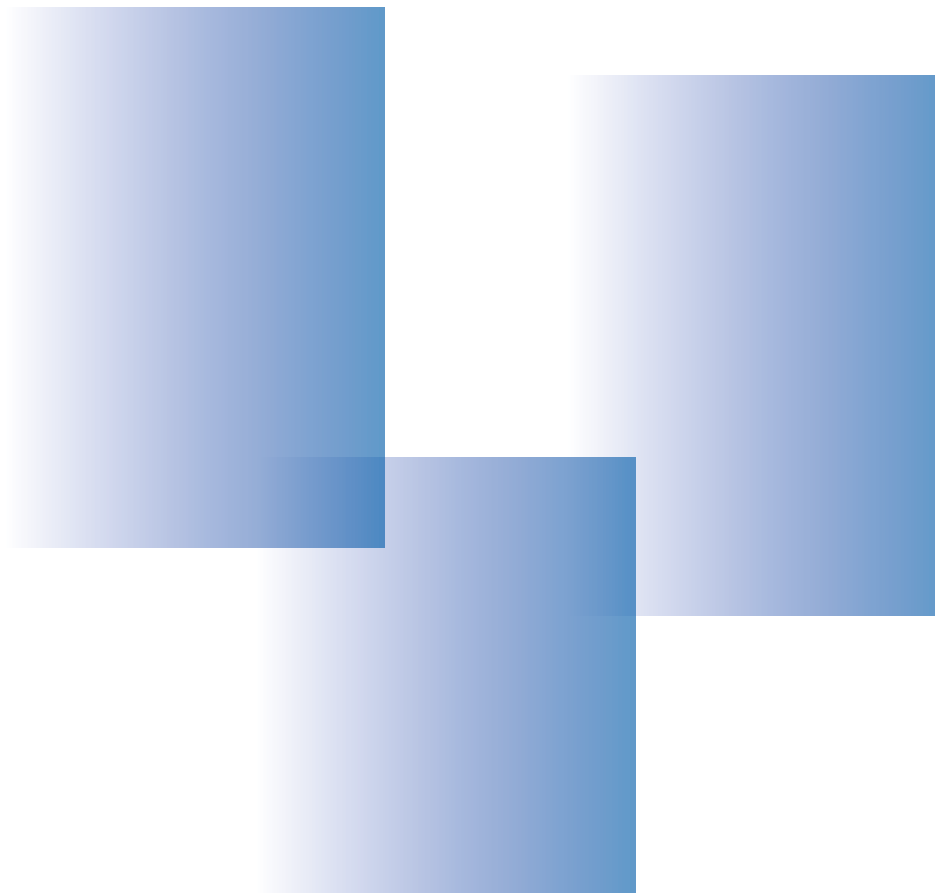
Annex A
Comparing Approaches to Publishing Government Data

The following sections describe the table on the next page:

General

All organizations offer a variety of different kinds of products through which their data can be accessed. Commonly a distinction is made between the "raw" data and publications. In the case of the Swiss Federal Statistical Office tables, graphics and maps are also considered separate products. Eurostat is by far the organization with the most product categories. These are explained in more detail under *3.5. Understanding: Producer Understanding*. For now it is important to note that while the "Statistics Explained" portal – a kind of wiki for Eurostat's statistical contents – could also be considered a publication, it was not analyzed in this table as it has a complexity that allows it to also include its own reports. Finally, most organizations also offer press releases and a page with news items. For the sake of simplicity, these are also not included in the table.

Publications

The default publication format for most organizations is still the PDF. Some organizations also offer an EPUB version which can either be downloaded or viewed online in a separate web application. Others, such as Eurostat and IPCC publish both digital, online publications and PDFs. The Office for National Statistics in the UK is the only organization that publishes their content in HTML and provides the option to download a PDF of the web content.

Most organizations publish the full report as well as an executive summary. Additionally, some also provide further versions of one report for different audiences. Eurydice, for example, sometimes creates an infographic sheet that summarizes the main findings of the report. For some publications, Eurostat provides a digital, online publication for a broad audience and a PDF for a more narrow, expert audience. The ONS publishes more interactive, shorter articles that are meant specifically for a broad public. Sometimes an article forms part of a denser and more complex statistical bulletin. The JRC might publish an infographic from a report separately and also produce an animation that summarizes the report. None of the organizations has a system to publish each report

Publishing Data-Driven Government Reports –
A Comparison of Different Approaches

– does not apply ■ yes ■ no

Organization	General		Publications		diff. versions for diff. audiences	Organization of Publications				Other
	Region / Country	Product Portfolio	Default Format	type of data presentation		versions are connected to each other	multiple pages with a publication list	typology is explained	typology is concise	data viz / info-graphics used on social media
Eurydice	Eurpean Union	**Comparative Reports**	PDF	static data vis., infographics	yes	yes	no	–	–	no
Eurostat	European Union	Data, **Publications**, Statistics Explained…	PDF, HTML	static & interac-tive data vis., infographics	yes	no	yes	yes	no	yes
Joint Research Center (JRC)	Eurpean Union	Databases, **Publica-tions, Media Hub…**	PDF	static data vis., inforgraphics, animations	yes	yes	no	no	no	yes
OECD	Worldwide	Data, **Publications**	PDF, EPUB	static data vis.	no	no	yes	no	no	yes
Intergovernmental Panel for Climate Change	Worldwide	Data, **Reports**	PDF, HTML	static data vis.	no	no	yes	no	no	no
World Bank	Worldwide	Open Data, **Publications**	PDF	static data vis.	no	no	yes	yes	yes	yes
Helcom	Baltic Sea Countries	**Publications**, Data & Maps	PDF	static data vis.	no	no	yes	no	no	no
Office for National Statistics (ONS)	United Kingdom	Data, **Publications**	HTML	static & interac-tive data vis.	yes	yes	yes	no	no	yes
Swiss Federal Statistical Office	Switzer-land	Tables, Data, Graphs, Maps, **Publications**	PDF, EPUB	static data vis., infographics	no	no	yes	no	no	yes
Republic of Slovenia – Statistical Office	Slovenia	Database, **Publications**	PDF	static data vis., infographics	no	no	no	–	–	yes

↑ Click to get to the website

↑ The products that are considered in the rest of the table are in **bold**

↑ data vis. = data visualization

↑ an executiv summary is not counted as a different product.

↑ Facebook and Twitter

Figure 97. A table that compares how ten government institutions publish their data-driven reports online.

in different versions for different audiences. Instead, versions for a broad audience are usually created either separately or additionally if the topic is deemed interesting enough for the public.

Organization of Publications

The connection between the different versions is not always clearly communicated. At its best, organizations connect the various different versions by providing links between them. Oftentimes, this is only done in one direction, i.e. by connecting an infographic to the full report but not vice versa. As a result, different versions are often scattered across the site instead of being interlinked and/or collected in one place.

Many of the organizations have multiple, separate pages that show a list of the publications. On the World Bank website, for example, reports can be found under each topic. A click on the "view all button" brings you to a publication list that is different depending on the topic. Also, when you click directly on the menu point "Research & Publications" and then on "view all" from there, you end up on a separate, different website again.

Most sites allow some sort of search and/or filtering by report type. This typology often lacks explanation. Eurostat and the World Bank are the only organizations that describe how the different report types are to be understood. Other organizations seem to either expect previous knowledge from the users or presume that their categories are intuitive. In the case of the ONS, for example, it is expected that a user understands what a "Statistical Bulletin" is. Looking at different typologies across these organizations, there seems to be little consensus on what constitutes a generally accepted typology for statistical government publications.

Beyond a lack of explanation, the internal logic of some of the typologies can cause confusion. Eurostat, for example, divides publications into digital publications and statistical books. Some of the digital titles reappear in the list of statistical books, making it unclear if these are indeed the same publications as in the digital publications list or different versions of one publication.

Other Channels

Many of the organizations publish data visualizations or infographics on their social media channel. The approach to how information is published on social media varies strongly between the organizations. Some, such as Eurostat, choose to publish mostly infographics on their social media channels, while others, such as the ONS, publish actual data visualizations. Others again mix data visualizations and infographics with other content and content types. The IPCC for example also publishes facts in the form of text overlaid on photographs.

