



ABDDO: An Approach for Helping Companies to Become a Data-Driven Organization

Master Thesis

Jingting Luo (s1838040)

Supervised by: MSc Dylan Veerman, Plat4mation
Dr Lucas Meertens, University of Twente
Dr João Luiz Rebelo Moreira, University of Twente

Master Business Information Technology

University of Twente

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Management Summary

Data-driven organizations (DDOs) are able to capitalize on business insights by making informed decisions on the basis of data, boosting profitability and making them outperform traditional competitors. As a result, an increasing number of companies embark on the journey of becoming data-driven. However, a data-driven transformation is a resource-intensive initiative that comes with many technical and organizational challenges. This has led many data-driven initiatives to fall short on their promises, resulting in wasted resources and a discouraged workforce.

To address these underlying risks, companies are increasingly turning to consulting firms for support, which offer the necessary expertise in data and change management. However, there currently seems to be no scientific literature which focuses on how consulting firms can support their clients on the journey to becoming data-driven.

The goal of this research was therefore to develop an approach that consulting firms can apply to help their customers become data-driven and thereby improve business decision making.

To achieve this goal, several steps were taken. In a systematic literature review, the scientific literature on the topic of becoming data-driven was reviewed.

Requirements for the approach were identified based on the goals of the consulting firms and their customers, and design components for the approach were identified in the literature based on these requirements. The results were synthesized into an initial version of the approach, which was further refined using feedback of experts. The refined version of the approach was validated using a survey questionnaire that assessed whether the approach fulfilled its requirements. The validation confirmed that the approach achieved its goals and was suitable to be translated into a service offering with which the Plat4mation could help their customers become data-driven.

The result of this research is the Approach for Becoming a Data-Driven Organization (ABDDO), a workshop-based approach that consulting firms can apply to collaborate with their clients on building data capabilities from the ground up. The approach works in 'cycles', with each cycle targeting one department or business unit, starting with a pilot project which functions as a 'proof of value' for decision-makers.

The ABDDO engages all levels of the organizational hierarchy: C-level executives are able to maintain a high-level overview of their company through the use of high-level dashboards, middle management can track the most important metrics for their departments using KPI dashboards, and employees use data analytics and data-driven reporting in their day-to-day workflows.

By establishing the so-called Data Excellence Center, it is ensured that data capabilities are developed at the customer and that the benefits of the transformation can be sustained after the project is completed.

By following the ABDDO, consulting companies can support their clients in dealing with the increasing complexities of today's business environments by relying on high quality data in their decision-making processes.

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I am looking forward to the new adventures that await me!

Jingting

Cheers!

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1 Introduction

1.1 Background

Data-driven organizations (DDOs) are organizations that generate business value by capitalizing on insights from the use of data analytics [5]. Data plays an increasing role in guiding companies' decisions and for exploring new business cases and therefore plays a crucial role as a competitive advantage in the modern business world [8].

The defining characteristic of a DDO is that decision-making is based on data, instead of the intuition of management [12]. This decision-making process is enabled and supported by a data-driven organizational culture, which promotes testing and experimentation at all levels of the organization and where most employees (not only IT experts and decision-makers) have a basic understanding of data analytics and its use in the business processes [5]. It has been shown that DDOs outperform traditional competitors and are more likely to be profitable [11]. As a consequence, an increasing number of companies decide to go on the journey of becoming data-driven and the topic has received more and more attention from the scientific community in recent years [12].

Data-driven organizations rely on a variety of tools to extract, process, and analyze data and to present the results to decision-makers [13]. While the literature identifies approaches to building a data analytics pipeline with dashboard from scratch, this approach is particularly challenging and comes with many pitfalls [1].

Because of the challenges associated with developing in-house tools, enterprise platforms are gaining in popularity in recent years [3]. These solutions integrate core business functions with the capabilities of various technical tools on a single platform, so that companies can access relevant data-related tooling without having to worry about integration issues [19].

1.2 Problem Statement

Although the advantages of being a DDO are numerous, only few businesses succeed in their attempt to becoming data-driven [6] [22]. A data-driven transformation is a resource-intensive initiative, which can span multiple years [21] and which requires the commitment of top-level management [15]. Companies on the journey to becoming data-driven need to overcome many barriers in all areas of the business [26] and at all levels of the organizational hierarchy [4].

