DATA SERVICE CARDS - A SUPPORTING TOOL FOR DATA-DRIVEN BUSINESS

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Abstract In the future, every successful company must have a clear idea of what data means to it. The necessary transformation to a data-driven company places high demands on companies and challenges management, organization and individual employees. In order to generate concrete added value from data, the collaboration of different disciplines e.g. data scientists, domain experts and business people is necessary. So far few tools are available which facilitate the creativity and co-creation process amongst teams with different backgrounds. The goal of this paper is to design and develop a hands-on and easy to use card-based tool for the generation of data service ideas that supports the required interdisciplinary cooperation. By using a Design Science Research approach we analysed 122 data service ideas and developed an innovation tool consisting of 38 cards. The first evaluation results show that the developed Data Service Cards are both perceived as helpful and easy to use.

Keywords: data driven business, card-based tools, data service development, business model innovation, design science research.

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1 Introduction

Companies that manage to create added value from existing or newly acquired data secure an important competitive advantage. But the necessary transformation to a data-driven company places high demands on companies and challenges management, organization and individual employees.

Whether customer data, measurement data, real-time data from sensors, analysis data, monitoring and log data from IT systems, data from existing data warehouse solutions or even external data from social networks, the Internet or business partners, all this is available and can be used today. Thanks to enabling technologies (e.g. anonymization, privacy-preservation) more and more data is becoming available for businesses to use, which leads to the question how they can now use those data in ways that benefit their business model. In order to generate concrete added value from data, the knowledge of how a data-driven service is developed must be built up in the company. As Bertoncello et al. (2018) stated, a lack of structured value proposition design and a limited understanding of customer benefits are challenges in developing data-driven services. Another challenge is the necessary collaboration of different disciplines e.g. data scientists, domain experts and business people. There are already several tools and methods supporting the development of new data-driven business, ranging from general tools like the Business Model Canvas (Osterwalder, 2010) to data specific tools e.g. the Data Canvas (Mathis & Koelber, 2016) or the Data Innovation Board (Kronsbein & Mueller, 2019). Although much research has been done, there is limited knowledge on how to facilitate creativity and co-creation amongst people with different backgrounds in the development process of data-driven product/service ideas.

Therefore, our main research objective is to design and develop a hands-on and easy to use tool (Data Service Cards) for the generation of data products/service ideas that supports the required interdisciplinary cooperation between (data) experts and non-data experts. The newly developed Data Service Cards (DSC) aims to bridge the gap between disciplines and backgrounds (IT, data science, business development, sales, etc.) The tool should engage the collaborative teamwork and help to innovate existing or new data-driven business opportunities. Specifically, we seek to answer the following research questions:

RQ: How should a haptic tool (cards) for developing a data-driven product/service idea be designed to support the co-creation process of innovation teams with different backgrounds and levels of expertise?

The paper is structured as follows: Section 2 provides the theoretical framework regarding data-driven business and cards as an innovation facilitation tool. Section 3 outlines the applied design science research method. The following chapter 4 is describing the research results, beginning with the categorization and followed by the design of the Data Service Cards. Subsequently, insights from a first evaluation will be presented in chapter 5. Finally, chapter 6 summarizes and discusses the results and provides an outlook on further research.

2 Background

2.1 Data-driven Services

Data and analytics hold the potential also for traditional organizations for service innovation (Engel and Ebel, 2019). Data and analytics can be used to improve internal processes and decision making (Wixom and Ross, 2017), to enrich existing products or services with data (Davenport, 2013) or even to create new data-driven services and business models (Hartmann et al., 2016). In data-driven services, data and analytics are used "to support the decision-making process of the customer via data and analytics-based features and experiences in form of a stand-alone offering or bundled with an existing product or service" (Schüritz et al., 2019). Despite the potential for business growth (Seiberth and Gründinger, 2018) it is very challenging for traditional organizations to innovate new services and business models based on data and analytics (Schüritz et al., 2017; Fruhwirth et al., 2018). There is a lack of data-focused innovation tools and methods support that process <<masked for peer-review>>. Further, there is very little knowledge available on how organizations could get started (Agrawal et al., 2018).

