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Identification of data representation needs in Service Design

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Abstract. Organisations are looking for new service offers through innovative use of data, often through a Service Design approach. However, current Service Design tools conceal technological aspects of service development like data and datasets. Data can support the design of future services but is often not represented or rendered as a readily workable design material. This paper reports on an early qualitative study of the tools used to work with data and analytics in a medium-sized organisation. The findings identify the current representations of data and data analytics used in the case organisation. We discuss to which extend the available representations of data and data analytics support data-driven service innovation. A comparison of our findings and current Service Design representations show that Service Design lack to represent data as design material. We propose the notion of expansiveness as a criterion to evaluate future data representations for data-driven Service Design.

Keywords: Service Design, Big Data, Design Artefacts, Organisations, Service Innovation.

1 Introduction

Data and the potential to analyse huge amounts of heterogeneous data has become a key asset for our society. More and more organisations turn towards Big Data to seek new or higher profit, new business possibilities or to improve existing work tasks [1]. The popular notion of Big Data often refers to the vast amount of data that may be analysed to reveal complex patterns and behaviours, allowing an organisation to for example discover trends and consumer patterns as large amounts of data are processed by computers [2]. However, while many organizations talk about applying Big Data, many actually work with Data rather than Big Data (e.g. organizations working with datasets containing a few gigabytes of data and not hundreds of terabyte). Working with (Big) Data encounters many different and often complex processes in order to make the heterogeneous data sources available for analysis and application. In line with [3:230], we propose to rather than referring to Big Data in terms of a particular amount of Data, we refer to Big Data as the collection of processes that is needed in order to make Data available for analysis.

In parallel with the increased awareness of Big Data's many possibilities, Service Design is becoming a recognized design discipline within industry. Service Design is as a design discipline facilitating a move from a product-oriented mind-set towards services. The use of Service Design tools allows organisations to better grasp and consider the intangible aspects of service development and innovation. An increasing number of organisations and companies attempt to make use of Service Design as a way to understand the role Big Data may have in the organization and how to design and implement services around Big Data [4]. As put forward by Ostrom et. al [5], Big Data has fundamentally changed how organisations can provide and innovate services. The evolving Service Design discipline aims to provide an explorative and holistic approach to the development and enhancement of services [6,7]. However, Service Design has not yet targeted specifically the design of data-driven services that require the design of analysis and integration of data from heterogeneous sources and across different organisations as part of the participatory design process. Thus, on the one hand organisations have difficulties with understanding how to make use of Big Data for service innovation and development. On the other hand, Service Design as a design discipline lacks methods and tools that enable organisations to design with Big Data and thus explore innovative possibilities for developing smart services [4,5].

To address this issue, the article questions how currently available and applied data and analytics tools confine data-driven service innovation in a Danish medium-sized service organisation. The article explores this question by juxtaposing the core representations in Service Design with empirical results from our early study on the use of representations of data and data analytics in the context of service provisioning.

The remainder of this paper is structured as follows: Section 2 discusses the paper's related work. We draw on the notions of design artefacts and expansive visibilization as theoretical underpinning to discuss the role of representations in design and present the core representations in Service Design. Section 3 presents a description of research methods, and Section 4 introduces the research setting. In Section 5, we present the findings from our early study. Then, in Section 6, we relate our findings to the literature discussed. Finally, in Section 6, we conclude by asserting a lack of representations of data in Service Design and argue it is necessary to consider and develop "a data dimension" in new tools and methods to support design of data-driven services in small and medium-sized organisations.

2 Related work

Why do representations of data in Service Design matter? This is a significant question to ask in our attempt to connect the field of Big Data and the Service Design discipline. To elaborate on the question, we first include the discussion on the role of representation in design. Here, we refer to the discussion on Design Artefacts in Participatory Design, Co-design and developmental work research. We elaborate on what constitutes Service Design and furthermore look at the kind

of representations Service Design is offering, especially for facilitating the participatory design of data driven services.

