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Designing a Data Sharing Tool Kit

Showing companies how to start using Data Sharing

Ilka Jussen ¹, Julia Christina Schweihoff², Maleen Stachon³ and Frederik Möller^{1,4}

Abstract: Sharing data is essential to the success of modern data-driven business models. They play a crucial role for companies in creating new and better services and optimizing existing processes. While the interest in data sharing is growing, companies face an array of challenges preventing them from fully exploiting data sharing opportunities. Mitigating these risks and weighing them against their potential is a creative, interdisciplinary task in each company. The paper starts precisely at this point and proposes a Tool Kit with three Visual Inquiry Tool (VIT) to work on finding data sharing potential conjointly. We do this using a design-oriented research approach and contribute to research and practice by providing three VITs that help different stakeholders or companies in an ecosystem to visualize and design their data-sharing activities.

Keywords: Data Sharing, Visual Inquiry Tools, Canvas Development, Design Science Research.

1 Introduction

The handling and use of data is a controversial topic. On the hand, it seems clear that sharing data has a high potential to improve data-based ecosystems [Az20]. On the other hand, companies face various challenges (e.g., trust issues) that make them reluctant to share data [Ge21, Op21]. Subsequently, the use of data as a core resource for designing data-driven business models [Ha14] is getting more critical by the day. Nowadays, data can help to enable more sustainable supply chains by sharing it between actors to reduce the carbon footprint jointly [Ga22].

A current study by the European Commission expects constant growth in the volume of data in Europe. The volume is expected to increase from 33 zettabytes in 2018 to 175 zettabytes in 2025. In addition, 80% of industrially generated data is not used, showing the potential already available [Eu22]. The European Commission estimates the value of

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the data economy at the end of 2019 at around 324.86 billion euros. This corresponds to approximately 2.6% of the gross domestic product (GDP) of the 27 member states of the European Union (EU-27) [Mi21]. Here, it is forecasted that the value of the data economy will grow to an estimated 829 billion euros within the EU-27 states by 2025 [Eu21].

At the same time, the monetization of data and the development of data-driven business models pose great challenges for many companies due to the unclear financial measurement of the value of their data [Pa21]. Other factors also influence the willingness of many companies to share data, as a study by the Institute of the German Economy from 2020 shows. This study shows the variety of obstacles that currently exist. These include concerns about unauthorized data use and ambiguities in data protection law [In21]. The need to create a secure space for data sharing is also reflected in creating the European initiative Gaia-X. The initiative by European countries pursues the goal of creating a secure and trustworthy framework for data sharing to ensure sustainable advantage between several involved actors [GA21].

Against this background, researchers and practitioners from different companies in an ecosystem require tools to assist them in uncovering the potential of data sharing. In the paper, we propose a tool kit using Visual Inquiry Tools (VIT) or Canvases (e.g., see the Business Model Canvas [OP10]) to assist in solving these issues. Canvases are excellent tools to work creatively and conjointly in interdisciplinary teams on a given problem area ([EP19, TMB19]). Based on this, the need to develop a thematically appropriate canvas is therefore purposeful. With the help of the developed canvases, we want to answer the following research question: *How to bring together interdisciplinary stakeholders in data sharing projects?*

2 Theoretical Background

2.1 Data sharing

There is no comprehensive definition of '*data sharing*' in the literature. Instead, the term is often used synonymously with '*data exchange*'. Table 1 shows some of the approaches to defining data sharing. According to [NST19], data sharing involves exchanging data between two or more parties. [VHT19] also focus on data access in data sharing and emphasize the possibility of using data to develop innovations and services. An additional focus in the conceptual definition is given by [Ma20], who refers to the different financial modalities of data sharing. Data can be shared either free of charge, for a financial fee, or for other data. In addition, they distinguish between direct data sharing, in which data is shared one-to-one, and indirect data sharing in the form of data-based services.