2.2 Data Product Canvas

A visual innovation tool, the "Data Product Canvas", developed in a previous design science research paper by Fruhwirth et al. (2020) aims to help organisations in developing, structuring and communicating ideas for data-driven services. The newly conceptualised canvas (see schematic representation in Figure 1) consists of five main categories (dimensions): "Data Sources", "Analytics", "Data Product", "Benefit" and "Pains and Gains". The dimension "Data Sources" specifies the essential data sources for the service. "Analytics" describes common and advanced data science methods to generate insights from data. The insights are delivered and presented via the "Data Product" dimension to the internal or external customer or user. The user gains a certain "Benefit" in a specific decision-making process by using the insights presented in the data product. In order to create value for the data service user, the data product is addressing "Pains and Gains", specifically decision problems of the user.

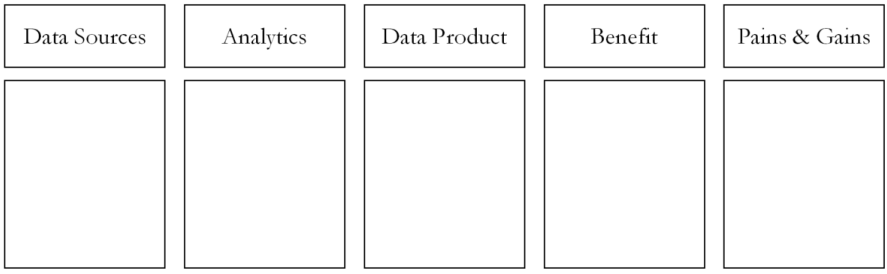


Figure 1: Schematic representation of the Data Product Canvas

Based on the solid basis of the Data Product Canvas as a visual tool for supporting the innovation of data-driven services we applied the previously described 5 dimensions as meta-categories for the card development process (see section 4.1)

2.3 Cards as an innovation method

One of the main driving forces in idea generation workshops is the diversity of its participants. (Rietzschel et al 2006). Cards are a tool commonly used to facilitate creativity and co-creation amongst people with different backgrounds. (Kwiatowska et al., 2014). Research and experience show that the use of cards supports creativity

whilst maintaining the focus on the relevant subject(s). They also stimulate discussion, group work and help when working with categorisation. (Sanders et. al 2010)

Cards are used in different areas, industries and are covering many topics. Innovation facilitating experts already apply cards as a powerful tool in participatory design and creativity workshops. For example, the Business Model Patterns Cards developed by Gassmann et al. (2013). The research team derived a number of patterns with regards to business model innovation, categorized its findings and designed 55+ cards which enable people without expert knowledge in business model innovation to reinvent, evaluate or develop a new or existing business model.

Cards are an especially adequate tool at the very beginning of an innovation process when the focus lies on generating as many solutions as possible and the main obstacle is lack of inspiration. Research has shown that the haptic aspect of cards stimulates the creative process (Gassmann et al., 2013, Kwiatowska et al., 2014, Sanders et al 2010, Hornecker 2010). Albeit it is not only the tangible, physical aspects of cards that stimulate inspiration and creativity. It is also the way cards are designed with respect to their content such as pictures, text and other information such as visible categorisation or examples.

It is important that each card is self-explanatory and easy to understand but at the same time contains all the essential information relevant to the creative process (Gassmann et al.,2013). The selection of suitable, meaningful pictures to support the written information or adding stimulating questions also plays an important role in the usability and applicability of cards in the creative process. (Hornecker, 2010)

3 Method - Design Science Research

For the structured development of the artefact (Data Service Cards), we conducted a Design Science Research (DSR) project (Hevner et al., 2004). We allocated our research activities along the process model of Vaishnavi and Kuechler (2015), consisting of the phases "Problem Awareness", "Suggestion", "Development", "Evaluation" and "Conclusion". Table 1 reports on the conducted activities, applied

methods and outcomes of the first design cycle for the present research work and the further planned activities.