2.1 Why Design Artefacts are important

Most design disciplines work with haptic or semiotic representations of different aspects of the design in progress: representations serve to communicate knowledge of the current situation and the design challenge as well as anticipating future work practices and technologies [8]. Especially, in Participatory Design (PD) the representation of the future system and software have received special attention. PD aims at involving domain experts, that is, for example the future users in the design of their future work and tools. Design Artefacts here have the role to support communication and cooperation across professional disciplines. Already in 1995, Morten Kyng discussed in his article 'Making representations work' the need to choose representations well to support the open ended cooperative design [9]. Building on this work, Bertelsen discusses in depth the role of representations as Design Artefacts mediating and facilitating the design in three dimensions, being Construction, Communication and Conception [10]. A specific Design Artefact would support all three dimensions: The Construction dimension describes, how a design artefact supports the concrete implementation of design; a mock-up for example provides the instruction of the overall layout of the application. The Communication dimension describes the how an artefact can support the communication between different stakeholders. To use mock-ups again as an example: the mock-up provides a deictic space for users and designers to relate to functionality and data by pointing to interface elements. The Conception dimension that is facilitated by design artefacts is the conception of new ideas, the creativity that is part of all design. The mock-up supports conceptualisation when it allows the participants of the design session to follow ideas and take apart and reassemble a paper mock-up in line with innovative functionality. The mediating quality of Design Artefacts though does depend on the design constituency it is used with: Design Artefacts that serve well the cooperation with non-IT professionals might not be suitable to mediate a design discussion between the software architect and the development team.
Engeström's article 'Expansive Visibilization' from 1999 [11] can be read as an elaboration of the last of Bertelsen's facilitation dimensions: He compares different ways of representing work processes, and argues for the need that the representations support not only the communication of workflows and the social and spatial arrangements that implement it, but also the learning and change of the arrangements.

As further discussed below, in the context of data driven services, data is not any longer only an enabler of services, but becomes part of the material that can be used to improve or design new services. In order to be subject to cooperation between service designers, domain experts and software developers, data has to be represented in a way that supports not only the construction of

computer support, e.g. in form of integration of heterogeneous data sources, but also needs to represent data as design material. Applying these discussions on the representation of data sources in the context of Service Design, which prompt a list of questions: How do different representations relate to the design of the existing data infrastructure? Can the design be related to concrete future technical functionality? Do representations of data support communication and cooperation between designers, domain experts and IT experts? Last but not least, the representations of data need to support conception or the innovation of services. With other words, how can we create representations of heterogeneous data (re-)sources that support continuous improvement of data-driven services? These questions are relevant for future work in order to develop tools and methods for data-driven Service Design. However, to explore and answer these questions goes beyond the scope of this article. To build a foundation for future work, this paper focuses on the current situation and thus how available and applied data and analytics tools confine data-driven service innovation.

2.2 Service Design

Service Design has emerged from the needs, and perceived possibilities, of companies and other organisations to provide services to their customers [5]. A main objective for Service Design is to establish a holistic, user-centred perspective throughout the design process. (The term 'user' refers here to the service user, not necessarily an IT user.) A traditional product-centric business model focus on selling products such as a computer or coffee mugs. Here the company-customer relationship constitutes very few encounters, for instance at the time of purchase, and the value is exchange-based as the customer receives the product in exchange for money [12]. In the case of services, a company would not sell for example a computer once, but rather sell the service of on-demand computational power. That also means that a service per se does not have any value by itself, but that value is created through service use [6]. Some even go as far as stating that a service only exists, when it is used [13]. Designing a service is hence something else than designing a product, and being a service provider is different from being a product manufacturer or retailer. As pointed out by Polaine et al, Service Design as a consequence is different than other design practices such as Industrial, interaction or experience design [6].
Service Design uses methods and tools developed for a wider purpose, for example Personas [14] and Storyboards [15], but has also as a field developed its 'own' tools which specifically targets the design of services. Examples of these tools includes Customer Journeys [16], Service Blueprints [17], and Service Ecology Maps [6].

Customer Journeys, Service Blueprints, and Service Ecology Maps are all examples of tools strongly related to the Service Design community. These tools often have two functions in the design process: they work both as analytic tools to document a given situation or as a representation depicting the anticipated future (e.g. before or after a service has been (re-)designed).
A Service Blueprint is a tool that facilitates the process to map out and understand how a service will look like, unfold from a user or customer perspective, actions

needed at specific locations and infrastructural needs. A blueprint is divided into two sections by 'a line of visibility'; a front stage part that the user 'see', and a backstage part that contains important elements for the service but that is not noticeable by the user.