Annex B
Benchmark Analysis –
Inspiring Examples

Figure 98. The Planning the Bothnian Sea report (Helcom, 2013, photos by Besserwisser)

Planning the Bothnian Sea (Besserwisser for HELCOM, 2013)

The report _Planning the Bothnian Sea_ is available both in print and as a PDF. It features many maps, but also explanatory infographics and statistical charts. Photographs are used to structure the report. The printed version comes with a large-format map. Figures and text are treated as equals.

print single use
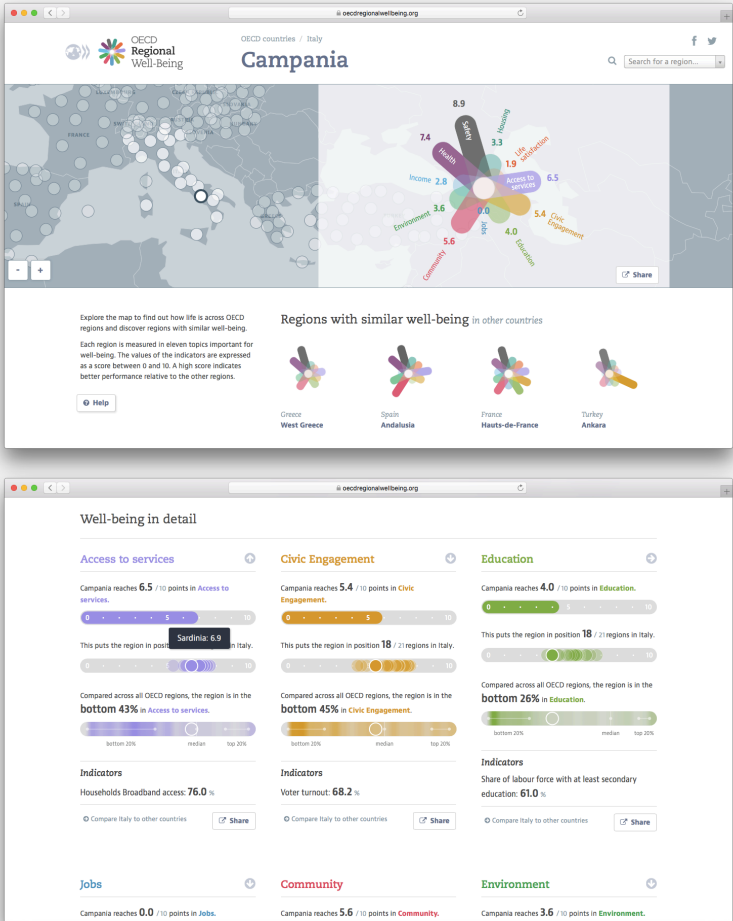
Figure 99. Screenshots of the OECD Regional Well-Being website (OECD, 2014).

Figure 100. Screenshots of the National Climate Assessment Report (Habitat Seven, 2014).

OECD Better Life Initiative (Moritz Stefaner for OECD, 2011/2014)

The *OECD Better Life Index* tool presents a milestone in the publication and visualization of government data. It allows users to explore different factors that contribute to a better life in the 35 OECD countries. Each country is visualized as a flower whereas the size of each petal indicates the score of each factor. Users can explore the better life index by in- or decreasing the importance they attribute to each factor. The index tool is complemented by the *OECD Regional Well-Being* website (see above) which offers insights into regional well-being that beyond country averages.

data exploration tool   collection of reports   continuously updated

National Climate Assessment 2014 (Habitat Seven for the U.S. Global Change Research Program, 2014)

The *National Climate Assessment Report* from 2014 is one of the first completely digital reports that I encountered. It contains a clear information architecture that allows users to browse the content of the report either by highlights or by topics. It offers many data visualizations, some of which are interactive. All figures and chapters can be downloaded seperatly. In contrast to many other government reports, it uses large-format photographs both as stylistic and structural elements.

full online report   single use
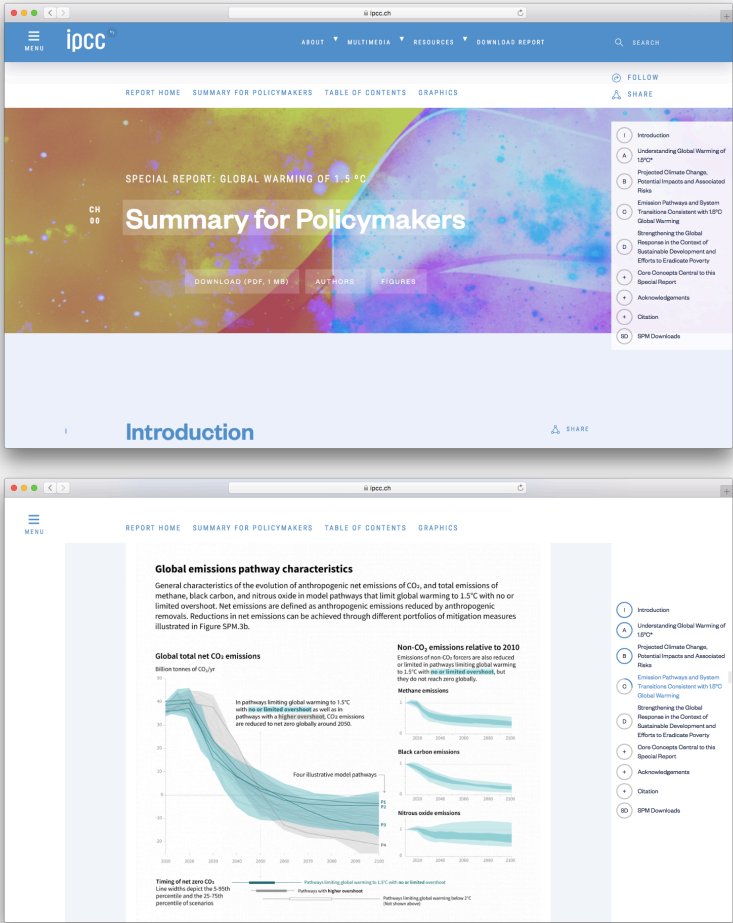
Figure 101. Screenshots IPCC Special Report on Global Warming of 1.5°C (IPCC, 2018).

IPCC Reports (Habitat Seven for IPCC)

The Intergovernmental Panel on Climate Change (IPCC) publishes reports directly on its website. The design this website allows each report to be structured slightly differently with some reports being more extensive in what they offer online and other reports being more of a summary of a PDF document. One of the more extensive reports, the *IPCC Special Report on Global Warming of 1.5°C*, features visualizations by the Info Design Lab that were created with a co-design approach involving over 1000 stakeholders.

`full online report` `whole system`
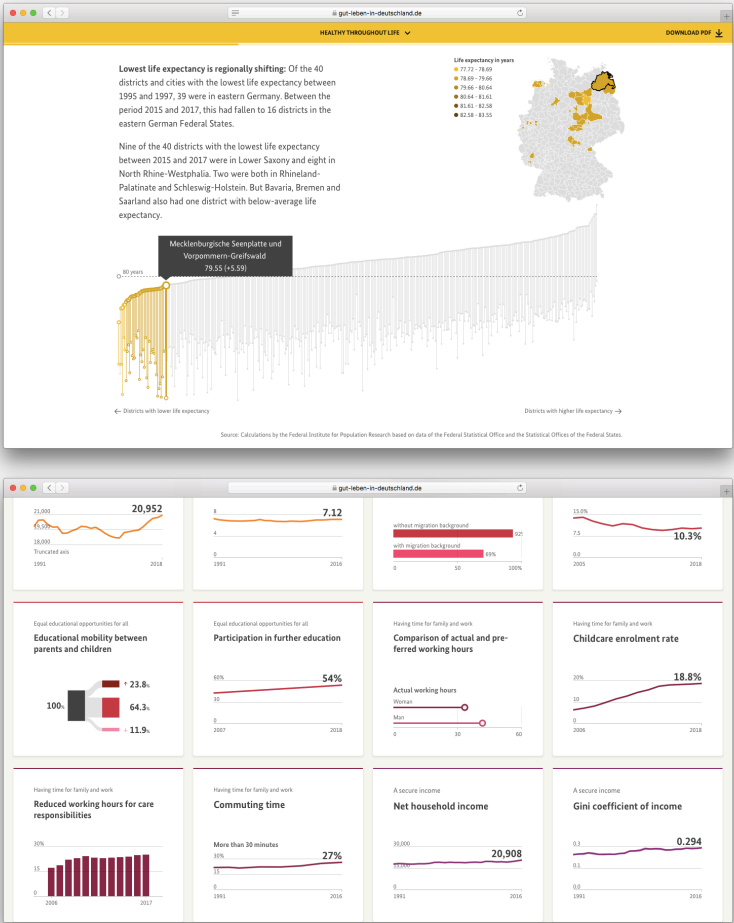
Figure 102. Screenshots of the Wellbeing in Germany website (Federal Government, 2016).

Wellbeing in Germany (Interactive Things for the German Federal Government, 2016)

This online publication allows users to explore 12 dimensions and 46 indicators. The user can either explore the interactive report that presents both the dimensions and the indicators as long-form articles that use scrolly-telling elements and interactive visualizations. Or they can look at the indicators separately as visualizations and download the graphics and the data.