To cope with the challenges involved in organizational and especially digital transformations, companies increasingly employ consulting firms, which offer the necessary change management and data expertise [17]. In the current scientific literature, there is a lack of research which specifically focuses on the topic of how consulting firms can support their clients to become data-driven.

This research is conducted in collaboration with Plat4mation, a global IT consulting firm specialized in assisting their customers' digital transformations through implementation of an enterprise platform (specifically, the platform Plat4mation uses is called ServiceNow).

The goal of this research is therefore to develop an approach with which companies, supported by expert consultants, can become data-driven by utilizing the capabilities of enterprise platforms.

1.3 Research Questions

This research follows Design Science Methodology (DSM) proposed by Wieringa (2014) [27]. Applying their proposed template for defining research problems, the objective of this research can be formulated as follows:

Enable consulting firms to help their customers become data-driven by developing an approach that utilizes an enterprise platform in order to improve business decision-making and gain competitive advantages.

Based on the research objective, the main research question for the final project is defined as follows:

What is a suitable approach that consulting firms can apply to help their customers become data-driven and thereby improve business decision-making?

In this research, the approach will be considered suitable if it achieves stakeholder goals, meaning that the customers of consulting firms following the approach become data-driven, and that it can be translated into a service offering for the customers of the case company, Plat4mation. Whether this is the case will be measured as part of the validation process by utilizing the Technology Acceptance Model (TAM), in which acceptance of a new technology is measured by its perceived usefulness, perceived ease of use and the users' intention to use [9].

To answer the main research question, the following five sub-questions are defined. The first three sub-questions (SQs) are going to be answered by analyzing the existing literature on data-driven organizations in the last decade (2014-2023). The last two sub-questions are going to be answered by applying the obtained knowledge from the literature review using DSM.

- 1. Which models and frameworks exist in the literature that companies can utilize to become data-driven?*
- 2. What are challenges, barriers, and enablers to becoming a data-driven company?*
- 3. Which tools can companies use to support their data-driven decision-making?*
- 4. What requirements should the approach meet so that it satisfies the stakeholder goals?*
- 5. What design components should the approach implement so that it meets the requirements?*

1.4 Research Methodology

1.4.1 Design Science Methodology

This research is conducted by following Design Science Methodology (DSM) as proposed by Wieringa[27]. Wieringa defines design science as "the design and investigation of artifacts in context" (p.3) [27], where the artifact describes something that is "created by people for some practical purpose" (p.29) [27], including software and hardware components or systems, processes and methods, and even conceptual structures. The problem context refers to the circumstances that surround the use of the artifact, including any technical components that interact with it, the processes in which it is used, or services that it relates to. The problem context can be further divided into the social context, which refers to the people (i.e., stakeholders) that the artifact interacts with, as well as their goals, values, etc., and the knowledge context, which consists of the scientific literature and other sources of knowledge that inform the design of the artifact.

Design science consists of two main activities: The designing and the investigation of the artifact. The design activity is informed and constrained by the social context, because an artifact should improve a problem context by addressing the goals of its stakeholders, who may also set its budget. The knowledge context on the other hand informs the investigation activity, which consists of the formulation and answering of knowledge questions.

By iterating between these activities, the researcher discovers the knowledge that is required to design an artifact that improves the problem context. By investigating the interaction of a newly designed artifact and its context, the researcher can then improve the design of the artifact and validate whether it contributes to achieving the goals of the stakeholders.

The interaction between the artifact and its problem context is referred to as the treatment. It is important to note that the goal of design science is not only to design an artifact, but to design a treatment that addresses the problem.

In order to arrive at a validated treatment, the researcher follows the design cycle (see **Figure 1**).

It begins with the problem investigation, during which the social and knowledge context are investigated, thereby identifying stakeholder goals as well as effects and phenomena that are relevant to the design of the treatment. In the next step, treatment design, requirements are specified that contribute to achieving the stakeholder goals. The knowledge context is investigated with regards to existing treatments, and if no treatments are available that satisfy the requirements, a new treatment is designed by the researcher. Lastly, in treatment validation, the researcher investigates if the artifact in context produces the desired effects. If the effects do not satisfy the requirements, a new cycle begins with the problem investigation.

It should be noted that Wieringa also discusses the engineering cycle, which adds another step, the treatment implementation, to the design cycle. However, due to time constraints,

this research will exclude the treatment implementation and therefore only consider the design cycle.