A Service Ecology Map represents actors and their relationships. It can take different graphical expressions, but is often a circular shape where the further away a representation of an object (like an actor, a technology, or infrastructure) is placed from the centre, the further away from the core service it is. The circle can be split up into different sections, representing for example different aspects and actors of the service, like how is something performed, who performs it, when is it performed, where is it performed, what enables it, and why is it performed.

A Customer Journey is a (graphical) representation of a scenario, visualizing how one or more actors interact with a service. The customer journey may for example visualize a trip to the hospital, being based on a particular patient persona and his or her envisioned use of a healthcare provisioning service. A customer journey can help the design team to foresee, plan and discuss possible user behaviour and service interactions based on for example a persona.

The above examples are representative tools used within the field of Service Design. While they allow a quick overview of both the current or envisioned future situation, with embedded possibilities and shortcomings, these tools are less optimal to use by themselves and in isolation for service design work where complex and high quantities of data are the main service enabler. To work with precise data flow analysis and design that can prepare a service for implementation, Unified Modeling Language or other tools must often be used to 'engineer' the technical side of the service, preparing for it to be programmed by a software developer. When designing services around Big Data, these tools do allow service designers to open up and explore aspects of data in these tools. They though are not meaningful to facilitate design together with domain experts.

3 Methodology

This research constitutes an early study for a subsequent action research PhD-project. Due to this linkage and because of the case organisation's underlying wish to create change through these research activities, we likewise adopted an action research approach for this study [18, 19, 20]. This section elaborates on the research setting, the applied methods and the analysis.

3.1 Research Setting

The empirical research took place at The Educational Secretariat for Industry, Industriens Uddannelser (IU), which is a medium-sized service organisation based in Copenhagen, Denmark. IU's main services and service provisioning are centred around the development of educational programmes for vocational training and adult vocational training in the industrial sector in Denmark. The organisation integrates

heterogeneous data sources including government data, personal data, and data generated through their service provisioning. Referring to the literature on Big data [18], IU's work with data resemble Big Data in terms of high variety, velocity and veracity though the volume is not comparable to that of data generated e.g. through social media platforms. As mentioned in the introduction, we thus refer to Big Data in this context. Besides being a service organisation, IU can also be seen as a knowledge broker organisation, that for example utilizes heterogeneous data to answer to knowledge and information needs [21]. Being a knowledge broker organisation, IU cooperates with a large number of organisations in order to generate and provide data for their key stakeholders, who have different needs for information and data analysis. IU and its cooperating organisations share the interest of many organizations, being how they can utilize data in more innovative ways, e.g. to improve their services. However, unlocking the data potential can be challenging for organizations, to transform data into a viable and reliable resource that can inform databased services and ideally create a competitive advantage and fuel growth [1, 4, 19]. For many organisations, like for example IU, it is also challenging to build and implement the necessary organisational structures to support data-based service provisioning as there is no "one size fits all" solution for how to create and implement data-based strategies [19, 20]. This study was initiated as a way to investigate IU's current work with data and data analytics tools in order to further understand how the organisation's current "data practices" can be changes and developed.

3.2 Methods

The data collection focused on how currently available data analytics tools mediate different ways of working with and exploring data in relation to service innovation. The primary data sources thus consisted of 4 semi-structured interviews, observations, participatory observations, a workshop, and studies of the tools used for data-related activities in the organisation (see table 1). The fieldwork was conducted at IU, and specifically focused on the work of the Statistic Team, a group (four people in total) in the organisation that was responsible to create periodical statistical reports and support other members of the organisation with data analytics. Members of the Statistic Team were interviewed about their organisational role and data-related tasks. The members of the Statistic Team were also observed as they performed individual data-related activities in their offices. Ambiguities which emerged were investigated by follow-up questions.

Empirical Data	**Amount**	**Total Length**
Individual interviews with the members of the Statistic Team	4	6 hours
Observations of the individual members of the Statistic team and team meetings	12	8 hours
Participatory observation of the statistic team's Statistic Seminar for	1	4 hours
Workshop	1	3 hours

Table 1.