`full online report` `continuously updated`
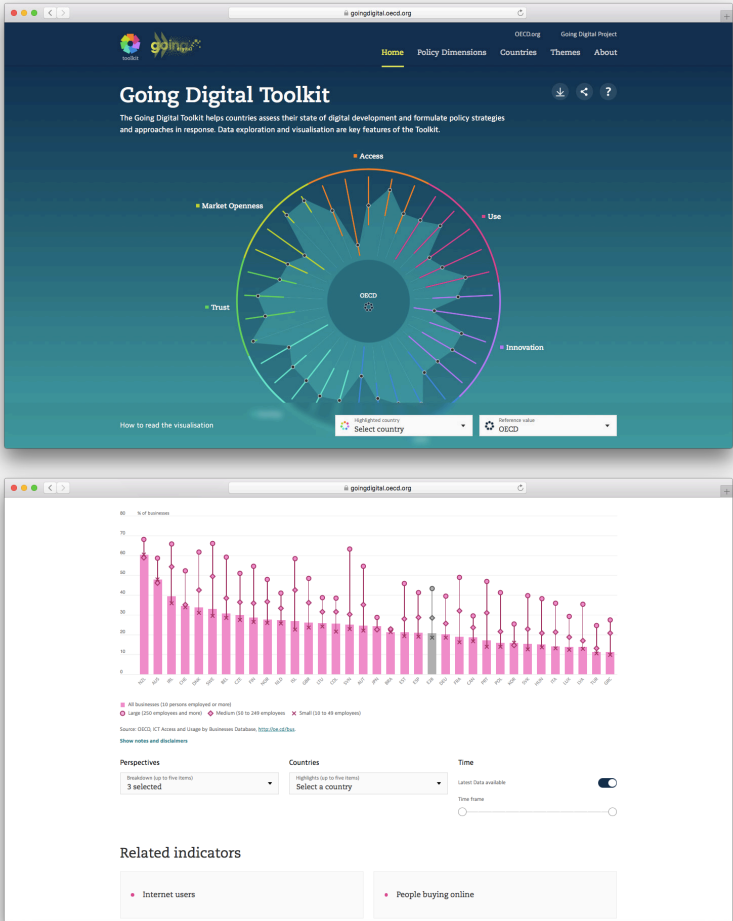
Figure 103. Screenshots of the OECD Going Digital Toolkit (OECD, 2019).

OECD Going Digital Toolkit (Interactive Things for OECD, 2019)

The *Going Digital Toolkit* platform allows the user to compare different indicators across OECD countries and find reports that are linked to those specific indicators. The indicators can either be explored by country or by topic and are presented as interactive data visualizations. The reports are provided as links that lead either to the OECD website or directly to the PDF-report.

`data exploration tool` `collection of reports` `single use`
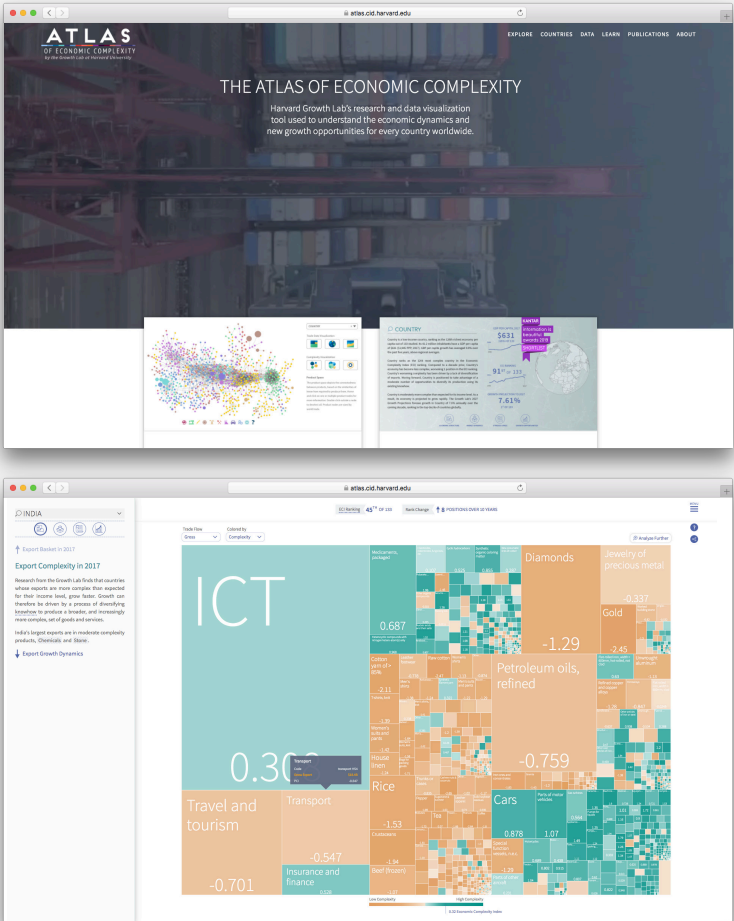
Figure 104. Screenshots of the Atlas of Economic Complexity (Harvard, 2018).

Atlas of Economic Complexity (Harvard Growth Lab, 2018)

The *Atlas of Economic Complexity* is a tool that allows users to explore "the economic dynamics and new growth opportunities for every country worldwide" (from their website). The tool provides an "explore" access and a "country" access to the data, as well as the data itself, publications, and a learn section. The explore page allows the user to ask different questions related to the import and export of goods in different countries. The country section features interactive country profiles that look at the different economic topics in depth for each country.

`full online report` `single use`
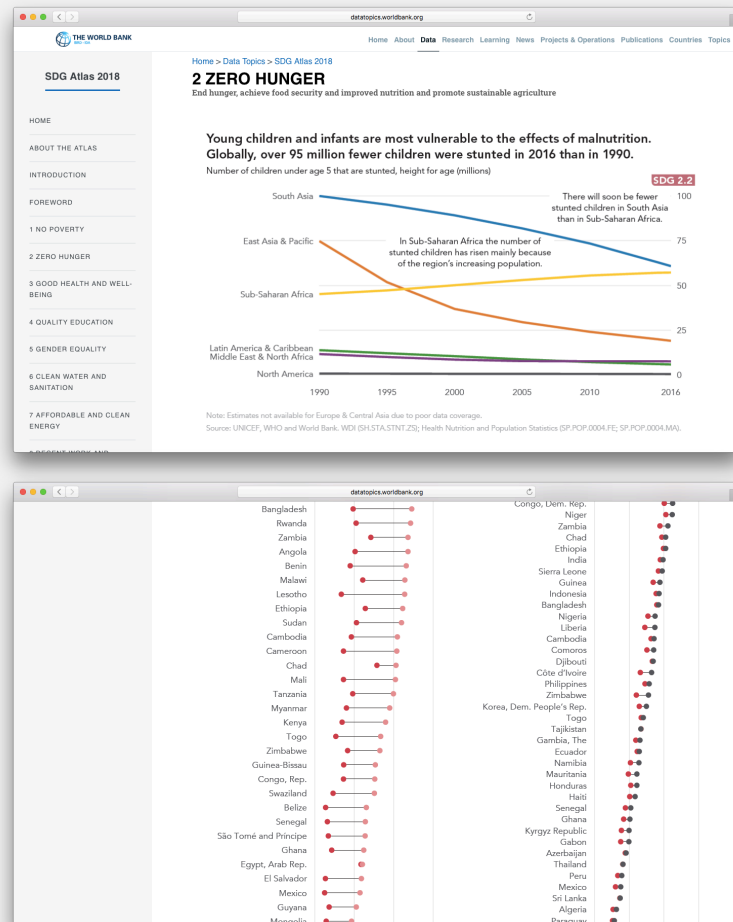
Figure 105. Screenshots of the Atlas of Sustainable Development Goals (Worldbank, 2018).

Figure 106. Screenshots of two articles on the Our World in Data website (2020).

The Atlas of Sustainable Development Goals (Worldbank, 2018)

The _Atlas of Sustainable Development Goals_ is a visual guide to the data that describes the _Sustainable Development Goals_ (SDGs). Each subpage is dedicated to one SDG and features visualizations that look at it from various perspectives – often transgressing from a more general view to a detailed country-by-country view. Other than the text in the visualizations, the subpages do not feature any text. The visualizations are all available as images and the code for the visualizations is open-source.

<div>full online report (only images)</div> <div>whole system</div>

Our World in Data (Global Change Data Lab, 2011)

The plattform _Our World in Data_ provides research on societal problems such as poverty, disease, and hunger. According to the _about_ section on their website, the goal "make the knowledge on the big problems accessible and understandable." Different topics are presented as long one-pagers with an anchor navigation that marks the subtopics. Each subtopic includes a text and an often interactive visualization. The visualization, as well as the data behind it, can be downloaded and embedded. Blog posts summarize the research findings into shorter, more personal stories.

<div>online articles</div> <div>whole system</div>
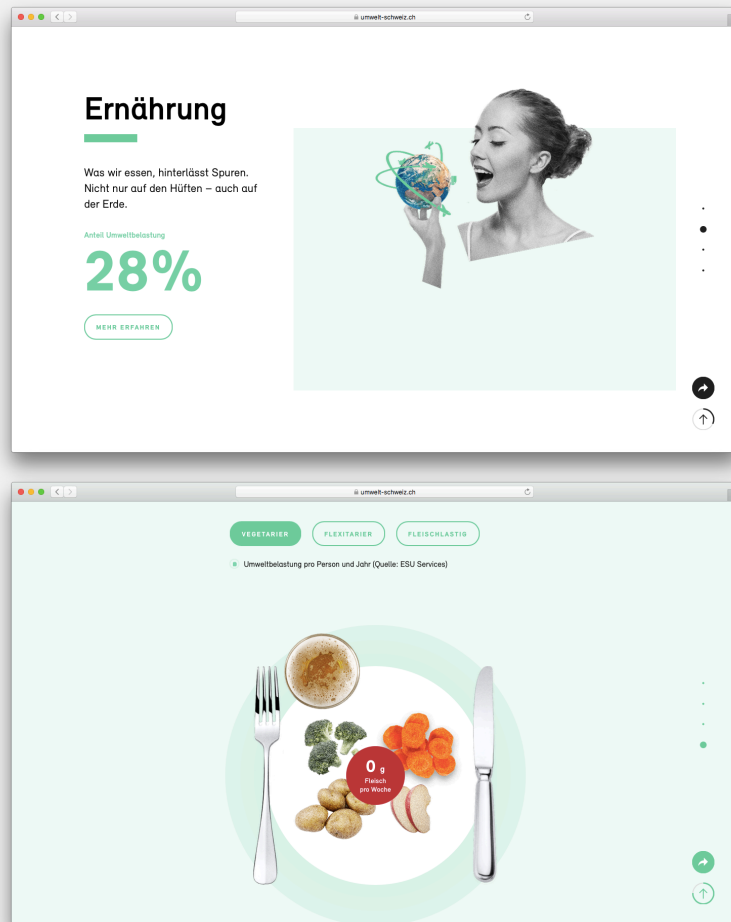
Figure 107. Screenshots of the Umweltbericht 2018 (Federal Office for the Environment).