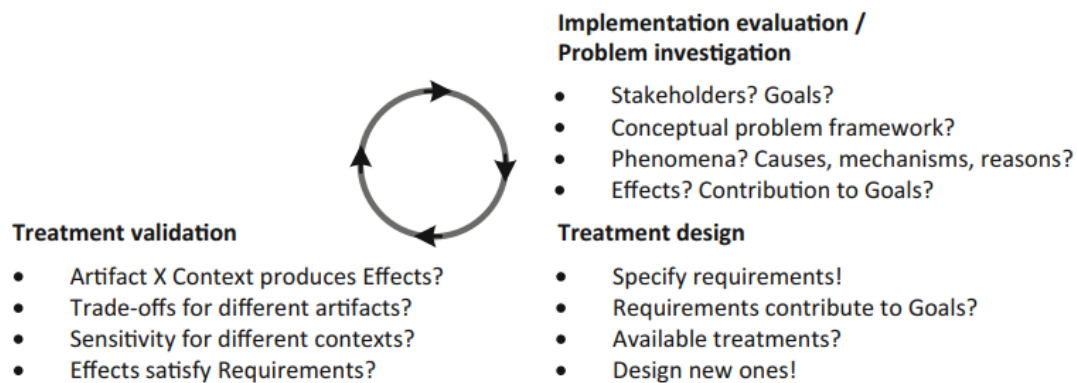


Figure 1. Design Cycle from [27]

1.4.2 Application of DSM in this Research

The goal of this research is to design an approach with which consulting firms can help their customers to become data-driven. This means that the approach is the artifact, and the problem context consists of the customer company as well as the experts of the consulting firm. The treatment is the application of the approach at a customer company, i.e., a service offering offered by the consulting firm. It can therefore be argued that this research is about “the design and investigation of an artifact in context” and constitutes design science, making DSM an appropriate research methodology.

The outline of this thesis is closely aligned with the design cycle: In the problem investigation, the knowledge context is investigated by answering three knowledge questions (i.e., SQ1-3) using a systematic literature review (SLR) based on the methodology proposed by Kitchenham & Charters (2007) [16]. Additionally, an analysis of the stakeholders and their goals is conducted. In the treatment design, requirements for the treatment are specified based on the identified stakeholder goals. Based on these requirements and the results of the literature review, design components of the artifact are identified, which are translated into an initial design.

The initial design is further refined by following the design cycle: An initial treatment validation is conducted through interviews (i.e., expert opinion) with two experts of the case company. The results of the interviews are assessed (problem investigation) and a refined treatment is designed based on the feedback (treatment design). The final version of the approach is then validated using a survey questionnaire that is based on the Technology Acceptance Model (TAM) and the previously identified requirements.

1.5 Thesis Outline

The structure of the remainder of this thesis is as follows. The second chapter, Systematic Literature Review, serves as the initial problem investigation. In the third chapter, Design of the Approach, stakeholder goals and requirements for the solution are identified based on insights from the literature and from meetings with practitioners. The requirements are then translated into design components and an initial version of the approach is designed. In the fourth chapter, Refinement of the Approach, semi-structured interviews are conducted with two experts, which serve as both treatment validation of the initial approach, and as problem investigation for the second design cycle. Based on the feedback, a refined version of the approach is designed. In the fifth chapter, Validation of the Approach, the refined approach is validated using a survey questionnaire. In the sixth chapter, Discussion & Conclusion, the results of this research are discussed in terms of their scientific and practical contributions, limitations, and directions for future research, and the research questions are answered.

Figure 2 shows the full outline of the thesis, including where the SQs are addressed, and which steps of the design cycle relate to which chapters.

