Use Your Data: Design and Evaluation of a Card-Based Ideation Tool for Data-Driven Services

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Abstract

Using data can significantly improve service design and development. However, for businesses, developing data-driven services can be challenging. To address this, we have developed the Data Service Cards (DSCs), a card-based tool to inspire the design of data-driven services. This paper presents two cycles of a design science research (DSR) project, focusing on the second cycle of redesign and evaluation of the DSCs. We conducted a two-step evaluation, including surveys and external expert ratings of data-driven service ideas. Survey results indicate that the DSCs are a valuable tool for developing data-driven services and external experts consider services designed using DSCs to be of higher quality. With the DSCs, we provide practitioners with a tool that facilitates and improves service design and supports digital transformation. Further, we contribute to DSR literature with a rigorous experimental procedure and to service innovation by supporting the early stages of data-driven service innovation.

1. Introduction

Data and data analytics have emerged as valuable sources for service innovation. Today, many companies strive to become data-driven and invest large resources in their data analytics strategy. However, the necessary transformation to become a data-driven enterprise is challenging (Bertoncello et al., 2018; Schüritz et al., 2017). It is not just about installing the right tools and applications to make data usable. The focus should be on making data and analytics part of the company's strategy, systems, processes, and culture (Grover et al., 2018). Innovating new data-driven services in a company requires roles and competencies from user-centered service design and data science. Especially for offline-established companies, it is challenging to develop new data-driven services and business models (Fruhwirth et al., 2018), as they usually do not have skills and competencies for using data and analytics in stand set. A literature review by Fruhwirth et al. (2020) shows that there are already supporting tools and methods available (Kronsbein & Mueller, 2019; Kühne & Böhmann, 2019). However, these are lacking aspects such as easy-to-understand information on various data-driven service components (possible data sources, applicable analytics, potential benefits), including inspiring examples and possibilities to select and combine these components. We have developed the Data Service Cards (DSCs) - in a design science research (DSR) study (Hevner et al., 2004; Peffers et al., 2007) to overcome these shortcomings. The DSCs aim to support non-data analytics and non-service design experts in developing data-driven services. The tool aims to facilitate idea generation and service design process by providing exemplary components of data-driven services. We evaluated the initial DSCs version in a first design cycle (Breitfuss et al., 2020). Evaluation results of test workshops showed that revising the DSCs in terms of usefulness and usability would improve the tool. Accordingly, we aim to answer the following research questions (RQ):

- **RQ1:** To what extent are the Data Service Cards a useful and easy-to-use tool?
- **RQ2:** How does using the Data Service Cards impact the quality of ideation and design of data-driven services?

This paper is structured as follows: First, in Section 2 we present an overview of the literature regarding designing data-driven services and cards

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as supporting tools for innovation. In the third section, we describe our general DSR approach. To fully comprehend the tool development we provide an overview of the first design cycle and respective outcomes in Section 4. In Section 5, we present the second design cycle, including the adaption of the DSCs, methodology, and results of the two-step evaluation. In Section 6, we discuss the results of the evaluation, answer the research questions, reflect on practical and theoretical implications, and propose avenues for further research.

2. Background and Related Work

2.1. Designing Data-Driven Services

Data-driven business models rely on data as the central resource (Hartmann et al., 2016) and have a conceptual focus on creating value from data (Guggenberger et al., 2020). The value proposition of such business models are "data-driven services" (Azkan et al., 2021) or "analytics-based services" (Hunke et al., 2017). In such business models, customers are assisted in decision-making with data- and analytics-based functionalities (Schüritz et al., 2019). These functionalities are independent offerings or supplements to existing products and services (Wixom & Ross, 2017).

Developing data-driven services and business models is particularly challenging for offline-established organizations (Fruhwirth et al., 2018), as this requires new capabilities (Schüritz et al., 2017). Particularly challenging is identifying and communicating appropriate business value (Bertoncello et al., 2018; Schüritz et al., 2017). Developing a compelling value proposition requires data, analytics, and customer-facing capabilities (Meierhofer et al., 2019) and thus combining business and data science expertise (Hagen & Hess, 2021; Mathis & Köbler, 2016). This development is challenging for organizations new to data and analytics, as respective competencies may not yet exist in the companies.