Umweltbericht 2018 (Bold for the Swiss Federal Office for the Environment, 2018)

The website umwelt-schweiz.ch playfully summarizes some of the main messages of the report *Umweltbericht 2018* (German, *Environmental Report 2018*) by the Swiss Federal Office for the Environment. It does so by using simple, interactive data visualizations, photo collages, and videos. The full report is available as a PDF, while the website is a stand-alone microsite. The PDF and the website are not designed by the same agency and both have their own visual language.

`online summary of PDF report` `single use`
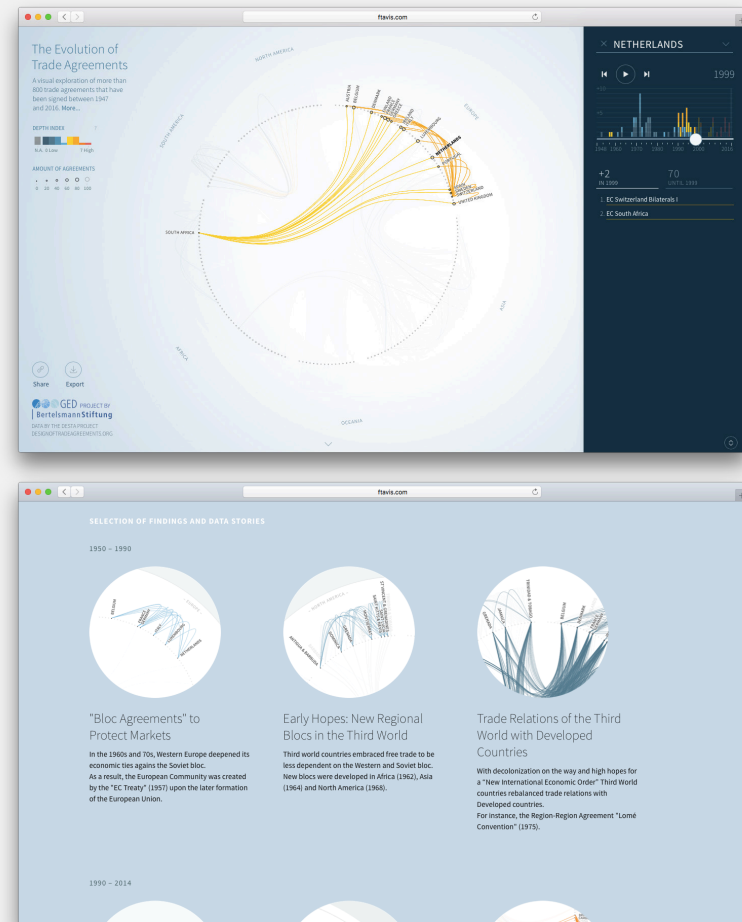
Figure 108. Screenshots of the Evolution of Trade Agreements website (Bertelsmann Stiftung, 2014).

The Evolution of Trade Agreements (Data Design for Bertelsmann Stiftung, 2014)

Ftavis.com is a website by the Bertelsmann Stiftung that shows the evolution of trade agreements from 1947 to 2016. The website has two sections: The top part is an interactive, circular visualization that lets the user explore the trade agreements between countries by year, country, depth, and amount of agreements. Clicking on a country brings the user to a second part of the page which provides more information on that country and describes its most important trade agreement stories.

`data exploration tool`
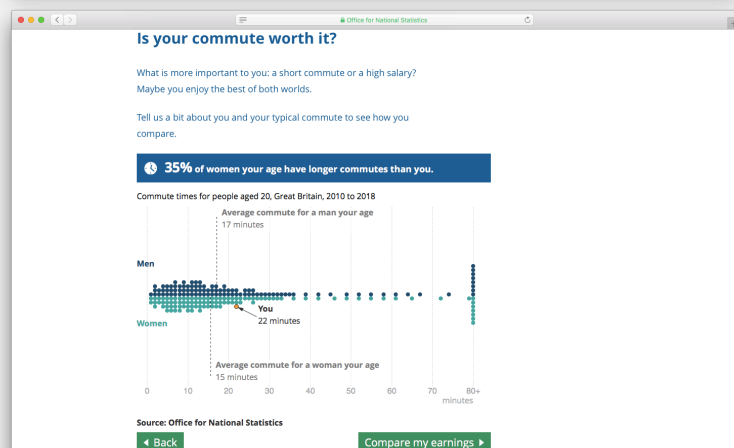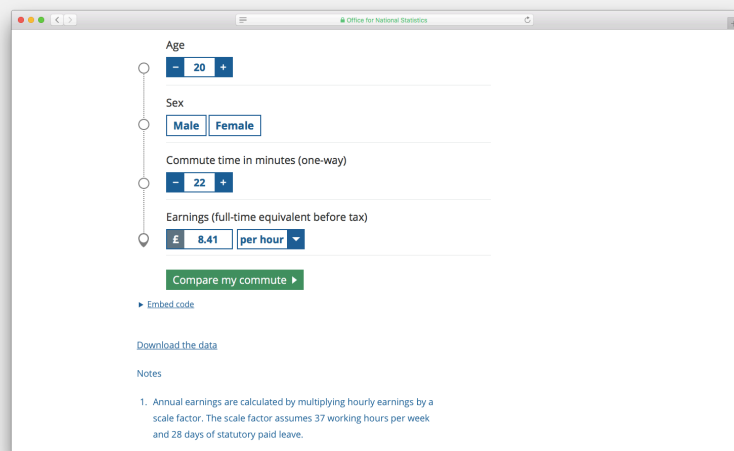
Figure 109.   Screenshots of the article Commuting Gap (ONS, 2019).

Figure 110.   Screenshots of the Lifelong Learning webiste (EPRS, 2018)

The Commuting Gap (Office for National Statistics, 2019)

The Office for National Statistic (ONS) of the UK publishes data stories for the broad public in the format of online articles. These articles include text and both static and interactive data visualizations. The article *The commuting gap: women are more likely than men to leave their job over a long commute* is one example. The article consists of text, three static visualization and two interactive visualizations. One of the interactive visualizations allows the reader to compare the lengths of their commutes with others.

online article   whole system

Lifelong Learning in the EU (European Parliamentary Research Service (EPRS), 2018)

This one-page website presents a selection of indicators on different levels of education in the European Union. The indicators are presented with a text and one to two interactive charts. The website also offers links to further reading to each indicator. An anchor navigation makes scrolling to the each indicator easier.

online article   single use

Figure 111. Billboards at the Statistically Speaking Exhibition (SURS, 2019, Photos: SURS).

Figure 112. Pages 22 (left) and 66 (right) from the report Key Figures on Europe (Eurostat, 2019).

Statistically Speaking, Exhibition at the 75th anniversary of the Statistical Office of the Republic of Slovenia, 2019

In 2019, the Statistical Office of the Republic of Slovenia (SURS) celebrated its 75th anniversary. For this occasion, they visualized and presented some of their data about Slovenia and its citizens, for example their statistics on most common names or their statistics on wine production and consumption. The graphic visualizations were presented on large billboards throughout Ljubljana.

Key Figures on Europe – Statistics Illustrated, 2019 Edition

The report _Key Figures on Europe_ offers a selection of key statistics on topics ranging from people and society, to the economy and business, and the environment. The facts are illustrated with various charts and infographics. A consistent color palette gives the whole publication a uniform look, as do recurring visual elements. The orange-red bar on the side of the left page shown above, for example, reappears on various pages. On this page, it lists the European Union (EU) Member states and European Free Trade Association (EFTA) countries according to their unemployment rate.

print single use

print single use

Annex C
Summary of Eurostat
Kick-Off Meeting

Please note that this is a working paper and might include some inaccuracies. It serves as an example of the methods that were applied in the design study.

MA Thesis
"Beyond the PDF"

**Kick-Off Meeting
With Eurostat:
Summary**

**Adina Renner
With Julia Urhausen & Louise Corselli-Nordblad
22 May 2019, Luxembourg**

1. Introductions

Julia Urhausen Information and communication officer – Eurostat Website.

Louise Corselli-Nordblad Team Leader – Statistics Explained.