Definitions	Sources
“In this article, we define data sharing as an exchange of data between different stakeholders, and when happening on a platform, as lateral data exchange in a network.”	[NST19]
“Data sharing can allow organizations to access complementary data sources and help them develop innovative applications and services. We considered data sharing as either third parties’ opening the data they own or their consuming the data from other providers.“	[VHT19]
” Data sharing is a label that may cover different economic modalities: sharing for free, trading for a monetary compensation or in exchange for other data, direct sharing of a dataset or indirect sharing of a data-based service only.”	[Ma20]

Tab. 1 Definitions of data sharing

Companies can own the data and, at the same time, share it with others to jointly solve business problems that the companies could not solve on their own. In this case, the companies learn to extract previously unknown information from the data [TWS19, vv15]. Companies can also learn to understand their internal processes better from data [Ga21]. Ideally, data sharing can lead to the development of creative ideas or new products, both for the data owner and the data user [TWS19]. One example is that monetizing data via data marketplaces or in direct cooperation with other companies can reveal a lucrative opportunity for companies [Ga21]. Another benefit is the shared increase in data quality, making it easier for the data user to use the data and improve it for the data owner [TWS19, DN19]. In general, the intensive use and sharing of data can lead companies, both data owners and users, to increase their capabilities regarding the use of data. This can happen, for example, through new capabilities linked to machine learning or artificial intelligence [TWS19]. To exploit the potential of data sharing, companies need to participate in an ecosystem. The incentives must be clearly communicated to companies to alleviate their previous concerns [Ge21].

In general, it becomes evident from our literature analysis that the current image of data sharing is associated more with the potential risks than with its opportunities. The fear of disclosing too much sensitive data plays just as big a role as the concern about hacking attacks [DN19, GO20]. In this context, it becomes clear how significant the worries are about losing control over one’s data or not being able to prevent possible data misuse on the part of users [Ba19, vv15]. The fear of losing intellectual property and knowledge to other companies leads to a lack of openness on the part of companies [GO20]. Among others, [ADR21] highlight the competitive advantages for other companies or competitors and fears of disclosing sensitive end-user data [Ga21, Ge21]. All the risks above can be justified by a lack of trust between the companies that own data and other actors within the ecosystem [DN19, KKT14]. This mistrust is evident between companies that already had business relationships with each other before the sharing of data [GO20]. Another risk for companies is the unclear costs that can arise during preparations and the

implementation of the data sharing [DN19]. The unclear financial valuation of their own data also poses major challenges for companies [MSO20, Pa20].

2.2 Visual inquiry tool design

VITs provide a collaborative space (often two-dimensional) to generate a ‘common’ playing field for teams to work on solving problems, developing new ideas, or designing new solutions [Av20, EP19]. Other terms commonly used to describe VITs are ‘design canvas’ (e.g., [TMB19]) or ‘visual collaboration tool’ (e.g., [Sa00]). The paper develops multiple VITs for inter-organizational data sharing.

To do this, we rely on two foundations. First, we use the design principles for VITs by [Av20] and, second, the design taxonomy for VITs by [MS22]. The iterative and interdisciplinary design process is ideally suited to the topic of data sharing. Opinions of different people who take on different roles in the company must be considered. A canvas lends itself to presenting complex and sometimes unclear topics or issues in a more understandable way. Furthermore, these tools are suitable for use both in academia and in practice as well as in the business environment [Av20, CN18]. Additionally, the collaborative process of idea development, both verbal and non-verbal communication in interdisciplinary groups, is a reason for its versatile applicability [Av20, MSO21]. For the development of the canvas, we followed the design principles of [Av20]. Twelve design principles imply the three main principles of ‘conceptual model’, ‘shared visualization’ and ‘instructions for use’. In addition to the design principles of [Av20], the taxonomy of [MS22] is used in this work on the topic of the design options of VITs. This taxonomy offers helpful characteristics regarding the aspects of the problem definition, the design process, the solution, and the final evaluation of the developed tools.

3 Research Design

Given that VITs are typically a product of design-oriented research (see [MS22, Sc21]), we use the *‘Design Science Research Methodology Process Model’* [Pe07] (see Fig. 1). The method is suitable for developing and evaluating innovative artifacts in information technology (IT) and solving organizational problems [He04]. The method of [Pe07] consists of six steps, of which the first five will be explained in more detail, as the sixth step, *‘Communication’* is the publication of this paper itself. Overall, the method is iterative. Accordingly, the steps are critically evaluated and questioned repeatedly to constantly improve the content and the knowledge gained in this work.