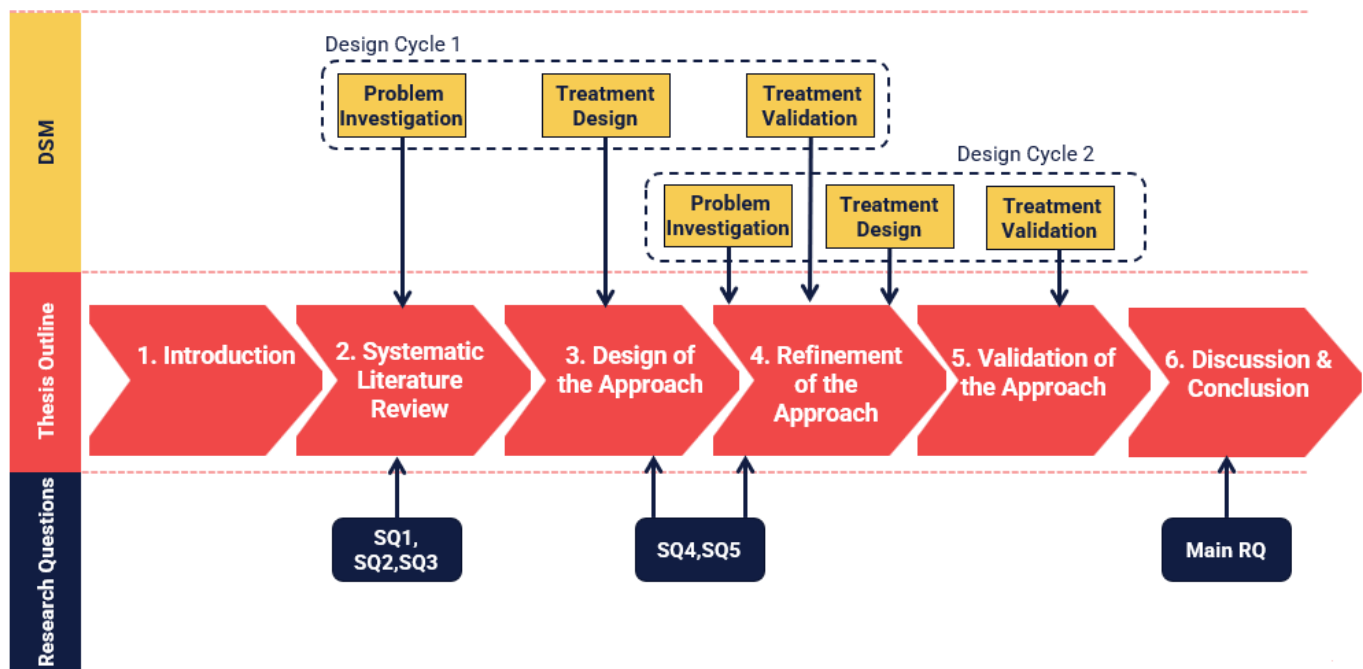


Figure 2. Outline of the thesis

2 Systematic Literature Review

2.1 Methodology

To gain an overview of all relevant literature with regard to data-driven organizations and obtain knowledge about the topic of data-driven transformation, a systematic literature review (SLR) according to the procedure proposed by Kitchenham & Charters (2007) [16] was conducted. In order to find an appropriate amount of good quality literature from 2014 to 2023 that answer the research sub-questions, the papers were carefully selected through combing a SLR and a snowballing approach.

According to Kitchenham & Charters (2007) [16], a systematic literature reviews 'aim to present a fair evaluation of a research topic by using trustworthy, rigorous, and auditable methodology'. To achieve this, a review search protocol is developed, which provides details for defining a search strategy, and study inclusion and exclusion selection criteria are established in order to ensure a reliable and non-biased selection of the relevant literature. Kitchenham & Charters (2007) [16] suggest an iterative approach, where the results of initial screenings of the body of literature are used to refine the search protocol.

2.2 Search Strategy

The search strategy was designed based on the research objective. Keywords were defined at the beginning in order to find the relevant literature which could help get a better understanding of this topic and find answers to the research (sub-)questions. These keywords were then grouped together to form a final search query. As it is important to ensure a comprehensive selection of all potentially relevant literature, synonyms of these keywords were also included.

The database Scopus was selected due to its large body of literature and its user-friendly features, which allow for saving searches or filtering and refining them using multiple criteria.