Table 1: Design Science Research Phases according to Vaishnavi and Kuechler (2015)

Phase	Method / Activities	Outcome
Problem Awareness	Observation of the problem in the creativity phase in data-driven innovation projects. Interviews with R&D managers of different industries.	Difficulties to balance different backgrounds and level of expertise of innovation teams within the creative phase (idea generation) of data-driven products/services. Lack of inspiring application examples and easy to understand explanations of e.g. data analytics methods.
Suggestion	Review of existing research (see section 2). Applying meta-categories from the Data Product Canvas (see section 2.2). Suggesting design of cards following Gassmann's example on 55 Business Model Patterns.	Concept for a set of cards for supporting the idea generation of data-driven products/services.
Development	First step: Classification of sample data through qualitative content analysis into 4 meta-categories. Second step: Iterative clustering of sub-categories (individual researcher and expert team). Third step: Content creation for the cards (text and pictures).	Relevant sub- categories for data-driven products/services out of an empirical data-set. Card design for each sub- category containing explanatory picture, an explanation text and an application example.
Evaluation	Idea generation workshop for data-driven products/ services with 18 companies including documented observations. Pen & paper survey about usefulness, perception and usability.	Indications regarding usefulness, clarity and completeness. Suggestions for improvements for a second design cycle.
Conclusion	Lessons learned workshop with card development team.	Start of a second design cycle through integration of the evaluation results. Further evaluation workshops planned.

Further details regarding the methods used as described in Table 1 can be found in the following chapters 4 and 5.

3 Development and Demonstration

We base our artefact developments on an analysis on data-driven product/service idea creation projects carried out at a European applied research institute. The selected projects executed at the institution in the years of 2018 and 2019 were following a standardized self-developed process which aims to generate and evaluate ideas for data services. These projects were conceived as 2 days of innovation workshops with innovation experts and data scientists from the research institution and an interdisciplinary team (6-10 participants) from the contracted company. Within a sequence of phases, different innovation methods were applied to identify ideas with the best possible effort-benefit ratio. Overall, 122 data-driven product/service ideas were generated throughout 7 company projects.

The data sample outlined in Table 2 is characterised as follows:

Table 2: Overview on data sample

No. of project	Domain	No. of employees	No. of service ideas
Company 1	Finance	5.000	18
Company 2	Public Service	500	27
Company 3	Renewable Energy & Environment	500	14
Company 4	Mechanical Engineering	1.000	14
Company 5	Pharmaceuticals	10.000	10
Company 6	Energy utility	5.000	20
Company 7	Energy utility	500	18

For each of the aforementioned 122 ideas, one main information template (see Figure 2) was compiled during the ideation and evaluation process. It contains a summary of developed information, in particular a description of the idea, expected benefits, data inputs, nature of the analytical function, desired function output and a presentation of the data inventory.

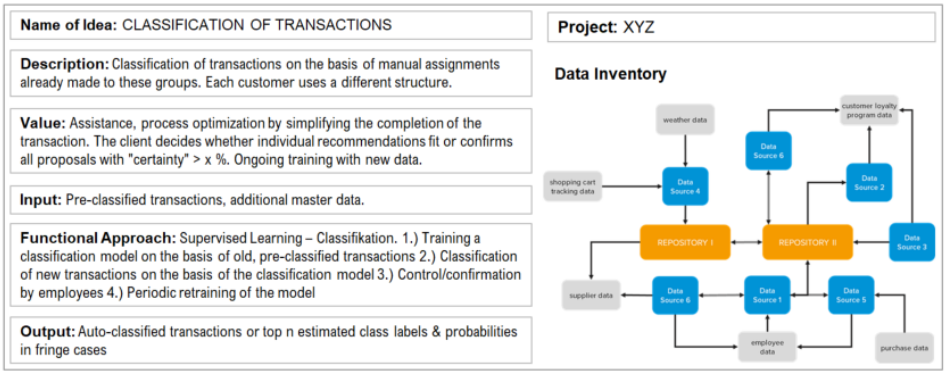


Figure 2: Exemplary description of a data product/service idea.

4.1 Categorisation

For the development of the subcategories, we followed a two-step approach. First, two independent researchers conducted a qualitative content analysis and classified the content of the 122 documented ideas (see example in Figure 2) where appropriate and possible, according to the 5 meta-categories (dimensions) outlined in section 2.2. The dimension "Data Sources" is linked to the data inventory and input information, the "Analytics" dimension to the description of the functional approach. The general description and output of the idea can be assigned to the "Service" dimension and the value information to the "Benefit" dimension. Since the data situation for the 5th dimension "Pains & Gains" was rather sparse and very company-specific, we refrained from using this dimension as a main category for the card-set. Another reason for the exclusion of this dimension was that the identified gains and pains could be assigned as counterparts to the "Benefit" dimension (no information gain). Furthermore, the assignment to the four dimensions was sufficient to specify a data product/service idea. The results of the assignments were

compared and any discrepancies that occurred were resolved through joint discussions.