The study lasted 3 months. During this time, the first author worked at the organisation and thus became of the everyday life at IU. Moreover, she immersed herself into data-related activities and initiatives taking place in the organisation to collect data from ongoing work concerned with data analytics tools. The data collection was documented through audio recordings, field notes, photos and documents distributed at participatory events. To prepare the analysis, audio recordings were transcribed word by word.

3.3 Analysis

A thematic analysis was used to identify and understand the employee's use of the currently available data analytics tools [19]. The analysis started in parallel with the field work through ongoing status meetings amongst the authors. The themes that emerged focused on barriers for data exploration, statistical data representations, the work processes of the statistic team, technical infrastructures and 'silo IT-systems'. The themes emerged based through two coding iterations; open coding and coding which focused specifically on data-related actions. In this article, we focus on four categories of tools used for data-related activities and on the purpose of their usage: Scripts, System Interfaces, Tables, and Infographics. This paper explores these categories in depth and questions how these tools confine data-driven service innovation.

The study included several ways to assure the trustworthiness of our results. Throughout the research and the analysis, the second and third authors took part in debriefing sessions supporting the reflection and direction of the research. We used multiple data sources to triangulate the findings. The statistic team was invited to comment on the developing themes and in a workshop the results were presented and discussed by a wider group of members of IU.

4 Findings

IU works to develop educational programmes for vocational training and adult vocational training in the industrial sector in Denmark. It is responsible for 45 vocational training programs and more than 1000 adult vocational training courses. Moreover, IU acts as a knowledge broker in a network of more than 20 cooperation organisations, which all work together to future-proof the Industry by creating the conditions that can provide the necessary, skilled labour. More specifically, they do so by aiming to get more people to choose (and complete) vocational educations and to get more unskilled workers to become skilled through attending adult vocational training. At the current state, the usage of data at IU primarily serves two overall objectives: Data is both used as proof to subsidise argumentation and as a foundation for decision-making.

Data constitute central elements in terms of how employees at IU deliver and improve services. The empirical data shows that data and analytics used to be applied in particular cases to support specific decision-making processes. To make the use of data and data analytics less time-consuming and more valuable for the organisation, the management decided to appoint a statistic team. The team consists of four employees from different departments in the organisation, who are responsible for staying updated on topics such as a data access and data security. Moreover, they are responsible for creating and publishing statistics about the development of all vocational training programmes and adult vocational training programmes on a regular basis. The tasks within the team are divided so that two of the members mainly provide the periodic statistical reports, while the other two members to a greater extend communicate with external stakeholders on topics such as data access. By observing the team members' work practices, we identified the tools, which are used to perform the various data-related tasks.

In presenting this study, we elaborate on the four identified categories of tools, which emerged in the analysis; Scripts, System Interfaces, Tables, and Infographics. Together, these categories of tools make up the IU's present approach to working with data, analytics and representations of data. Figure 1 illustrates how the tools are connected in relation to IU itself, external data providers, the public and stakeholders. The four categories embody representations of data and data analytics in different ways. The categories were divided into two groups based on the tools' and thus the categories' overall objective: while Tables and Infographics are representations of data; Scripts and System Interfaces are representations meant for producing data analytics. These categories of tools are relevant in the context of Service Design, as they might provide representations that allow for exploration of the potentials in data that need to be extracted through analysis. By elaborating on the four identified categories of tools, this paper aims to create a foundation for further research that can further support the creation of representations of data in Service Design, which will allow non-IT experts to explore and design with (Big) data.