Developing data-driven business models and services can be supported at various stages by tools and methods (Fruhwirth et al., 2020). Such tools and methods can be taxonomies and frameworks (Hartmann et al., 2016), visual collaborative tools - i.e., canvases - for structuring ideation (Kronsbein & Mueller, 2019; Kühne & Böhmann, 2019), or processes (Hunke et al., 2017). Many tools help structure, communicate, and classify data-driven services and business models. However, developing services and business models requires structuring, communication, and creative experimentation to develop new ideas (Bouwman et al., 2019). There are few examples supporting creative processes, e.g., inspiring design options for key elements of data-driven services. Generic tools do not fully serve the purpose of exploring new ideas (Athanasopoulou & De Reuver, 2020). So far, there are hardly any explicit instruments supporting such experiments or exploring new service and business model ideas. Such tools could benefit organizations that are relatively new to data analytics.

2.2. Cards as a Supporting Tool for Innovation

Both researchers and practitioners have experienced that card-based tools effectively support idea generation (Hornecker, 2010; IDEO, 2003). Such tools facilitate collaborative and divergent thinking, help describe complex concepts to non-experts, and trigger and guide brainstorming and ideation (Mora et al., 2017a; Mueller et al., 2014; Vaajakallio & Mattelmäki, 2014). Innovation experts already use cards as a powerful tool in participatory design workshops. In the area of business model innovation, for example, Gassmann et al. (2014) developed the Business Model Patterns Cards. The research team derived a set of patterns related to business model innovation, categorized its findings, and designed more than 55 cards that enable people without expertise in business model innovation to reinvent, evaluate, or develop a new or existing business model. Mora et al. (2017b) developed a card-based tool called TILES for the Internet of Things (IoT). The TILES card set, consisting of 110 design cards, supports the exploration of combinations of user interface metaphors, digital services, and physical objects. Deng et al. (2014b) designed a card set called Tango Cards to bridge the gap between design research on tangible learning games and the practice of designing such games. Lucero and Arrasvuori (2010) developed a framework of 22 cards (PLEX Cards) to inspire game designers.

Cards are a particularly suitable tool for starting an innovation process. In this phase, the focus is on generating many ideas, and the main obstacle is the lack of inspiration. Studies showed that the haptic aspect of cards stimulates creative processes (Hornecker, 2010; Kwiatkowska et al., 2014; Sanders et al., 2010). Furthermore, an appealing and differentiated visual design is essential to make cards self-explanatory and easy-to-use. Such differentiation in design can be achieved, for example, by using different font sizes or color-coding of categories (Hornecker, 2010). Integrating appropriate and meaningful images supports

the uptake of information. Such images could make it easier for users with less expertise to absorb the information displayed on the cards. In addition, other factors are relevant for the design of cards. As there is a mismatch between the fast-paced ideation process on the one hand and the need for fine-granular information on the other hand (Hornecker, 2010), the "appropriate" amount of information on the cards is vital. Further, providing adequate information and minimizing the user's distraction from the design flow must be balanced. Deng et al. (2014a) propose considering the i) user's knowledge level and ii) design activities (e.g., ideation, evaluation, and learning) when deciding on the amount of information on the cards. Ideally, each card should be self-explanatory and easy to understand but at the same time contain all essential information relevant to the creative task.

3. Design Science Research (DSR) Approach

To support organizations in data-driven service innovation, we have developed the Data Service Cards (DSCs) following a problem-centered DSR approach (Hevner et al., 2004; Peffers et al., 2007). We adapted the design cycles of Vaishnavi and Kuechler (2015) to design, evaluate, and iteratively improve the DSCs. The cyclical nature enabled us to learn quickly from each design and evaluation cycle. Our DSR approach is summarized in Figure 1, containing the following phases: problem identification, solution objectives, two cycles of design, development, evaluation, and the conclusion. The first cycle is described in detail in previous conference proceedings (Breitfuss et al., 2020), and the second cycle is the main focus of this paper. Following recommendations from (Peffers et al., 2012; Peffers et al., 2007; Prat et al., 2015) our artifact evaluation methods combined illustrative use scenarios with industry practitioners (see Sections 4.2 and 5.3.1) and a rigorous subject-based experiment, combining workshops, surveys and expert evaluation of workshop outcomes (see Section 5.3.2).