The first step is to *‘Identify Problem and Motivation’*. The potential of data sharing as a part of data-driven business models identified in the literature research is the motivation for our paper (see Sections 1 and 2). On the other hand, the lack of concepts that focus on the positive aspects of data sharing is identified as a problem.

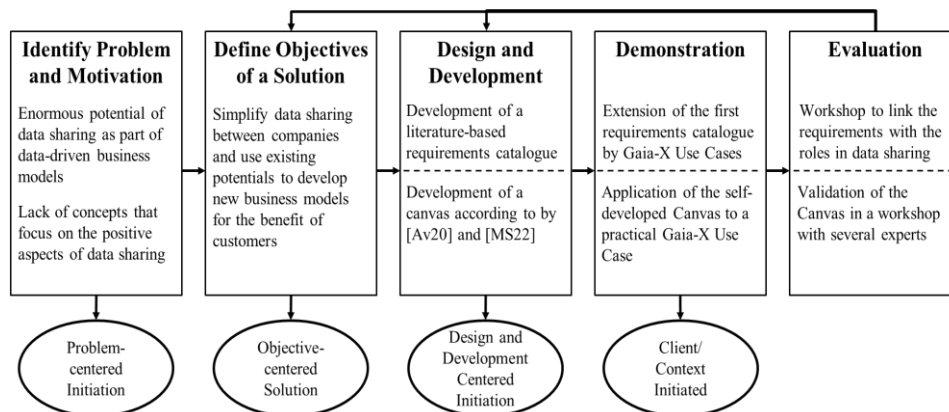


Fig. 1: Design Science Research Methodology according to [Pe07]

The second step of the method focuses on *'Define Objectives of a Solution'* for the intended solution. The research aims to simplify data sharing between companies by developing a helpful artifact and enabling new cooperation between companies or joint business models. These should use data sharing possibilities to create greater added value for customers than was previously the case. Depending on what insights are gained in the following steps, this step is iteratively conducted. The objectives are constantly redefined and more specific to focus on the work as precisely as possible. Following standard practice in DSR, we first develop a requirements catalogue for data sharing activities based on a literature review. Please note that the requirements catalogue is not explained in detail due to spacing limitations. In step 3 *'Design and Development'*, we propose three VITs, that address these requirements based on the roles they are associated with (e.g., data provider, data consumer, and orchestrator). For this purpose, the findings of [Av20] and [TMB19, TMB20] are used as guidance from the literature (see Section 2). This step aims to develop the first version of a canvas that will be iteratively refined in the future. In the fourth step, *'Demonstration'*, the canvas is applied to a practical use case to see, based on the practical application, areas where there is still a need for change. In the last step, *'Evaluation'*, the canvas is applied in a workshop with experts from various field. Here, the participants' external perspective should help evaluate and identify further suggestions for changes to the existing canvas. Through the iterative procedure, the individual interim results are critically analyzed as much as possible and constantly evaluated to bundle the collected findings in a canvas.

4 A Tool Kit for Data Sharing

4.1 Developing and evaluating the tool kit

To identify relevant requirements for data sharing between different actors, we conducted a literature review according to [WW02]. For this purpose, we searched for the terms '*data sharing*' and '*requirements*' in the title, abstract, and keywords in various combinations on the AiSeL and Scopus databases. In this literature review, we identified 24 papers as helpful, which state requirements that need to be considered for the different roles in data sharing. The relevant requirements that need to be defined at the beginning of data sharing between different actors include aspects such as data sovereignty, data security, and data quality. The first step was to develop a canvas tool kit with relevant building blocks and questions for the three essential roles of a data ecosystem, according to Oliveira and Lóscio (*data provider, data consumer, and intermediary*) [OL18], which were also classified as relevant for data sharing. This canvas consisted of 10 building blocks that included topics such as data sovereignty, data quality, and data value. These ten building blocks were assigned to the superordinate areas of value proposition and data sharing environment. Pictograms and arrows were used in addition to the headings and questions of the building blocks to make it easier for the user to use the canvas. This also represents a design principle according to Avdiji et al. by thematizing the common visualization [Av20].