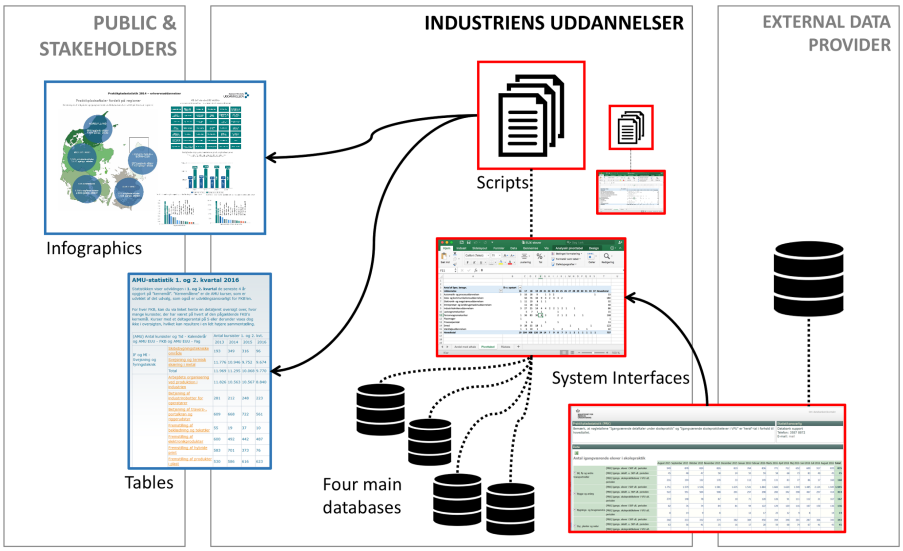

Fig 2. Categories of tools currently used at Industriens Uddannelser for data-related activities

4.1 Scripts

As mentioned, the statistic team is responsible for creating and publishing statistics and statistical representations for internal and external use on a regular basis. The data and the representations of the data are produced in a manner, which makes them comparable to previous statistical statements. During the process of extracting, analysing and representing the data, the appointed employee makes use of detailed instructions in form of documents to solve the data-related task. These documents functions as scripts to make up visualisations, as guidelines that enable an employee to do specific data analysis activities. It explains systematically how a human actor can complete a specific and predefined activity. In this way, scripts serve as tools with the objective of making data analytics. However, the script in itself does not invite its users to go beyond and explore the data. The empirical data shows two forms of scripts: One form are standard word documents containing screenshots and detailed descriptions of various procedures. The second form constitutes a Wikipedia-inspired page known within the organisation as “Stati-pedia”. Located within Microsoft OneNote, this page is a part of a larger knowledge-sharing initiative across the organisation. The page contains specific information and links to websites that are often used to access system interfaces where government data can be accessed in order to generate relevant datasets. “Stati-pedia” was introduced by the Statistic Team as a way to make their way of working with data-related task transparent and accessible for the whole organisation.

4.2 System Interfaces

This tool category refers to an interface as a point of interaction, which enables people to engage with a computer-based system. System Interfaces supports the transfer of data between a user and a computer system. By facilitating this transfer, the System Interface becomes a visualisation of data analytics. This category emerged from observations of the members of the Statistic Team and their use of various System Interfaces during the process of producing data analytics. More specifically, the empirical material shows the usage of three different System Interfaces, which includes Excel, an Excel Macro customized to produce statistical representations, and "The Databank" (a system interface provided by the Danish Ministry of Education). Systems Interfaces are more open for free exploration compared to Scripts, in that they do not 'dictate' certain actions. System Interfaces add a layer to data analytics, which aims to enable users to interact with data in a less predefined way. However, it is necessary for a user to know and understand the interfaces in order for him or her to use them for exploratory purposes. This means, that System Interfaces embody increased possibilities for data exploration, but they are at the same time difficult to access for users, who do not have comprehensive knowledge about the interface's expansiveness.

4.3 Tables

At its core, a table is a data arrangement that consist of columns and rows, which furthermore enables a relation between these. In contrast to the two preceding tool categories, tables are schemes with the objective of representing data. At IU, tables are often used to show selected data. An example is when the organisation represents statistics about adult vocational training on the organisation's website. Representing data in this way depicts data in a linear manner; from one data point to the next and often in relation to time. Moreover, these tables only depict data from the past and thus do not include any databased extrapolation or prediction. This form of data representation excludes all aspects of the data analysis process, and only shows the result of that process. In sum, tables are structured schemes that do not invite users to explore the data further.