4. First Design Cycle

4.1. Methodology of First Design Cycle

To identify the problem space regarding challenges in the ideation phase of data-driven services, we conducted interviews with R&D managers (Breitfuss et al., 2020). As a result, the following challenges emerged: First, difficulties regarding the collaboration of different disciplines, e.g., data scientists and business executives. Second, challenges in balancing diverse

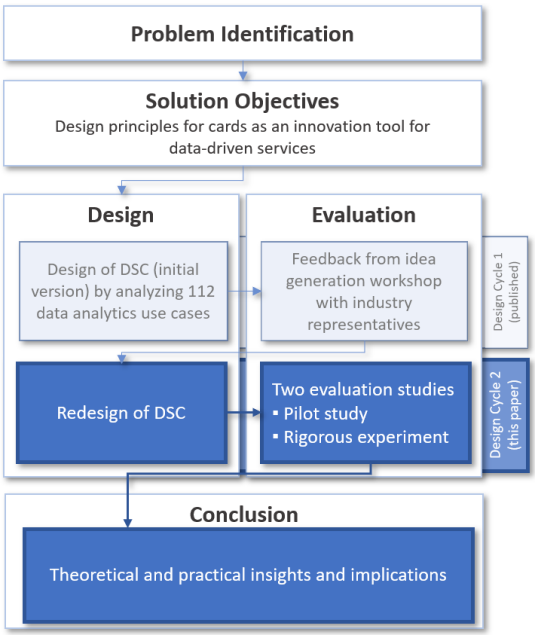

Figure 1. Design Science Research Approach.

levels of expertise in innovation teams, and third, the absence of structured value proposition design processes. Design principles for the DSCs were derived from existing literature on card-based innovation tools (see Section 2.2). The cards' content is based on 122 data-driven service use cases from various industry sectors - collected by applied research organizations. We conducted qualitative content and cluster analyses using structured use case documentation to further develop categories. This content extraction informed the initial set of 40 cards, consisting of four categories. We evaluated the DSCs in a four hours idea generation workshop, in which eighteen representatives from different companies tested the cards. The workshop participants were divided equally among three groups and performed different tasks using the DSCs. At the end participants completed a survey about the usefulness, perception, and usability of the DSCs.

4.2. Outcome of First Design Cycle

The main outcomes of the first design cycle are the card design, the card content, and the evaluation results. The general card design contains a color code for each category, a category name as a heading on the front and back, and a card title on the front below. Each card includes an illustrative picture (front side), an explanatory text (top of backside), and a company example (lower backside). Figure 2 displays an example card including these characteristics.

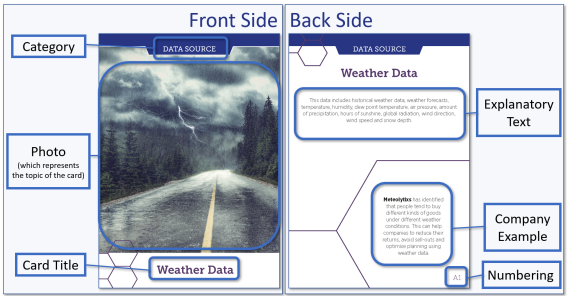

Figure 2. Card Example with Design Elements.

The evaluation results showed that the DSCs are generally well understood and useful. However, based on the feedback of the participants, we identified areas for improvement in the design and content of the cards, such as *uniqueness* (overlap in content between cards), *completeness* (missing content - categories and cards), and *understandability* (some cards descriptions were difficult to understand). Besides these content-related comments, we received suggestions for formatting, such as *numbering* (consecutive numbering on the cards) and *language* (request for an English version of the cards).

5. Second Design Cycle

5.1. Methodology of the Second Design Cycle

To address the issues highlighted in the first design cycle, we adapted the DSCs (see Section 5.2). To evaluate these design adaptations, we conducted a two-step evaluation consisting of a pilot study (see Section 5.3.1), and a rigorous subject-based experiment that involved workshops, surveys and expert evaluation of the quality of workshop outcomes (see Section 5.3.2). The study participants then compared their experiences with the cards to their experiences without them. Further, external innovation experts evaluated the quality of the service design results, as elicited by five dimensions (Dean et al., 2006) - these dimensions are described in Section 5.3.2.

5.2. Adaption of the Data Service Cards

Based on the evaluation results of the first design cycle, we made content and design adaptations to the card set, which are presented in Table 1. Due to the positive feedback on the card design, such as color code and structure (front and back side), we retained the main design. The present adapted version consists of 50 cards, five explanation cards for the categories - one for each category (i.e., data sources, data analytics, data service, benefit, revenue models) - and two general explanation cards (i.e., general information and usage instructions). Figure 3 displays all card categories with a brief description of each category.