The search was conducted in Scopus on 7th of October in 2023 and used the following search query within the article title, abstract or keywords:

"becom* data-driven" OR "adopt* data-driven" OR "use data-driven" OR "utiliz* data-driven" OR "appl* data-driven" OR "implement* data-driven" OR "data-driven organization" OR "data-driven company" OR "data-driven business"

The following two restrictions have been applied to define the boundary of this research:

- i. The subject area was limited to business, management and accounting
- ii. The literature publication year was limited starting from 2014 to 2023

2.3 Study Selection Criteria

To select the literature that is relevant to this research, three rounds of paper assessment were conducted. In Round 1, the papers were selected by first skimming through the titles and checking the availability of all search results and excluding obviously non-relevant papers. Subsequently, in Round 2, the abstracts of the papers that met the inclusion criteria from the previous round were assessed and only papers were included that were specifically related to implementing data-driven decision-making (DDDM) in organizations or organizations becoming data-driven. In Round 3, the full content of the remaining papers was read before deciding which papers should be included in the literature review. Particular attention was paid to whether the insights of the papers were applicable to different industries or were at least generalizable and could therefore contribute to answering the research questions. Furthermore, a few additional papers were selected using a snowballing approach, i.e., by searching for documents that cited selected papers via Scopus.

The three rounds of selection were carried out carefully, meaning that if it was unclear whether a paper met the inclusion criteria, it was taken to the next round and was only excluded when it was certain that it would not be used to answer any of the three research sub-questions.

The inclusion and exclusion criteria of the study selection for each round are shown in **Table 1**.

	Inclusion criteria	Exclusion criteria
Round 1 (Title)	Paper relates to DDDM, data-driven organizations, or the use of data analytics/data science in a business context	<ul style="list-style-type: none"> • Paper is not in English • Paper is not accessible • Book/book chapter
Round 2 (Abstract)	The topic/content of the paper is about the implementation of DDDM or otherwise about becoming data-driven	<ul style="list-style-type: none"> • Different focus (e.g., data privacy, AI, legislation, etc.) • 'Specialized' DDDM or highly technical
Round 3 (Full text)	The same as Round 2	<ul style="list-style-type: none"> • Focus on one specific industry, insights are not generalizable • Focus on one specific technique • Focus (exclusively) on data-driven business models (DDBM) or DDBM innovation

Table 1. Inclusion and exclusion criteria

The study selection process and the number of papers left after each round of the review is shown in **Figure 3**.

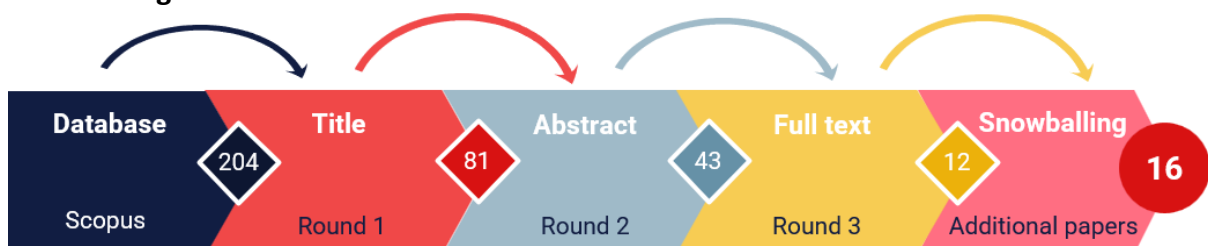


Figure 3. Study selection process flowchart

Figure 4 shows the distribution of the selected papers corresponding to the publication year in the last decades. It is clear that there was more research focused on data-driven organizations in the last five years, starting from 2018. This shows that the topic of becoming a data-driven organization is getting increasingly popular in recent years.

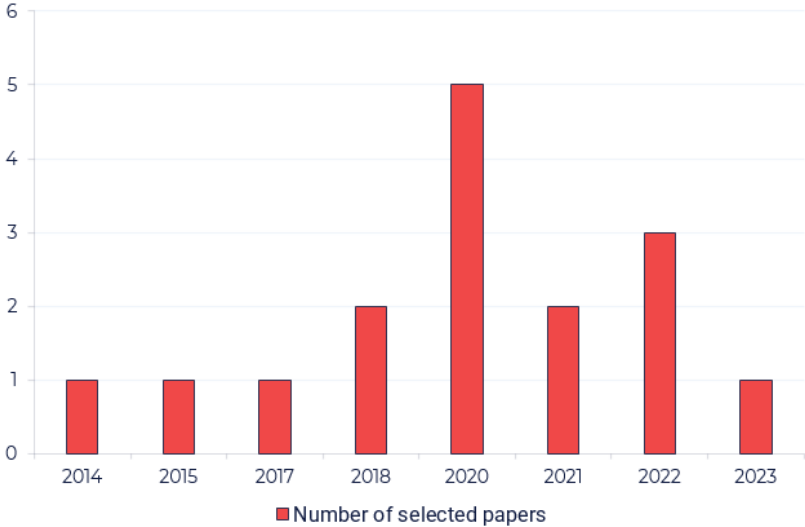


Figure 4. Selected papers per publication year

An overview of the 16 selected papers for this literature review can be found in **Table 13** in Appendix A.