4.4 Infographics

The final tool category constitutes Infographics, which are graphical visualisations of selected data that intends to present data analysis quickly and clearly. Infographics was initiated by the Statistic Team as an attempt to represent data in a new way. The deviation from the standardized data representations in forms of tables generated positive feedback from external stakeholders. This new way of representing data also created a new demand in form of additional requests for visualising other types of data in the form of Infographics. Compared to tables and graphical representations of statistics, the Infographics enabled a new and different way of representing data, which resulted in positive reactions and new demands. However, in order to visualize

data in this 'easy to read' manner, there are two central prerequisite steps: First, the employee has to generate a specific dataset, which is then further prepared using a separate system. In other words, the employee is required to make use of both System Interfaces and Scripts to be able to create Infographics about new data. This makes Infographics less accessible.

In a workshop with both the statistic team and representatives of the consultants and the administrative staff they support with data analytics, both the need and wish to work with the data in different and innovative ways in the future was discussed. There was a widespread awareness about problems with the current way of making use of data: issues about privacy, veracity and lack of overview were discussed. Likewise, the potential of new ways of working with data were clearly articulated. As a first steppingstone, knowledge sharing workshops and the above mentioned Stati-pedia have been initiated by the statistic team. However, the challenge remains to make data accessible and understandable for non-IT professionals. These challenges are further detailed in the following section.

5 Discussion

The empirical research described above indicates that data in organisations like IU is an intrinsic part to the services provided. Data is in this case not a technical commodity underpinning the service delivery that can be black-boxed, but it needs to be made visible and accessible to design as core ingredients when designing the service. Below we further discuss the qualities and limitations of the representations used in IU respectively available as part of the service design toolbox.

5.1 The expansiveness of data and data analytics

In the related work in Section 2, we emphasised that design artefacts need to represent relevant aspects of the design in an expansive way, that means in a way which invites creative ideas and new conceptualisations. How would expansive visibilizations of data look like? This has yet to be investigated. However, we can see how expansive the representations of data and data analysis are today. Above, we have identified four categories of tools that have been used for data-related activities at IU. Despite having different functionalities and objectives, these tool categories also vary in terms of possibilities for data exploration. The majority of the organisation's currently available tools for data and analytics related activities reflect what Engeström calls the linear dimension [11]. Scripts communicate how to extract one specific set of data. Tables represent data without allowing to explore correlations. Though infographics make more dimensions of data accessible, they do not allow the reader to explore additional relations. They only make the outcome of the employee's data analysis and processes visible and they represent static data. System Interfaces, though, are tools made to enable users to engage with data analytics. However, a system interface's ability to support data exploration is closely related to the skills of the employee, who uses it.

During the workshop described above the members of the statistic team and the representatives of the consultants supported by the team clearly stated that the current data analytics tools are insufficient to support the improvement of the quality of the current services. It also became clear that potentials for future developments, e.g. designing a set of data that would be indicative to the health of an educational program or the ambition for prediction of educational needs based on past and current data, were hardly accessible based on the current tools. For this, more exploratory tools were needed that allowed the domain experts to connect to the possibilities the rich data sources IU has at its hands.

Last but not least, the discussion here indicates that expansiveness is a relevant criterion to evaluate data representations as design artefacts. However, it also indicates that expansiveness might be dependent on whether the representation is understandable and accessible to the user. As database-level system interfaces allow exploring the bare bone data model, such an interface is only accessible for people with at least a basic understanding of databases and data analytics.

5.2 Making (Big) data meaningful in service innovation

Like IU, more and more organisations are looking to develop smarter, data-driven services that e.g. can automate processes and in this way, improve an organisation's service provisioning. However, little attention has been given to the challenges that the process of designing with data encounters. As the empirical research reported above shows, members of organisations like IU who try to develop new ways of working with data do not have adequate tools. This research analysed the present data analytic tools used at IU in order to understand how data-related work and innovation is supported – or limited – by them. The findings show that the currently available tools facilitate very limited possibilities for exploring data, unless the user has developed advanced knowledge about the tool and the data available through it. This exemplifies how data analytics tools, which are difficult to access, and thus implement in work practices, affect employees' ability to make sense of and innovate with data. Moreover, the tools' limited possibilities for data exploration make it difficult for the user to make sense of what data is available/accessible beyond the scope of a particular, pre-defined data-related task, which arguably restricts data-driven service innovation. The research indicates the necessity of implementing data analytics in the organisation's future service innovation. It is essential for organisations, such as IU, to be able to discuss data as part of their service innovation as a malleable material to design with. Therefore, a question for future work remains; how do we facilitate this discussion?