Table 1. Content and Design Adaptions.

1) Understandability. Two researchers reformulated the descriptive texts of the cards to be changed. We revised the descriptive texts of 27 cards (out of a total of 40) to improve the understandability.
2) Uniqueness. The research team analyzed the card content focusing on the company examples and the trigger photos. As a result, we modified eight company examples and replaced five trigger photos.
3) Completeness. First, we structured the adaption requests. Second, we discussed the proposed content extensions with data-driven business experts with the result of expanding the card set with an additional category (ten revenue model cards) and two additional cards in the category of data analytics.
4) Numbering. Since numbering was highlighted as useful in the first cycle; we added consecutive numbering to the cards.
5) Language. We translated all card content into English to target a broader user group. Through the translation work, we gathered valuable feedback regarding the understandability of the card content.

5.3. Evaluation

As first step of the evaluation, we conducted a pilot study to determine whether our adaptions of the DSCs resolved the particular issues identified in the first cycle. We aimed to test if the adaptations produced the desired subjectively rated effects, more specifically, if the use of the cards was perceived as intuitive, easy, and useful. In the second evaluation step, we took a rigorous experimental approach. In the experiment, study participants designed a data-driven service with and without the Data Service Cards. Subsequently, the study participants evaluated their experiences with the cards compared to those not using them. And finally, external innovation experts evaluated the services designed by the study participants, based on five quality dimensions from Dean et al. (2006).

5.3.1. Pilot Study *Study Setup.* According to our DSR methodology, we piloted the adapted version of the DSCs in workshops. Due to the COVID-19 pandemic, we implemented a digital version of the DSCs in an online whiteboard tool (MIRO - https://miro.com/). We conducted two online workshops

Figure 3. Overview of the Categories of the DSCs.

N=40 participants. After introducing the cards, participants worked in subgroups (4-6 participants) on two tasks. In the first task, the participants reconstructed and extended a commonly known data-driven service - the recommendation service of Netflix - using the DSCs (illustrated example see Figure 4). In the second task, the participants constructed a new data-driven service for a fictitious company using the DSCs. Subsequently, participants presented their results. Concluding the workshop, participants completed a survey with demographic questions and questions about the perceived usefulness, ease of use, and intention to use the DSCs according to the Technology Acceptance Model (TAM (Davis, 1989); TAM2 (Venkatesh & Davis, 2000)). We adapted the TAM items slightly, in the sense that we inserted the word DSCs instead of [artifact] in the items and preset the context of "development of data-driven services" (example item: "The *Data Service Cards* are a useful tool for the *development of data-driven services*"). This adaptation makes it easier for participants to mentally relate to the specific artifact and context when answering the questions. The TAM model generally states that the attitude towards using an artifact depends on "perceived usefulnes" and "ease of use". "Perceived usefulness" describes the subjective perception that the design artifact improves the corresponding work process; "ease of use" describes a person's perception of how small the effort is to learn to use the design artifact. Subsequently, the "intention to use" expresses how someone intends to use the design artifact in the future. The items testing all constructs are based on a five-point Likert scale (from strongly disagree (1) to strongly agree (5)). In addition, participants gave qualitative feedback on the DSCs.

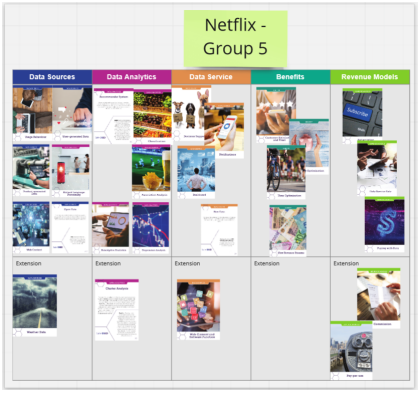

Figure 4. Example Output from Pilot Study.

Participants. Of 40 workshop participants, 29 (age: M = 30.62 years, SD = 6.81 years; gender: 6 female, 23 male) completed the survey. On average, the participants had 10.2 years (SD = 6.77 years) of work experience in following industries (abs. frequencies): Automotive / Mobility (14), Mechanical Engineering (11), IT (8), Research (5), Traffic (4), Public Sector (3), Climate & Energy / Economy & Finance / Environment / Education, Culture & Sport / Agriculture, Forestry & Fisheries (2) - (for interdisciplinary sectors, more than one industry could be selected).