For each research sub-question, the content of the relevant papers was extracted and summarized individually. Answers to the research questions summarizing the insights can be found in the Discussion section of this report. **Table 2** shows the number of selected papers for each research sub-question.

Research question	Topics	Selected paper (#)
SQ1	Frameworks & Models	6
SQ2	Challenges & Barriers & Enablers	8
SQ3	Tools	5

Table 2. Number of selected papers per research sub-question

2.4 Results

2.4.1 Frameworks & Models

Six papers were identified that propose frameworks or models relating to the topic of becoming data-driven, most of which propose process models that guide organizations on their journey to becoming data-driven. The majority of the identified frameworks can be categorized as roadmap approaches, which provide organizations with a number of steps they can follow or phases to go through in order to become data-driven [11][15][18][21][23].

Gökalp et al. (2021) [11] and Rane & Mishra (2018) [21] are distinct in so far as that they can also be categorized as capability or maturity models:

Gökalp et al. (2021) [11] is primarily a capability model, but the authors stress that it can be used to develop a roadmap for improving on the five organizational management processes according to the six capability levels. In contrast to the other roadmapping approaches, the order in which the resulting steps should be taken is not defined, and the paper is not as clear as some of the other papers on how the steps should be implemented in detail.

Nonetheless, the capability model approach has the advantage of taking the starting requirements of companies on their journey to becoming data-driven into account and may therefore be advantageous in cases where some data capabilities are already present.

Rane and Mishra (2018) [21] on the other hand is more similar to a traditional roadmapping approach, consisting of four phases which build on each other and should therefore be implemented consecutively. The authors note that these phases are analogous to maturity levels. It could be argued that this interpretation would apply to other roadmapping approaches as well, even though their authors do not make this point. This highlights the similarities between the two approaches, which together make up almost all of the identified models and frameworks.

Compared to the other roadmapping approaches, Kayabay et al. (2022) [15] is an outlier, because they do not propose a pre-defined roadmap that all companies should follow in order to become data-driven. Instead, the authors encourage companies to develop their own roadmap, following their workshop-based Data Science Roadmapping (DSR) framework. According to the authors, the process of developing the roadmap is actually even more valuable than the final roadmap. Another advantage of this approach is that the resulting roadmap is tailored to the unique context of the company that applied the approach and may therefore be easier to follow. A disadvantage of this approach is that the development of a roadmap is not only a time-consuming process, but also requires in-depth knowledge of the enterprise and its business context, as well as outside expertise in the form of consultants. As a result, this approach requires a large resource commitment, although it could be argued that this is required for any data-driven transformation. However, in contrast to the other approaches, DSR also requires a time commitment from upper management, as high-level managers are directly involved in some of the teams that plan and conduct the pre- and post-workshops as well as the final review. Overall, it can be noted that Kayabay et al. (2022) [15] is the most comprehensive of the identified frameworks, which may in part be because it builds on the authors' previous work in Kayabay et al. (2020) [14] (discussed in SQ2). However, it may also be the most difficult to apply for a company on their own, due to the lack of a structured process for the data-driven transformation which puts the entire responsibility of developing a functional roadmap on the company themselves. It is therefore understandable why DSR is the only paper that explicitly calls for the support of external consultants, which should already be experienced in the application of the framework.