Julia and Louise also work on publications and especially on digital publications together.

Adina Renner: Graphic Designer, studying Information Design at Aalto University

2. Interview Julia Urhausen: Key Points

Big Picture Challenges for Eurostat
- Constantly changing demands due to technological developments and changing user expectations. Eurostat stays up-to-date on user demands through conferences, meetings with NSIs, own research (e.g. OECD), media and user support (feedback from users and journalists).
- It's not enough anymore to just have official, high-quality statistical data. The platform also has to be attractive.
- Eurostat, like OECD, is not a platform many people turn to directly. So it is important to get people's attention
- Maintenance of multiple projects and platforms.

Big Picture goals
- Attract users! Both regular users and users who are not that familiar with statistics.
- Enhance statistical literacy.
- Get rid of the image that "Statistics are scary" or that "Statistics are boring".
- Become the source to turn to, when you want to check facts that are related to the EU. Become a reliable source in a time of disinformation.
- Offer attractive products through which people have fun checking up on facts.

Eurostat's Mandate
- Serve citizens
- produce high quality statistics (mission mandate)
- disseminate and communicate those statistics

"We are not producing statistics for experts; we are producing statistics for everyone. Policymakers can use them but also my mom. So, you need different products to target different audiences or the attention of different audiences."

The roles of Eurostat
- Role 1: Eurostat is the central body of the European Statistical Systems (ESS). The NSIs are also part of the ESS. They are the data producers; they provide Eurostat with data and Eurostat aggregates the data and produces comparable statistics. There are between 200 and 250 meetings a year with statistical experts from the member states.
- Role 2: DG of the European Commission. Eurostat is the data provider for the other DGs of the European Commission.

Difference between Eurostat and Eurydice
Eurostat is a statistical office that does not answer questions on a political level. They explain the statistics, e.g.: "Inflation increased by 10% in March. This was mainly driven by the inflation in petroleum". Eurydice goes a step further and have the mandate to do so. They publish information on a social / policy level.

H2020 ESS
Key area 5: Reaching new user groups, with different, more targeted products and finding new ways to communicate statistics.

Users and Persona research
- Two large user groups:
  - Regular Users: policy-makers within the European Commission and EU Parliament, researchers at Universities and research institutes, economists, news agencies and journalists, people who know statistics or are in a certain sector in which they need to look at EU statistics.
  - New Users: Users who are not so familiar with statistics, especially young users.
- Pull vs. Push: Policy-makers come to Eurostat; they have a "pull approach". For other people the information has to be pushed. This can happen in various ways, often however via journalists or social media.
- Largest supply gap: Eurostat feels that they are still not attractive enough for young people.
- Personas: For Eurostat, the most interesting aspect of the personas are their key tasks and main goals. These aspects drive the users' behavior. Their job description is secondary as a job title can still mean different tasks and goals.
- Users are not static. Instead they are on a "user continuum". For example, people evolve from being students, to getting a first job, to becoming experts.

"What purpose should our products serve? They have to serve the users. In the end, we are paid by tax payers money so we have to produce something that users use. And for people to use it, they need to understand it and they need to feel attracted to it."

Products
- Gap in Product Portfolio: "What's new?" is one article per day. The production process for "What's new?" is short. "Statistics Explained" entries and digital publications, on the other hand, are much more work. It would be nice to have something in between that is not as work-intensive as statistics explained or a digital publication but has more content and bone to it than a "What's new?" article. In terms of content that would be less than what a digital publication offers but more than what a social media post can offer.
- In the dissemination, cooperation with NSIs is crucial. By translating the publications, it is possible to reach a whole new user group. This has been a huge success.

- Under the category of "Visualisation Tools" Eurostat has created products that allow users to place themselves within the data (e.g. "You in the EU"). These products have been largely popular. Wishes from users include the need for an overview and more context. There is a lot of potential to make more use of storytelling methods in these kinds of publications.

"We are not static. We don't try to fit the content into the same format. Every time we look at: "Where do we want to go, who do we want to target, who is the audience, what is the structure of the content, how much is it, do we show everything, do we show a picture, do we let the user choose for themselves…"

Will PDFs be replaced by digital publications?
- Yes and no. People like digital publications but people still want to bring a printed version of the report for conference or events.
- There is currently no plan to move completely away from a pdf publication. But more and more, the pdf version is supplemented with a digital publication.

Would you want to make two or three versions for each product?
It depends on the topic. If it is really also for a broader audience, then yes.

3. Eurostat Products and Users (Exercise 1)
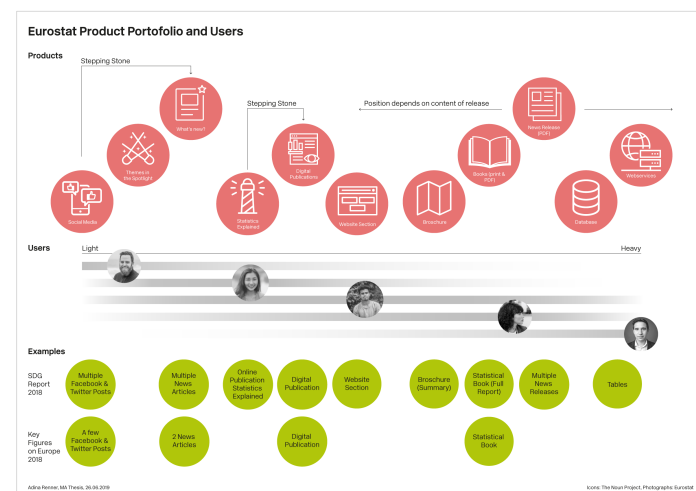
Figure 1. Eurostat Product Portfolio and Users. See enlarged Version on Page 7.

Example SDGs Product range (notes from the interview)
The full report is very detailed and is thought for advanced users. The brochure is a summary of the full report. While it serves mainly intermediate users, it can also be used by advanced users as an overview or as something they can take with to conferences. The brochure is still too dense for light users. The digital publication is for everyone but mainly for light and intermediate user. In user feedback, it became clear that advanced users also enjoy the digital publication. It's not true that advanced users always just want the raw data. They also like to look at a chart, select different indicators and browse. The website section on SDGs contains a lot of information. It is more for intermediate and visual oriented users but also for everyone with a slightly deeper interest in SDGs.

Example Eurostat Yearbook (notes from the interview)
After stopping to print a full yearbook, yearly summaries remained only on Statistics Explained. This meant that you could not really print anything. In 2018, Eurostat decided to produce a real yearbook again. They didn't want to go back to what they had but decided to make a flagship product to give to people at conferences. It's a kind of "shopping window" to Eurostat's services and products.

4. Eurostat's Process, example "Key Figures on Europe" (Exercise 2)
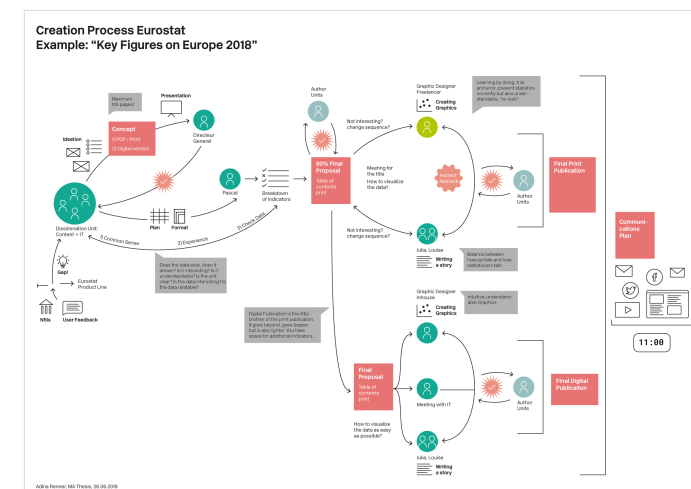
Figure 1. Work Process Eurostat. See enlarged Version on Page 8.

Annex D
Survey Civil Servants

MA Thesis "Beyond the PDF" – Preliminary Questionnaire

This questionnaire serves to gain an understanding of the nature of your work, how you used the 2014 edition of the report "Key Data on Early Childhood Education and Care", and how you might use the 2019 edition of the report.

You are free to answer only the questions that you are comfortable answering. If any of the information given in this survey is published in the thesis, it will be in an anonymous form. Your data will be handled confidentially and will not be shared with a third party.

Thank you for participating!