The first Canvas was tested with academic staff researching in the field of data sharing. For this purpose, a partial scenario for a Gaia-X⁵ use case was developed as an example to test the application of the Canvas using a real-life example. The testers evaluated the use of the Canvas using the Likert scale to provide feedback to the researcher on how the Canvas can be further developed [Li32]. Among the key findings of this evaluation is that it was recommended to develop three separate canvases for the respective roles. Furthermore, the individual building blocks should be questioned to see if all building blocks are equally relevant for the three roles. In addition, the corresponding questions on the building blocks should be adapted to the perspective of the respective role. After this first round of evaluation, the canvas was fundamentally changed based on the feedback from the users. In this way, the three canvases as a tool kit were created that were classified as important for the three roles in data sharing. The number of building blocks was also reduced. Therefore, the consumer canvas has six building blocks, the producer canvas has five building blocks, and the mediator canvas has four building blocks.

⁵ Gaia-X Use Case 'Collaborative Condition Monitoring': <https://www.bmwi.de/Redaktion/EN/Artikel/Digital-World/GAIA-X-Use-Cases/collaborative-condition-monitoring.html>

4.2 The data sharing tool kit

Below, we explain the three canvases in more detail (see Fig. 2, 3, and 4) for the respective roles. The canvases are shown in a filled-out version with the help of the Gaia-X (*Collaborative Condition Monitoring*) use case based on the evaluation. We have developed three canvases, as it became apparent during the development process that the stakeholders consider similar but not the same issues to be important. The consumer's canvas consists of the six building blocks: *Data Interest*, *Purpose of Data Use*, *Data Sovereignty*, *Expected Data Quality*, *Data Preservation*, and *Data Value*. The first building block, '*Data Interest*', contains which data the consumer would like to have from the provider. This can be data the provider is already collecting or data that the provider could collect with additional effort. The building block '*Purpose of Data Use*' is only classified as necessary for the role of the consumer. The consumer should indicate to the provider the purpose for which the data provided is to be used. The provider, in turn, only must agree to this purpose. Accordingly, this would only be a yes/no decision by the producer depending on the intended use on the part of the consumer. In addition, the building block of '*Data Sovereignty*' was found to be relevant to the present context.

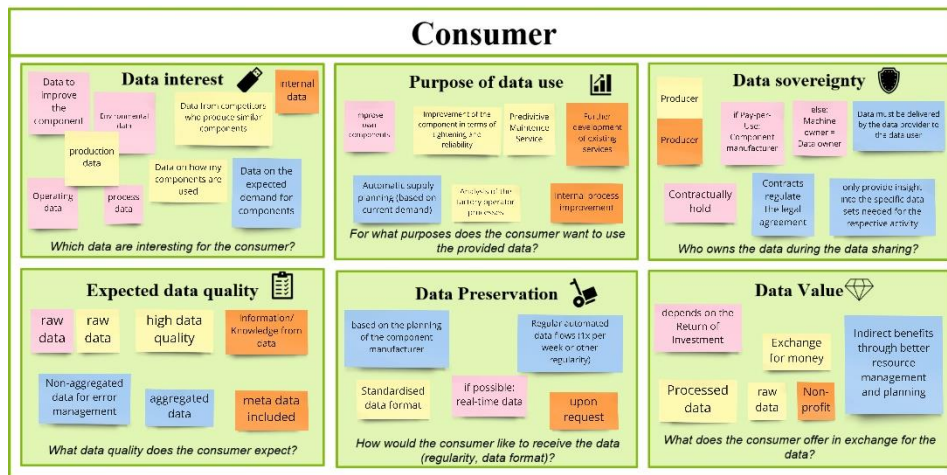


Fig. 2: Data Sharing Canvas - role: consumer (use-case based evaluation)

This implies a highly relevant question for data sharing, i.e., which actor is the owner of the data while the consumer is using it. Maintaining sovereignty over one's own data can counteract the current risks that companies see in sharing data. Furthermore, '*Expected Data Quality*' defines another building block of the developed canvas. Certain parameters must be defined for the data to be useful to the final consumer. These include aspects such as the inclusion of metadata or the integrity of the data, which implies the correctness and completeness of the data. Besides the building blocks already mentioned, the building block of '*Data Preservation*' should be jointly defined within the data-sharing framework. This component includes aspects such as the temporal continuity of the provision and the

data format in which the data is shared. Factors such as the provision of data in data catalogs and the portability of these should also be considered in this context. The value proposition's sixth and final building block is **'Data Value'**. As already mentioned above, this represents a major challenge, or rather even a risk. The danger of passing on data to others for too low a price characterizes the image of companies.