Second, a cluster analysis was carried out by one independent researcher per dimension. The respective results were discussed in an extended group of experts (6 persons) in two iteration cycles. The final clustering result of the respective dimension is shown in Tables 3-6.

Table 3: Categorization of data sources

Data Sources	no. of ideas
Weather data	16
Geoinformation data	29
Product-generated data	82
User behaviour	61
Web content	31
Marketing and sales data	30
Logistics and mobility data	9
Process data	30
User-generated data	64
Open data sources	28

Table 4: Categorization of data services

Data Service	no. of ideas
Automated actions	25
Decision support	82
Data interface (API)	29
Automated report	69
Dashboard	25
Web element and software function	63
Key performance indicators	33
Benchmark	25
Raw data	19
Notifications	52

Table 5: Categorization of benefits

Benefit	no. of ideas
Information and Knowledge gain	92
Proactivity	56
Image gain	25
Customer satisfaction and trust	61
New customer acquisition	29
Cost optimization	50
Time optimization	58
Quality optimization	47
New revenue streams	11
Flexibilisation and dynamisation	28

Table 6: Categorization of analytics

Analytics	no. of ideas
Reinforcing learning	4
Classification	39
Cluster Analysis	41
Regression analysis	44
Recommendation service	28
Outlier detection	21
Natural Language Processing	44
Association rule learning	23

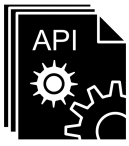
4.2 Design of Data Service Cards

For designing the Data Service Cards, the authors applied the design principles from the literature on cards as an innovation tool (section 2.3) as well as the developed subcategories per dimension (see section 4.1). Each card (front and backside) contains an explanatory picture (frontside), an explanation text (top of backside) and an application example (lower backside). The content creation process was carried

out by one or two researchers per dimension. The script for each card was revised in two iteration cycles by the entire research group. The graphic layout of the cards and the selection of the explanatory pictures were supported by an external partner.

Overall, we created content for 38 cards, 4 explanation cards for each dimension (data sources, data analytics, data product/service, customer benefit) and 2 general explanation cards (usage introduction). Table 7 shows an example of the content of one card per main category.

Table 7: Example cards per main category

Text/Pic (frontside)	Explanation text (backside)	Example text (backside)
DATA SOURCES Web Content 	The internet as a data source is almost inexhaustible and can of course also be used systematically to search for information. This is done using special computer programs (crawlers) that automatically search the World Wide Web for specific content such as search topics, offers, email addresses or links.	The TRENDONE trend explorer systematically searches the web with the help of web crawlers in order to discover trend-setting products, services or technologies. These information are provided to customers in an user-friendly way for early reaction or as a source of inspiration.
ANALYTICS Natural Language Processing 	Natural Language Processing (NLP) combines linguistics and computer science to process, and in the context of a certain problem understand natural language data such as text documents or voice recordings. Rules and algorithms are used to process large amounts of knowledge automatically, or to provide natural interaction between humans and computers.	Google uses NLP in a wide variety of areas. Google's Assistant uses NLP methods to identify the user's information needs. The search engine uses NLP to determine similarities between documents, to display structured information from web pages in info boxes or to list similar questions. Another field of application is the machine translation service Google Translate.
DATA SERVICE API 	An Application Programming Interface (API) is a software interface that enables the exchange of machine-readable data between programs, websites or data storage systems.	Google Maps API enables other companies to integrate Google's map material into their own applications (e.g., websites or apps). BMW's car sharing service DriveNow, for example, used this interface to locate vehicles.
BENEFIT Customer Acquisition 	Employ your data to better understand how to acquire new customers and leverage your current ones to grow your business.	Hydrique generates real-time inflow forecasts of water flows for hydropower producers. In parallel, local communities have emerged as new customers by requesting these information for flood protection.