Results. Figure 5 present the results according to the TAM constructs "perceived usefulness", "ease of use", and "intention to use" of the DSCs, as well as a qualitative statement. To analyze the answers to the TAM, we calculated overall interpolated medians (IM) of the corresponding items. We calculated IM due to the response alternatives on a five-point Likert scale. This statistical parameter adjusts the median value (for IM up to ± 0.5) in the direction in which the data is more heavily skewed. This representation of central tendency is suitable for results of ordinal data as given on Likert scales (Gallego et al., 2008; Hassler, 2020). Figure 5 shows the absolute frequencies, interpolated medians, and ranges of the responses for each item of the TAM-based scales. The analysis of the survey results shows that participants perceived the DSCs as overall useful (overall IM = 4.31, $range$ = 3). They also rated the "ease of use" as given (overall IM = 4.03, $range$ = 4) and were optimistic regarding their "intention to

use" the DSCs (overall IM = 3.94, $range$ = 3). The qualitative feedback shows that the valuation of the tool was generally very positive, e.g., *"[...] the cards offer ideas about the most important services - especially useful if you are completely planless"*.

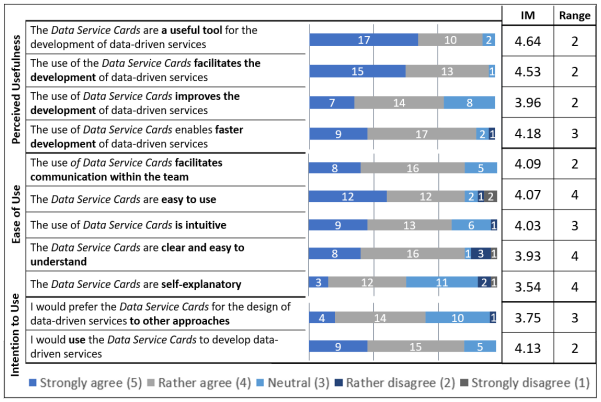

Figure 5. Pilot Study Results of the TAM (Davis, 1989; Venkatesh & Davis, 2000) Survey.

5.3.2. Experimental Evaluation Study In addition, we conducted an experiment to test the quality of the DSCs. In this experiment, we determined whether the DSCs are rated as effective compared to a control condition ("blank-paper" condition) and whether the results designed with the card set were also externally rated as high quality.

Study Setup. We conducted the experiment in an online workshop with N=22 participants (see details on participants below). Our experiment contained two experimental conditions (see study design in Figure 6). In the first condition without intervention ("blank-paper" condition), the study participants, divided into subgroups of 4-6 participants, were asked to design either an external (for customers) or an internal (for internal company processes) data-driven service for a fictitious company. In the following condition (Data Service Cards condition), they were asked to design again an external or an internal data-driven service for another fictitious company, but this time using the DSCs.

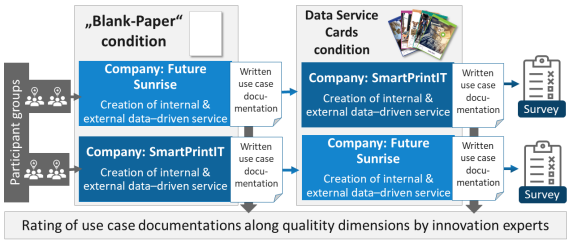

Figure 6. Overview of the Experimental Design.

The fictitious companies were "Future Sunrise" - a photovoltaic company, and "SmartPrintIT" - a printer company - both described as having little experience with data-driven services; we specifically formulated the company descriptions very similar to ensure comparability. Each subgroup documented their ideation and design results in a structured template for both conditions. After completing both conditions, we asked the participants to complete a survey. As in the pilot study, the survey contained items assessing the constructs "perceived usefulness", "ease of use", and "intention to use" according to the TAM model (Davis, 1989; Venkatesh & Davis, 2000) (short description of TAM categories see Section 5.3.1). However, in the experiment survey, we asked about the constructs regarding the usage of the DSCs compared to not using them (instruction above rating items: "Using the following statements, rate the Data Service Cards in comparison to the creation without a specific tool (Task 1)"). Since all study participants had experienced both conditions, they could make this comparison. Further, we asked participants to provide qualitative feedback and demographic information. To evaluate the results of the data-driven service design process, we asked six external innovation experts to rate the quality of the design documentation produced by the participants along five dimensions. These dimensions are based on a scheme developed by Dean et al. (2006) for evaluating ideas in terms of novelty, creativity, and quality. This scheme was developed based on 90 creativity and ideation studies. The quality of ideas is evaluated according to four dimensions (i.e., novelty, feasibility, relevance, and specificity) and two sub-dimensions per central dimension. Five of the eight sub-dimensions were applicable to our card-based tool and experiment and thus were used for our expert evaluations. The selected dimensions are originality, applicability, desirability, clarity, and feasibility. All experts rated each design documentation according to these dimensions on a five-point Likert scale (strongly disagree (1) - strongly agree (5)) without knowing in which condition each documentation was created.