The producer's canvas in Fig. 3 consists of the fifth building blocks: *Data Availability*, *Existing Data Form*, *Data Provision*, *Data Sovereignty*, and *Data Value*. The building block **'Data Availability'** implies which data the provider is willing to share with the consumer. Here, it is expected that there is sensitive internal company data that stakeholders do not want to share, unlike specific process data. Furthermore, the building block **'Existing Data Form'** addresses the quality of the data available to the producer. The quality of the data can have a massive influence on the usability of the consumer. Subsequently, the building block **'Data Provision'** implies how the data is provided to the consumer. Questions such as the frequency of data provision or the data format used should be clarified here. As for the consumer, the **'Data Sovereignty'** building block is also relevant for the producer and the intermediary. All three actors must also come to a common understanding of the data's owner during data sharing. The situation is like the building block **'Data Value'**. Here, what the consumer offers for the data must match what the producer expects in terms of compensation for providing it.

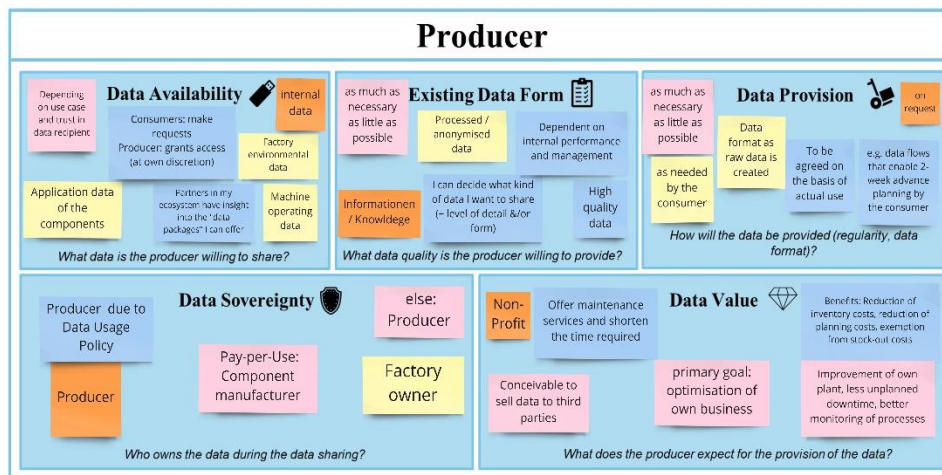


Fig. 3: Data Sharing Canvas - role: producer (use-case based evaluation)

The intermediary's canvas in Fig. 4 consists of the four building blocks: *Data Sovereignty*, *Remuneration*, *Platform*, and *Data Security*. As already mentioned, **'Data Sovereignty'** is also important for the intermediary. The building block **'Remuneration'** means that the intermediary must state how he/she wishes to be remunerated for his/her services. This can be done, for example, by a percentage of financial participation for each data sharing process. Another building block is **'Platform'**. The intermediary would adapt this to the

requirements of consumers and providers. The last building block is '*Data Security*', by which we mean how the intermediary wants to secure the data sharing process in the sense of the actors involved. In this context, questions regarding securing data access for authorized persons only should be considered.