Personal & Professional Information

1. What is your full name?

2. What is your background? (studies, further education, previous positions)

3. What is the name of the agency / ministry / university / company you work at presently?

4. What is your current position? (your role in the agency / ministry / university / company)

5. How long have you been working in that position?

[   ]

6. What are typical projects you work on in your current position?

[   ]
[   ]
[   ]
[   ]

7. What are the most important documents / resources for your work?

[   ]
[   ]
[   ]
[   ]
[   ]

8. What does your typical work week consist of?

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Meetings	○	○	○	○	○	○	○	○	○	○
Writing texts	○	○	○	○	○	○	○	○	○	○
Writing and responding to emails	○	○	○	○	○	○	○	○	○	○
Reading	○	○	○	○	○	○	○	○	○	○
Talking publicly	○	○	○	○	○	○	○	○	○	○
Organizing	○	○	○	○	○	○	○	○	○	○
Coaching	○	○	○	○	○	○	○	○	○	○
Travelling	○	○	○	○	○	○	○	○	○	○
Other: [ ]	○	○	○	○	○	○	○	○	○	○
Other: [ ]	○	○	○	○	○	○	○	○	○	○

9. In what kind of spaces do you work?

	10%	20%	30%	40%	50%	60	70%	80%	90%	100%
In a private office	○	○	○	○	○	○	○	○	○	○
In a shared office	○	○	○	○	○	○	○	○	○	○
In an open office	○	○	○	○	○	○	○	○	○	○
At home	○	○	○	○	○	○	○	○	○	○
In public spaces	○	○	○	○	○	○	○	○	○	○
En route / In transit	○	○	○	○	○	○	○	○	○	○
Other: [ ]	○	○	○	○	○	○	○	○	○	○

10. What kind of tools do you use at work?
Multiple answers are possible.

- ☐ Laptop computer
- ☐ Office computer
- ☐ Desk with a big screen
- ☐ Desk with multiple screens
- ☐ Computer Keyboard
- ☐ Computer Mouse
- ☐ Tablet
- ☐ Mobile phone
- ☐ Physical folders / filing systems
- ☐ Books / brochures / printed documents
- ☐ Other: [   ]

11. What kind of software do you use at work?

- ☐ Word
- ☐ Excel
- ☐ OneNote
- ☐ Internal Content Management System
- ☐ Adobe Reader / Adobe Acrobat

☐ Other: _____

The 2014 Report

12. How did you learn about the report?
Multiple answers are possible.

☐ I learned about it on the Eurydice Website in the "News & Articles" section
☐ I learned about it on the Eurydice Website in the "Comparative Reports" section
☐ I saw it announced in a Eurydice newsletter
☐ I saw it announced on Twitter
☐ I saw it announced on Facebook
☐ I heard about it from my colleagues
☐ I heard about it at a conference
☐ Other: _____

13. In what kind of format(s) did you read the report?
Multiple answers are possible.

☐ I read the PDF on a large screen (computer or laptop)
☐ I read the PDF on a small screen (tablet or mobile)
☐ I printed the PDF
☐ I printed parts of the PDF
☐ I received a printed copy from Eurydice
☐ Other: _____

14. How did you read the report?
Multiple answers are possible.

☐ I read it linearly from beginning to end
☐ I read it linearly but skipped chapters as I went along
☐ I read it linearly but skimed chapters as I went along
☐ I read it linearly but skipped parts (figures, paragraphs, notes...) as I went along

☐ I read it linearly but skimed parts (figures, paragraphs, notes...) as I went along
☐ I jumped directly from the table of contents to a specific chapter or subchapter I was interested in
☐ I jumped back and forth between chapters or subchapters
☐ I jumped back and forth between parts (figures, paragraphs, notes...)
☐ Other _____

15. Which chapters of the report did you read, which did you skip, and which did you skim?

	Read	Skim	Skip
Foreword	☐	☐	☐
Main Findings	☐	☐	☐
Introduction	☐	☐	☐
A – Context	☐	☐	☐
B – Organisation	☐	☐	☐
C – Participation	☐	☐	☐
D – Funding	☐	☐	☐
E – Staff	☐	☐	☐
F – Teaching Processes	☐	☐	☐
G – Support Measures for Disadvantaged Children	☐	☐	☐
References	☐	☐	☐
Glossary	☐	☐	☐
National System Information Sheets	☐	☐	☐
Acknowledgements	☐	☐	☐
Other _____	☐	☐	☐

16. Which parts of the report did you read, which did you skip, and which did you skim?

	Read	Skim	Skip
Introductory texts (e.g. "Currently, in Europe, there are two approaches to…")	☐	☐	☐

	Read	Skim	Skip
Quantitative descriptions (e.g. "Around a quarter of European education systems provide…")	☐	☐	☐
Figure descriptions (e.g. "Figure B3 shows the difference…")	☐	☐	☐
Country examples (e.g. "In Latvia, Education Law, Section 17 stipulates that…")	☐	☐	☐
Figures – Graphs (Maps, Charts, Diagrams)	☐	☐	☐
Figures – Tables	☐	☐	☐
Figures – Explanatory notes	☐	☐	☐
Figures – Country notes	☐	☐	☐
Footnotes	☐	☐	☐
Other: _____	☐	☐	☐

17. What kind of actions supported your reading of the report?
Multiple answers are possible.

☐ I highlighted parts of text
☐ I highlighted parts of figures
☐ I made notes
☐ I drew / doddled
☐ I wrote my own summary
☐ I looked up terms in the report's glossary
☐ I looked up things that are in the report (terms, facts, topics) online
☐ I looked up things that are in the report (terms, facts, topics) in other documents
☐ I zoomed in on graphics to look at them more precisely
☐ I discussed the report with my colleagues in Finland
☐ I discussed the report with my colleagues in other countries
☐ Other: _____

18. If you wrote your own summary, where did you write it?
Multiple answers are possible.

☐ I wrote it by hand on a piece of paper
☐ I wrote it digitally in an application (e.g. OneNote, Word, etc.)

19. If you made notes, how did you make them?
Multiple answers are possible.

☐ I made notes in the margins of the PDF (e.g. in Acrobat Reader)
☐ I made notes in the margins of the printed copy
☐ I made notes in a separate, digital document (e.g. in Word, OneNote…)
☐ I made notes on a separate piece of paper
☐ Other: _____

20. How often did you use the glossary?

◯ Very Frequently
◯ Frequently
◯ Occasionally
◯ Rarely
◯ Very Rarely
◯ Never

21. How did you usually use the figures (graphs and tables)?
Multiple Answers are possible.

☐ I just took a quick look at them
☐ I actively read them
☐ I went back and forth between the text and the figures
☐ I looked more at the figures than at the text
☐ Other: _____

22. How often did you use the report?

"Using the report" can mean anything from reading it, to looking something up in it, to studying the tables or graphs.

- ◯ Every day
- ◯ A few times a week
- ◯ Once a week
- ◯ A few times a month
- ◯ Once a month
- ◯ A few times a year
- ◯ Once a year
- ◯ 1 – 3 times since the report was published

23. When you used it, how much time did you usually have to do so?

"Using the report" can mean anything from reading it, to looking something up in it, to studying the tables or graphs.

Multiple answers are possible.

- ☐ A few minutes
- ☐ 15 minutes
- ☐ 30 minutes
- ☐ 45 minutes
- ☐ 1 hour
- ☐ Up to 3 hours
- ☐ Up to 5 hours

24. What did you use the report for?

Multiple answers are possible.

- ☐ I used it as an inspiration
- ☐ I used it to see ECEC in Finland from an outside point of view
- ☐ I used it to assess how good ECEC in Finland is
- ☐ I used it to compare ECEC in Finland to ECEC in other European countries
- ☐ I used it to look up things about ECEC in Finland
- ☐ I used it to look up things about ECEC in other European countries

- ☐ I used it as a basis for further inquiries
- ☐ I used it as source for further literature
- ☐ I used it in a literature review
- ☐ I used it as a source for data
- ☐ I used it as a basis for a recommendation
- ☐ I used it as a basis for a conversation
- ☐ I used it as proof for my arguments
- ☐ I used the figures in my own documents
- ☐ I quoted parts of the text in my own documents
- ☐ I used it to get in contact with colleagues in other countries
- ☐ I used it to advertise ECEC in Finland
- ☐ I used it to advertise the work we do at the agency / ministry / institution / company
- ☐ Other: _____

25. Did you know about and read the separate policy brief of the 2014 report?

https://eacea.ec.europa.eu/national-policies/eurydice/content/eurydice-policy-brief-early-childhood-education-and-care-2014_en

- ◯ I didn't know about it
- ◯ I knew about it, but didn't read it
- ◯ I knew about it and read it

26. Do you have any further comments or questions to the 2014 edition of the report?

_____
_____
_____
_____
_____

The 2019 Report

27. How did you stay up to date about when the 2019 report will be published?

Multiple answers are possible.

☐ I learned about it on the Eurydice Website in the "News & Articles" section

☐ I learned about it on the Eurydice Website in the "Comparative Reports" section

☐ I saw it announced in a Eurydice newsletter

☐ I saw it announced on Twitter

☐ I saw it announced on Facebook

☐ I heard about it from my colleagues

☐ I heard about it at a conference

☐ Other: [＿＿＿＿＿＿＿＿＿＿＿＿＿]

28. Which chapters of the 2019 report will you likely read, which will you likely skip, and which will you likely skim?

	Read	Skim	Skip
Executive Summary	☐	☐	☐
Introduction	☐	☐	☐
A – Governance	☐	☐	☐
B – Access	☐	☐	☐
C – Staff	☐	☐	☐
D – Educational Guidelines	☐	☐	☐
E – Evaluation and Monitoring	☐	☐	☐
References	☐	☐	☐
Annexes	☐	☐	☐
Glossary	☐	☐	☐
National System Information Sheets	☐	☐	☐
Acknowledgements	☐	☐	☐
Other	☐	☐	☐

29. Do you plan on using the 2019 report in a different way than the 2014 report?

e.g. "I plan to use it more often", "I plan to just use the digital PDF instead of printing it out", "I plan to look only at the graphics"…

[＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿]
[＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿]

Annex E
Prototype Descriptions and Summaries of the Feedback Sessions

Prototype 1 (for the Civil Servants)

Based on: Workshop with Civil Servants

Description: This first prototype consisted of a rough wireframe of the chapter overview page (called "Dimensions") and one, fully designed chapter page. Through a first, elementary navigation design, it also illustrated the information architecture of the site.