Participants. In our experiment, 22 male participants (age: M = 28.68 years, SD = 4.24 years), took part. On average, they had 8.09 years (SD = 4.31 years) of work experience in following industries (abs. frequencies): Mechanical engineering (13), Research (8), Automotive & Mobility (7), IT (5), Traffic (4), Climate / Energy (3), Public Sector / Economy & Finance / Education, Culture & Sport (1) - (for interdisciplinary sectors, more than one industry could be selected).

Survey Results. As in the pilot study, we analyzed the TAM constructs "perceived usefulness", "ease of

use", and "intention to use" of the DSCs. Hence, we calculated interpolated medians (IM) for all items and an overall IM for each construct. The survey results indicate that participants found the DSCs useful overall (overall IM = 4.2, $range$ = 2). They also rated the "ease of use"(overall IM = 4.40, $range$ = 4) as very positive and were optimistic about their "intention to use" the DSCs (overall IM = 4.05, $range$ = 3).

External Rating Results. We calculated interpolated medians (IM) and ranges of experts' quality dimension ratings (Dean et al., 2006) for the data-driven service design documentation for the fictitious companies in both conditions, also differentiating between external or internal data-driven services. We calculated an overall quality score from ratings by calculating the overall IM across all dimensions. Table 2 shows the interpolated medians of the external ratings for the service design documentation under the different conditions in all quality dimensions. The analysis shows that for the company "Future Sunrise", for both external and internal services, the service design documentation of the DSC condition achieved a higher overall quality score, than the documentation of the "blank-paper" condition. For "SmartPrintIT", internal service design documentation of the DSC condition achieved a higher overall quality score for external service, the quality score of "blank-paper" condition was higher. *Qualitative Results.* The qualitative feedback was almost exclusively very positive, e.g. *"I find this tool very helpful, especially if you have no experience in this area."*; *"[...] I like the cards very much, because on the one hand they have a nice design and on the other and they look a bit playful. The whole process of brainstorming and implementation is not only facilitated but also more exciting."*, and *"Very good idea in developing ideas in a team; Promotes creativity."*. One possible area of improvement would be to add more cards and categories, as one feedback indicated that: *"Categories and cards per category could be more"*.

6. Discussion

Answering the Research Questions. Both pilot study and experiment show that "perceived usefulness" and "ease of use" of the DSCs are very positive. Further, the results show that people who used the DSCs in the workshop would use the cards to develop data-driven services (intention to use). In addition, the DSCs are perceived as a tool that facilitates the development of data-driven services and communication within teams. Based on these results, we can infer - regarding RQ1 - that DSCs are a useful and easy-to-use tool that facilitates the development of data-driven services. Plus, the DSCs are considered to be very useful in terms of qualitative feedback. However, we might consider adding more categories and cards in a possible further design cycle based on the qualitative results. External ratings of innovation experts show that the service designs created with the DSCs are considered good in several quality categories and, in most cases, are considered higher in quality than use cases created without the DSCs. Therefore, regarding RQ2, we can infer that DSCs positively influence data-driven services' ideation and design results in terms of quality. This result is observable in both, the subjective, and external results w.r.t. service designs created with DSCs.

Theoretical Contribution. We contribute to service and business model innovation literature by providing a rigorously evaluated tool that supports creative and concrete ideation, particularly by filling a gap in early-phase data-driven service innovation (Fruhwirth et al., 2020). The contribution of our problem-centered DSR approach (Peffers et al., 2007) can be considered in part as an *exaptation* (Gregor & Hevner, 2013), as it adopts a participatory design-type of the tool into the realm of data-driven service innovation, and in part as an *improvement*, when contrasting it with the already presented first design cycle paper (Breitfuss et al., 2020). We also contribute to discussions on how tools - partic-

Table 2. Interpolated Medians of External Ratings for Service Design Documentations Created in the Different Experimental Conditions - Along Quality Dimensions by (Dean et al., 2006) and Overall Quality Score.