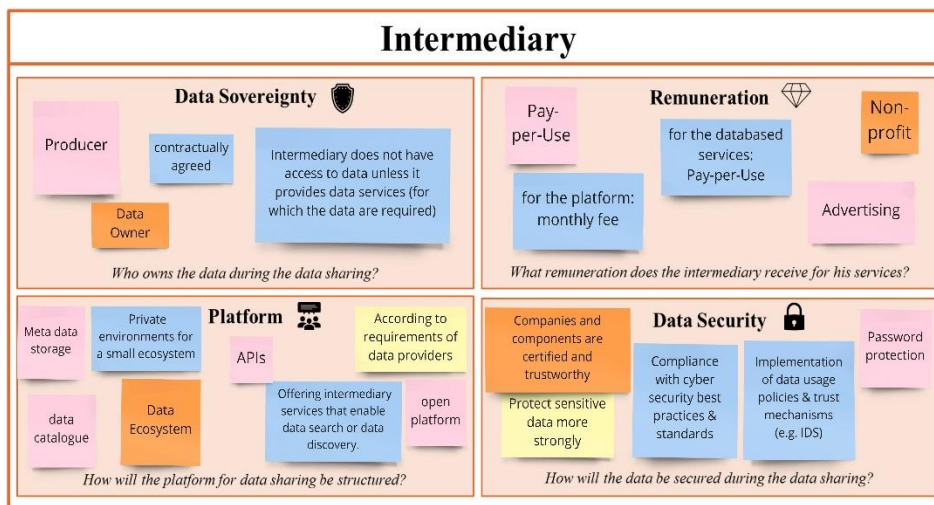


Fig. 4: Data Sharing Canvas - role: intermediary (use-case based evaluation)

The tool kit aims to facilitate collaboration between interdisciplinary groups on data sharing and wants to ensure that the different roles clearly define their position before the start of the inter-organizational data sharing. Users should ask themselves the following questions: *What is important to me in sharing my data with other actors?* Depending on their role in the data sharing process, they should fill in the respective canvas. The components of the canvases reflect some aspects that are important for data sharing across all sectors, regardless of the specific use case. If actors take on more than one role, they should also fill more than one canvas. Thus, with the help of the tool kit, a common understanding is to be established before the data sharing begins to prevent misunderstandings that could negatively influence trust among each other.

5 Contributions, Limitations, and Outlook

Even though the potential of data sharing is sufficiently well known, it often still fails to be implemented because there is often neither trust nor transparency between the companies. To prevent this in the future, tools are needed to support this sharing between the different companies, some of which we **contribute** here. Inter-organizational data sharing allows companies to use data as a resource to drive the new and further development of their own processes and services [RS19]. A variety of potentials through

data sharing have been identified in this work. These include the development of new services and products or learning from others. On the other hand, concerns and risks were repeatedly associated with data sharing. Aspects such as the loss of control or doubts about the security of one's own data influence the openness of companies towards inter-organizational data sharing. In the course of this work, it became clear that data sharing is not to be considered in isolation but is strongly linked to other large blocks of topics, such as data law, data value, and data sovereignty. The artifact users are companies interested in data sharing, which so far lack a guideline that implies the relevant aspects that need to be defined before data sharing begins.

To be able to classify the results in a differentiated manner regarding their significance, we now discuss its **limitations**. One limitation of this work is the perspective chosen for its implementation. The topic of inter-organizational data sharing was viewed from an economic and business model-focused perspective. The information technology perspective, which is interesting in this context, was neglected in this work and should be included in future research. The tool kit was developed based on the researcher's opinion. Some requirements were found to be more significant and therefore form their own building blocks. The researcher gave the decision on which building blocks or underlying requirements are relevant in the first step and then influenced by the testers. Furthermore, a differently chosen use case could possibly focus on other building blocks. In addition, it should be noted that the developed tool kit can serve as a tuning tool before the start of the data sharing and accordingly cover a subprocess rather than the entire data sharing.

After the intensive examination of inter-organizational data sharing, **further research** will now be considered that was not taken up in this work due to the limited scope. The evaluation in a setting with companies representing each role would enhance the validity of the canvases. What could emerge from further developing and evaluating the canvases is a need for more role-specific canvases (e.g., in scenarios where there are more detailed roles or specific types of roles or data to be shared). These can also be sector-specific roles that are necessary for the specific application. But not only the number of canvases can be expanded in the future, but also the variety of canvases about their time of application. In this work, three canvases were developed that can be used as a voting medium before data sharing begins. Accordingly, the development of further tools suggests itself, which could, for example, be used again and again during the data sharing as a basis for the further planning of the inter-organizational data sharing. Questions can be focused on how existing activities for data sharing between different actors can be further intensified.

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