Process: The prototype was developed over two weeks, following the workshop with the civil servants. Participation rates in early childhood education and care (ECEC) settings are high on the political agenda in Finland. Therefore, I chose to work with a chapter that details the percentage of children in ECEC in each country and compares this rate to European benchmarks. The focus lay on developing features that the civil servants required to be able to work with the report, such as the possibility to annotate text, download graphics and to highlight countries in the charts. Much consideration was given to the design of the charts and the layout of user interface elements that enable the user to interact with the chart. Various chart types were explored to represent the data. However, in the end, the same ones were used as in the original report as they present the data in a clear and familiar way. The text was reformatted and rewritten to allow for a more user-friendly flow of information. Taking into consideration that a more accessible online report allows people without any previous knowledge on ECEC to find their way to a subchapter, I added an introductory part that explains underlying concepts that are crucial to the chapter's main message. I also added a concluding part that shows the situation in each country in more detail. These editorial decisions allowed the chapter to be more self-contained.

Feedback from: the same civil servants who had participated in the workshop (in person).

Feedback: The feedback was overwhelmingly positive. The civil servants were especially delighted about the feature that allows you to download one subchapter as a PDF, and the possibility to highlight certain countries in a chart and download

that chart. They were also very enthusiastic about the prospect of various different kinds of stories, for example in the form of short videos. They also liked the way the chart title already summarized the main findings of the chart.

One of the first comments was that the type size used in the charts was too small to be able to read without trouble. Another issue was the name of the chapter overview page: They felt that "Dimensions" was not a clear enough term. They also wished for the possibility to switch between the graph and a visually prepared data table that could be downloaded like the graph.

"I like that the title of the graph already looks ahead. Because when you're writing a publication, the thumb rule is that the hasty reader should already get a summary of the publication when reading the titles. But traditionally the names of the titles are very technical.

"Now when you make this beautiful prototype can we already use it afterwards?"

"I think it is a good attempt to make it more clear and user-friendly and more modern."

Prototype 2 (for the Parents)

Based on: Workshop with parents, Interview with policy advisor and parent, interview with Journalist (how does that come to shine?)

Description: The second prototype consisted of the chapter and the chapters overview page from the previous prototype, as well as one story, and a first design of the stories overview page.

Process: The prototype was developed over the course of three weeks. Following the workshop with the parents, this prototype focused on developing a concept on how to show content from the report in a lighter, simpler way. This would allow for the producers to share parts of the report on social media and would provide regular citizens with an easy access

point to the report. Beyond providing this entry point, the stories are meant to educate the public about crucial concepts from the report. Finally, the stories should give citizens an idea of how these reports are made and what kind of work goes into them. Letting the broad public "see behind the scenes" allows them to understand where their votes and tax money is going. In other word, it is one way of being and promoting a transparent, progressive institution. Experimenting with these goals in mind resulted in three different content types to be included in the story section of the site: data essays, "behind the scenes" videos, and social media channels. These different categories are described in more detail the section on the final prototype.

As the parents had expressed interest in the topic of the childcare gap, I used this theme to create an example of how a data essay could look. Through sketching, I experimented with different ways and various media to show the data. In the end, I decided to use photographs of small, abstract objects that could be used to encode the data. Counter to other photographic data visualization where a whole image is composed to reflect a certain data set, this method would allow the producers to draw from a collection of photographic elements to create various different kinds of visualizations. Another important decision for the story format, was the idea to use scrolling as an axis along which data can be encoded. This means that various elements can appear and disappear through scrolling (so called scrollytelling) but also that the act of scrolling can be used to denote variables such as time or distance. Furthermore, I continued to work on the information architecture of the page, focusing specifically on the typology of the content organization.

Feedback from: Former kindergarten teacher (in person)

Feedback: This feedback session was short and included showing the first design of the story to a former kindergarten teacher. Nonetheless, it was interesting to see an emotional reaction through the act of scrolling down. Three important assumptions I had from the workshop were confirmed: 1) The first thing people do when they look at a data visualization is look for themselves, their country or anything that might be

related to them. 2) The visualization becomes more relevant to them when whatever relates to them is particularly good and especially when it's particularly bad 3) It's important to include an option to act upon what can be seen in the visualization.

"It's nice that you show this. It tells a little bit about my attitude towards this because I was immediately checking: "Ok how is Finland, how are we doing compared to others?" So that's kind of like the angle where I am coming from always when I see some reports or graphs around the world. I'm like, 'ok, so where is Finland?'"

" [Realizing that Ireland's childcare gap is 7 years] Wow! I'm sure that this graph would be very interesting for like parents, for instance if you're an Irish family and you see the chart and you're like "What the fuck? Why is this so that we have this huge gap and some countries, they have a negative gap?" And then they can could reach out to their parliament representative. So, in that sense, it's very useful. This sort of thing can work as an ignition for a debate or discussion: "Is this something we should fix or is this something we are happy with and can work around somehow?"

Prototype 3 (first complete prototype)

Based on: Feedback from Prototype 1 and 2. Some of the input from the interview and workshop with the researchers.

Description: In this prototype I added the start page, the overview pages, and a country page.

Process: The aim of this prototype was to create a version that included all important pages and subpages. This meant developing the start page, the chapter and the country overview page and the "Highlights" page. I also designed one country page that summarizes the indicators under the point of view of one country (in this case, Finland).
In this iteration, I also focused strongly on getting all the

building blocks right: I tried various different fonts, worked on the color palette, and created many variations of the user interface elements that would allow the user to interact with the charts. I also worked extensively on the design of the navigation.

Feedback from: a group of civil servants at the National Agency of Education in Finland (12 people, in person), someone from the Eurostat User Support and Dissemination Unit (by email), and someone from the Office for National Statistics in the UK (by video call)

Feedback: The prototype received a mixed feedback from the group of civil servants. The fact that it was not quite a wireframe anymore, but also didn't really have a visual style led to some confusion: Many mentioned that it was "quite plain" and "a bit boring". Others regarded the simplicity of the design as a positive aspect, saying it looked "very clear and simple". Two people felt that there could be less text and more graphics and info boxes. One person missed an overview that contained more information on what this report is about in general. Positive feedback included how easily understandable the graphs are, especially in relation to the titles that summarize the graph's main message. Another person really liked the fact that it was possible to create one's own copy of the report by adding notes and highlights to the content.

"Brilliant idea. I really hope to see this in reality in the future. This would really benefit me personally."

The feedback from the National Office of statistics was generally positive. They recommended to add more options to personalize the story and, in general, to organize content by what function it has. Another note was that it is important to trust the advanced users to find the information they need. This means that, while detailed, technical information should always be available, it is ok to move this content into the background for example by hiding it behind a button or making it visually less prominent.

The feedback from Eurostat was generally positive as well. They provided me with a detailed list of issues and ideas on

how to solve these issues. They liked the idea of the stories and the resources, as well as the boxes with the key messages and the user interface of the graphs. They felt that the start page lacked clarity and was generally too long. In terms of country names, they recommended to use the full country names instead of the abbreviations as most people don't know them. They also said that in the case of data visualization it is ok to not use the official country sequence mandated by the EU and instead use a sequence that makes sense to the reader. Beyond that they had many comments about how the text could be written more clearly.

Prototype 4 (for EU DataViz 2019)

Based on: Feedback from Prototype 3.

Description: Added Style, Finished Overview Pages. Locked down content of start page, explored different styles

Process: The aim of this iteration was to create a prototype that I could show at the EU DataViz Conference. Similar to Prototype 3, I focused on creating an overall look and design for the whole page. I also made many decisions on what kind of content should be on the website and how this content should be organized. For instance, I completely reworked the content of the start page by thinking about what the most important information is to the different target audiences.
Using the start page as an example, I also tried different styles and colors to give the whole page a unique look. Using the topic of early childhood education as an inspiration, I experimented with various kinds of line drawings, photographs, and graphic shapes. I also tried different looks and layouts for the chapter and the country overview page. However, I couldn't find any satisfactory solution and ended up just leaving these pages as simple lists for the time being. Finally, I also designed the footer of the website as a kind of sitemap that provided another, alternative way to access the content of the website.

Feedback from: Various people from the Eurostat User Support and Dissemination Unit (4 people, in person), attendees of the EU DataViz conference (in person at the conference and in

writing after the conference) (see below for a summary of this feedback)

Feedback Session: For the feedback session with Eurostat I used the presentation I was going to give at the EU DataViz conference the following day. In that way it was as much about rehearsing the presentation as it was about presenting the prototype. Apart from some suggestions for the start page, the feedback on the prototype was predominantly positive. The people at Eurostat noted that it was good how my proposal didn't just emulate the paper or PDF version but was indeed truly digital. Beyond that, two specific features warranted a lot of intertest: For the stories, I presented the concept of providing users more insight into how the statistics in the report were actually created through short videos. The idea of somehow giving users more insight into how data is produced and what role Eurostat play in that regard. The second thing was an interesting in spending more with the target groups to find out about their needs.