5 Evaluation

The first evaluation of the Data Service Cards was carried out in the course of an idea generation workshop for data-driven products/services organised by a cluster organisation. 18 representatives from different companies of the green-tech industry were invited to test the DSC in a half-day (4 hours) workshop. The participants were divided equally among 3 groups. Each group was supervised by one researcher. After a short introduction into data-driven business, the DSC were explained using commonly known data services. Subsequently, the 3 groups were requested to perform 3 different tasks by using the DSC.

1. Joint reconstruction of a commonly known data-service by using DSC
2. Joint development of a new data service starting with "Benefit" cards
3. Joint development of a new data service starting with "Data Sources" cards

During the execution of the three tasks, three researchers (one per group) observed and documented the participant's behavior and their interaction with the DSC. Before the end of the workshop, the participants were asked to fill in a brief feedback questionnaire about usefulness, perception and usability (see Figure 4).

Generally, the DSC are well understood and perceived as helpful. The layout and design of the cards were also highlighted as positive. After a first getting to know the cards the participants mostly started intuitively with dimension "Benefits" and tried to perform the first task. For some participants, it was difficult to decide which card to select if several cards could fit. A comparison between task 2 and 3 showed that it is more difficult to develop a service based on "data sources" than starting with "benefits". When following discussions of the participants it was pointed out that categories are missing, some explanations of the cards are not clear enough and some distinctions between cards could be better.

The results of the feedback questionnaire (Figure 4) show, in general, positive feedback, especially on usefulness and ease of use of the DSC.

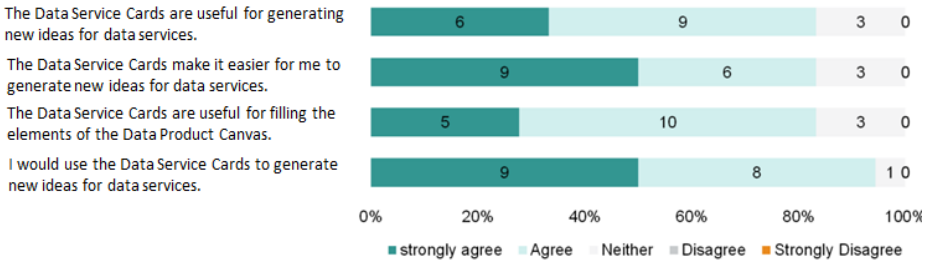


Figure 3: Results of the feedback questionnaire

The first evaluation results show already implications for changes in content and design. In a second design cycle, the following improvement topics are planned:

d) Rework of distinction of some subcategories e.g. in dimension "Benefits"
e) Improve the clarity of subcategory descriptions(e.g. sub-category "Dashboard")
f) Add new categories in dimension "Analytics" e.g. descriptive statistics
g) Insert consecutive numbering on cards
h) Provide an English version of the DSC

6 Discussion Outlook and Conclusion

The present paper demonstrates the development process of a supporting artefact (the Data Service Cards) which aims to facilitate the complex process of generating data products and services. The paper contributes to the challenging collaboration of different disciplines and level of expertise which is needed to develop a data-driven business. Together with the developed subcategories the outcome of the paper are a valuable addition to already existing tools e.g. in combination with canvas artefacts. The results of the first evaluation show that the DSC are both perceived as helpful and easy to use.

Since the development of the DSC has only gone through a first design cycle, our research implies certain limitations. As outlined in the evaluation results and also based on the limited data sample, the derived subcategories do not claim to be complete. The effects of not considering the 5th dimension "pains & gains" due to

the data situation also represent a limitation of the research. It would be interesting whether and in what form this information could be integrated into the card tool. A further limitation is shown by the fact that the evaluation was only carried out once and therefore no valid conclusions can be drawn regarding the effectiveness of the cards.

Further research projects could address a detailed investigation regarding the effect of the cards as ideas stimulus versus a possible limitation of creativity by given categories. Another research stream could explore the effect of how cards as an innovation tool (DSC) could support visual collaborative tools (canvas) in the idea generation process. In general further evaluations of the DSC concerning different domains, different company sizes and different evaluation settings are needed. Since the DSC are currently available only in German language with local company examples, an English version with international company examples is already in progress. Research results from tests and evaluations in an international environment would be very valuable for the further development of the DSC. Finally, further research is needed on how the current tool can be used to develop business based on new enabling technologies (e.g. anonymisation, privacy-preservation).

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