	Conditions							
	SmartPrintIT				Future Sunrise			
	internal service		external service		internal service		external service	
Quality Dimensions	BP	DSCs	BP	DSCs	BP	DSCs	BP	DSCs
Originality	2.17	2.83	3.50	2.75	4.00	4.50	4.17	4.00
Applicability	3.83	4.00	4.50	4.50	4.17	3.83	4.50	4.17
Desirability	4.00	4.10	4.10	4.25	4.17	4.50	4.50	4.17
Clarity	3.50	4.50	4.50	3.83	4.25	4.50	4.17	4.17
Implementability	2.25	3.83	4.10	3.00	3.25	3.50	3.00	4.75
Overall Quality Score	*3.17*	*3.94*	*4.09*	*3.75*	*4.06*	*4.14*	*4.12*	*4.21*

Note: BP = "blank-paper"; DSCs = Data Service Cards

ularly card-based tools - support business model innovation (IDEO, 2003; Mora et al., 2017b). The positive quality evaluation of outcomes created with the DSCs supports the notion that card-based tools foster analogical reasoning in service innovation (Ebel et al., 2022). However, creativity and originality of ideas should not be considered as given results of such tools due to risks of idea fixation. This can arise when designers' knowledge of previous solutions unintentionally constrains the solution space (Ebel et al., 2022) and creativity. Possibly, creativity restriction occurred in one of our conditions as well as one DSC use case did not outperform the blank paper in overall quality. However, since all other use cases created with the DSCs are of higher quality, we argue that the DSCs generally do support idea generation. We will further investigate potential issues in creativity restriction w.r.t. DSCs and card-based tools in general. Regarding DSR literature, we contribute by providing a detailed account of how to evaluate i) artifact usefulness and ease-of-use and, most relevantly, ii) the impact of using the artifact on outcome quality. Included in the latter, we offer an evaluation experiment design and a compounded literature-based idea quality score (Dean et al., 2006).

Practice Contribution. We provide an enhanced version of the DSCs, accounting for a card-based data-driven service innovation tool that positively contributes to the quality of developed design results and is perceived as useful and easy-to-use by users. This tool can facilitate the complex process of collaboratively designing, developing, or improving a data-driven service, particularly for non-domain experts in multidisciplinary teams. The tool is already integrated into study programs in European universities and training programs for companies. Practitioners expressed interest in additional language versions and extensions (e.g., to support circular economy innovation).

Limitations and Future Research. Regarding methodological limitations, the evaluation considered i) a limited number of participants and ii) a quite homogeneous sample. However, we argue that this i) has been compensated by a rigorous experimental design and ii) should be considered in a further design cycle. Topics of future research could be the development of standardized usage method (i.e., repeatable process design) of the DSCs, as already done for other innovation tools (Avdiji et al., 2020; Lucero & Arrasvuori, 2010; Mora et al., 2017b; Sammon & Nagle, 2017). To further improve user experience, cards could be enhanced in terms of gamification (Hornecker, 2010; Vaajakallio & Mattelmäki, 2014). It could also be explored to what extent the integration of card-based and canvas tools can promote idea generation. In this regard, there is already separate research on both types of tools (Avdiji et al., 2020; Deng et al., 2014a; Mora et al., 2017b; Thoring et al., 2019), but to our knowledge, not in combination. This direction also addresses a recent call for research on combining tools in data-driven business model innovation (Fruhwirth et al., 2020).

7. Conclusion

Data is considered an essential resource for service and business model innovation. However, few tools support organizations in designing and developing data-driven services, especially within multidisciplinary teams with little expertise in data science. In this research, we adapted, improved, and evaluated the Data Service Cards (DSCs) - a card-based tool to facilitate the process of data-driven service design. We improved the DSCs' understandability, uniqueness, and completeness using a Design Science Research (DSR) approach. Our evaluation exhibited positive results because the DSCs i) are seen as a useful and easy-to-use tool, and ii) enhance the idea quality when developing data-driven services. This research fills a gap in data-driven service innovation, supports DSR method application with an enhanced experimental design, and provides practitioners with an actionable tool to support companies' digital transformation efforts.

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