EU DataViz 2019

It may look like data visualization happens after the, let's say, real work of creating, cleaning and analyzing the data. But in fact, it starts with the structured collection of data at the very beginning of the data life cycle. This is where the public sector needs to adapt it's working procedures. (…) The Publications Office of the European Union recognizes the enormous potential of data visualization today when publishing is shifting from "one size fits all" documents to user-tailored experiences and applications.
— Strohmeier, 2019, 6:58)

The EU DataViz Conference was held for the first time in Luxembourg in November 2019 under the motto "serving citizens through better data visualization." It was organized by the EU Publications Office as a one-day event that drew around 500 participants from across Europe (conference website). Around 60% of the attendees were from the public sector (40% EU, 20%, national or regional public sector) and 20% percent worked the private sector. The remaining 20%

was more or less split between people from academia and people who identified as "data professionals" (source). The conference consisted of keynotes and multiple, parallel thematic session as well as presentation stands and poster sessions. I presented my thesis in the session *New Ways to Present Reports* in a 12-minute talk (Figure 113 & Figure 114) that also included a short Q&A.

The talk was an opportunity for me to summarize and communicate the findings I had made in my thesis so far. For the presentation, I divided my process into two simple steps: understand and translate. In the understand part, I explained how I had come to an in-depth understanding of the audiences' needs through co-design workshops and presented the analysis of the results from those workshops. In a visual summary of those results I showed the differences between the needs of a broad audiences in terms of volume and depth (which later became scope), correlations (which later became intertextuality) and affect. In the translate part of the presentation, I then introduced the prototype by the means of four guiding principles, each of which addressed an issue I had discovered in the analysis of the audiences' needs:

– In general, the dynamic, varied nature of the audiences' needs calls for a product that allows users to engage with content on various different levels and to move seamlessly between these levels of engagement. I termed this the squid principle: The squid's body illustrates the core product where all information from the report is available in different depths, volumes, and complexities. The two tentacles are the main entry point to this platform – an organization's website and social media. The squid's arms represent additional products such as a newsletter or a press release.

– Different storytelling methods can address the audiences' varying needs in terms of depth and volume. Based on Kosara's argument structure for data stories (2017), for example, we can combine various amounts of charts and text in different sequences to create stories of varying length and complexity.

– For varying needs in terms of correlation we can follow a principle of explanation by default, exploration on demand. This means that the user follows a story provided by the author by default but can delve into the content and explore it in more depth if wished. We can facilitate this behavior through the use of interactive elements that hide, emphasize, and animate information.

– Finally, a modular system can allow users to see themselves in the report's content and to personalize the report in different ways, addressing varying needs in terms of affect.

I ended the presentations with some appeals directed at people who produce reports. Among others, the final slide included a prompt to spend quality time with one's target audiences, to simply explain the data instead of building complex, exploratory dashboards, and to have more trust in that text and visualizations are different but equal partners when it comes to storytelling.

Feedback to the presentation was surprising in so far as it didn't focus that much on the prototype as on the way I had summarized my findings. Many people commented on the way I was thinking about the process and the design rather than on the design or the content of the ideas themselves. One person found the "rigour" of how I had approached the problem fascinating, another commented on the "brilliant reasoning on needs of different audiences». Many people liked how "practical" the presentation was in that it provided the audience with tips. In fact, those two aspects – the participatory design process and the fact that I included some practical guidelines – was also what set my presentation apart from many of the other presentations.

What caused some confusion for the audience was the fact that what I was presenting was just a design prototype. Many people asked me if the project I had presented could already be used online and one person from the OECD asked about statistics on how the use of my solution compared to the use of the original report. Another person seemed confused as to what
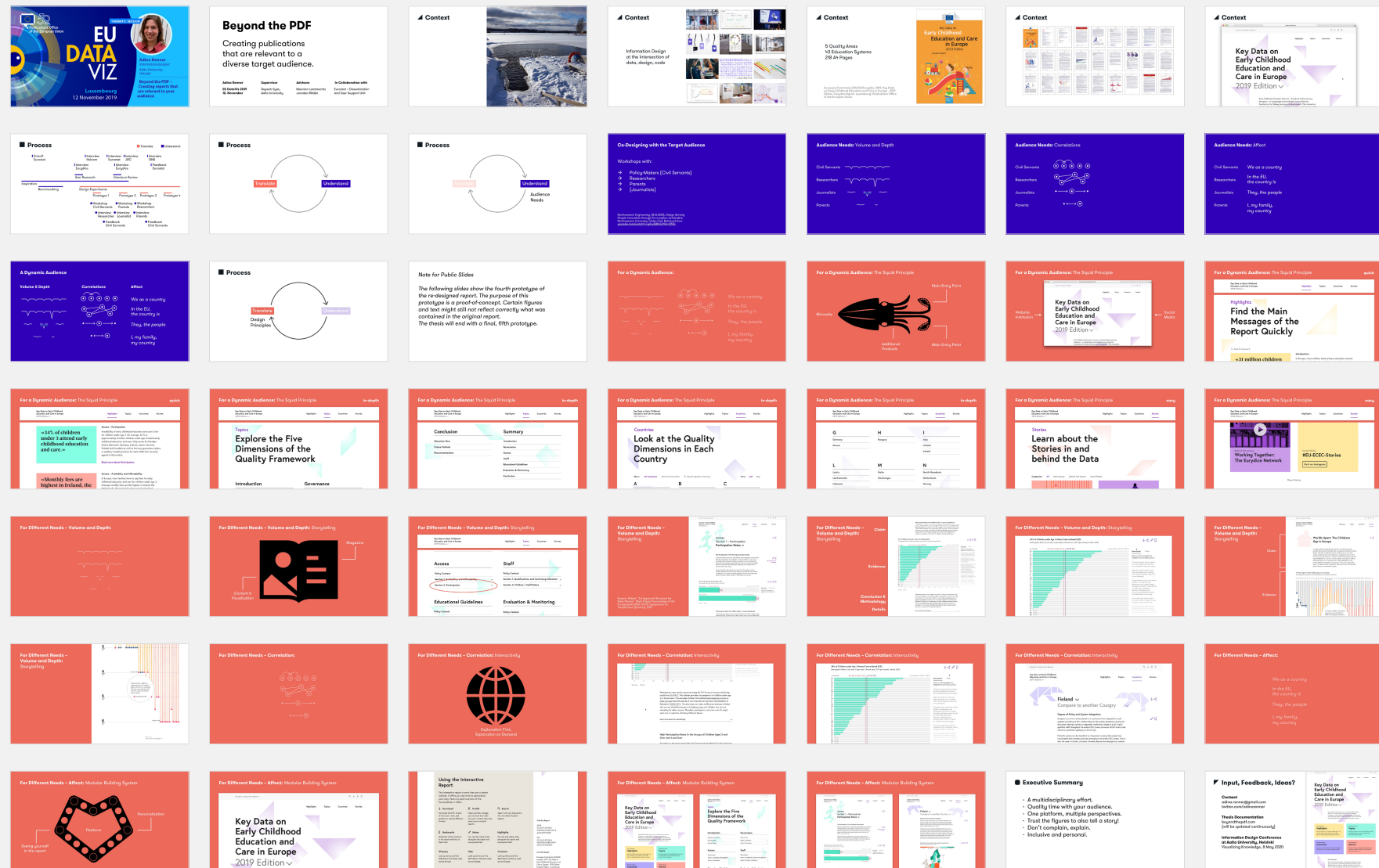
exactly my contribution had been, asking if I had simply cut and paste what had been in the original report into a new format. The presentation might have benefited from an overview of what new content had been produced and what had been simply reconfigured and re-written in order to turn the PDF into an online report.

Beyond providing a first platform for my thesis, the conference allowed me to connect with like-minded people and be inspired by others' work. In the same session I was presenting there were other, interesting approaches to make reports more user-friendly and especially more visual. Tony Fujs from the World Bank presented a project in which they had turned the Atlas of Sustainable Development Goals into an online report that consisted solely of data visualizations and managed without any additional text and Suzan Fiack from the German Federal Institute for Risk Assessment talked about how they had turned an annual report into a magazine that contained playful infographics and data visualizations.

Another session that ran in the same room include some equally interesting approaches under the topic "Understanding Policy". Annie White from the Harvard Growth Lab presented the Atlas of Economic Growth and their agile development cycle that includes iterative design sprints and extensive user testing. Joanna Sleigh and Manuel Schneider presented a new way of visualizing ethic frameworks and policy document in the form of an interactive systems map. Further research will include exploring how their concept can be applied to policy documents from other fields, developing a tool that can automatically transform a policy document into an interactive systems map, and an evaluation study with users. These examples all looked at the problem of making reports and documents easier to use, more pleasurable, and more useful but offered widely different approaches and solutions. These ideas opened up new ways to think about and develop my own work.

Figure 113. A selection of slides from my presentation at the EU DataViz Conference.

Figure 114. All slides from my presentation at the EU DataViz 2019 Conference.