5.3 Service Design as a sensemaking activity

Weick first introduced the concept of sensemaking to describe how we structure the unknown in order to navigate and thereby be able to act in it [24]. The empirical material shows how IU's cooperation organisations increasingly requests data, which

means that IU needs to allocate an increasing amount of time and resources to be able to understand how to go about these new incoming data-related tasks.

Prendiville, Gwilt and Val propose that Service Design can be developed into an approach for organisations in the pursuit of turning "the abstract and intangible nature of Big Data into human-centred services with social and economic value; thus transforming highly technical forms into something that can be understood and consumed by broader communities" [4: 225]. They argue the use of tools to facilitate visualisation, mapping and co-design in Service Design offers sensemaking activities that can function as a foundation to establish the necessary organisational structures to bring together relevant stakeholders required to enable data-driven service innovation. However, at the same time, they underline that the currently available tools need to adapt and evolve in order to enable organisations to act in the unknown world of data. It is thus in this context that the identified gap of Service Design's incapacity of data representations manifest itself as an issue. As mentioned in the related work, most design disciplines work with haptic or semiotic representing different aspects of design in progress. Kyng argues that well-established representational artefacts often continue to be used "not because they mirror that which is represented, but because they do not, that is, the representation captures a few intentionally selected qualities of that which is represented and nothing more" [9: 46]. This quote underlines an inevitable contradiction, which all representations embody. On the one hand, the simple configuration of Service Design tools makes them accessible for people who are unfamiliar with practicing Service Design. In part, the simple configuration is a key enabler for organisations, who draw on Service Design to innovate services despite of internal competences [12]. On the other hand, Service Design tools conceal technological aspects of service development and especially the data, which can support the design of smart, data-driven services. The identified gap between Service Design and (Big) data calls for new or improved tools that includes representations of data, in order to support stakeholders to collaboratively explore, make sense of and design with data. This prompt the final question in this paper, which is how the identified necessity for data exploration in service innovation changes the requirements for Service Design tools? We discuss this question in the following section.

5.4 Data exploration changes requirements for Service Design tools

As described in the Related Work section, a number of Service Design tools exist to facilitate the design process. These tools constitute simple representational artefacts to support a defined design activity [10]. At the current state, it is only the Blueprint of the aforementioned tools, which to a limited extend considers technical integrations of service development. As a tool, the Blueprint [17], represents the phases of a service experience from start to end including points of interactions between users and service, and the support processes which occur throughout the service journey. Through "the line of visibility" the Blueprint facilitates the considerations of actions and processes that might occur even though they are not visible to the user of the service. However, the Blueprint does not represent data in a way that allows to design with data.

A first step towards tools for data-driven service design seems to be to avoid black-boxing data. Next, the research indicates two additional requirements for the design of new Service Design tools: First, data needs to be represented in "expansive" ways that enable exploration. Second, the representation and exploratory tools need to cater to non-IT experts and thus need to abstract from unnecessary complexity.

6 Conclusion

We started out with the aim to explore the representations useful for Service Design with Big Data. We did so by juxtapositioning related representations from Service Design and practices in a broker organisation to give an understanding of the needs such representations have to fulfil.

First of all, we can state that there is a need for representations that allow non-IT professional to explore and work with data when improving their data dominant services. Second, we also can conclude that the representations used are not very expansive, as they do not support exploration of and learning with and about data for the normal domain expert. And third, we need to admit that Service Design does not provide adequate representation, as data and its analysis are normally not subject to service design but black-boxed as technical commodities provided by software developers.

So the main result of the article is the identification of a gap: a need for representations that at the same time are expressive and expansive enough to make data and data analysis accessible as ingredients for services design but abstract from technical aspects not necessary for the design. The gap between Service Design and (Big) data calls for new or improved tools that includes representations of data, in order to support stakeholders to collaboratively explore, make sense of and design with data. We propose to evaluate the expansiveness and accessibility of such visibilizations as criteria to evaluate such representations. This directly points to the future research that we have recently started.

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