The papers that use a more traditional roadmapping approach [18][21][23] vary in the number of phases as well as the scope of the initiative that they support. While Rane & Mishra (2018) [21] and Shankararaman & Gottipati (2015) [23] propose four phases, Lu et al. (2020) [18] proposes 3 stages (although the authors differ in their terminology, it can be assumed that phases and stages are synonymous). It should be noted, however, that the four phases of Shankararaman & Gottipati (2015) [23] are used as part of a traditional process improvement methodology consisting of as-is modeling, as-is process analysis, to-be modeling, to-be process analysis, and solutions requirements definition. Within this methodology, the four phases are applied as part of the to-be process analysis. This makes the scope of Shankararaman & Gottipati (2015) [23] similar to that of Lu et al. (2020) [18], because their three stages only describe the implementation of the business analytics life cycle, and not an organization-wide transformation towards becoming data-driven. The first phase of both papers is similar, as it has the goal of identifying business opportunities for data analytics. However, Lu et al. (2020) [18] achieve this through an exploratory data analysis, which may be better suited to a team consisting of data experts, such as data scientists, whereas Shankararaman & Gottipati (2015) [23] use the business process model from the previous to-be modeling as input, which is more suitable if the team has a process improvement instead of a data focus. This difference regarding the focus of the two approaches becomes even more apparent after the identification of business opportunities and use cases: For Lu et al. (2020) [18], data collection, preparation, and even the computation of descriptive statistics and data visualizations are still part of the first step, which highlights their focus on practical work with data. For Shankararaman & Gottipati (2015) [23], who view business analytics from a business process engineering perspective, the definition of decision criteria (and as a result, the type of analytics that will be used) and the identification of relevant data sources are the next two phases, but at no point in the process does their approach include the work with data. This may have advantages when working in a large company with highly formalized processes and process engineers with (access to) in-depth knowledge about their company's data sources and analytics capabilities. On the other hand, this disconnection between theory and practice could have the effect that the implementation of the designed processes faces barriers which were previously not anticipated, which could delay the initiative considerably and increase costs. The difference between the two approaches could be summarized as bottom-up with a data focus [18] versus top-down with a process improvement focus [23]. Which of the approaches is more suitable may depend on various factors, such as the size of the business, its degree of formalization, and the expertise of the team conducting the initiative. Despite these differences, the overall approach of the two papers for the implementation of the data analytics life cycle is similar. After the identification of data sources and types of analytical models, these models are applied, insights are generated, and the results are incorporated in the business decision-making processes. Again, Shankararaman & Gottipati (2015) [23] treat this step from a high-level perspective, i.e., deciding how the data models are embedded in the various process workflows which they are meant to support, while Lu et al. (2020) [18] focus on the communication of the results of their initiative to individual

decision-makers. This could mean that the bottom-up approach by Lu et al. (2020) [18] is more suitable for companies that are not fully convinced of whether or not it is worthwhile to become data-driven and that want to experience the potential benefits through a pilot study. The approach by Shankararaman & Gottipati (2015) [23] on the other hand seems more suitable for organizations that have already decided on a data-driven transformation, have committed resources to its realization, and have an experienced team in place that can make use of already developed data capabilities. In this case, their approach would facilitate the transformation to a data-driven organization much faster, as data-driven initiatives could be implemented at multiple levels of the business simultaneously or in quick succession. This could save costs and accelerate benefits realization but brings a greater risk of interfering with day-to-day operations, in case of problems are emerging along the way.

The approach by Rane & Mishra (2018) [21] is more focused on the organizational path to becoming data-driven, from initial pilot to organization-wide deployment, with the focus on building strong data team which leads the initiatives. In the first phase of their DIPPS model, organizations create a cross-functional team of business and IT experts, which identify 'low hanging fruit' while gaining some practical experience in a pilot project. In the second phase, they apply data analytics to business problems and develop innovative solutions, before moving to predictive analytics in the third phase. Up to this point, the approach is comparable to Lu et al. (2020) [18] due to the focus on working directly with data in order to find data-driven business opportunities, although Rane & Mishra [21] place a bigger focus on the learning path of the team, by suggesting the training the members should receive at different stages of the journey to becoming data-driven. However, the last phase in their model describes how to achieve organization-wide deployment of data analytics. The authors note that while the first three phases involving only one team can be implemented in a few months, the organization-wide transformation to a data-driven organization can take multiple years. Like Kayabay et al. (2022) [15], Rane & Mishra (2018) [21] highlight the importance of starting with a small pilot project. The advantages of this approach are that it makes it easier to attain the approval of upper management by demonstrating quick wins, which is vital to becoming a data-driven organization, and that the data-driven processes can be tested and optimized in a smaller setting. Organizations starting with a pilot project will likely also face unanticipated problems which could interfere with day-to-day operations.

Compared to the other papers, Hagen & Hess (2020) [12] is an outlier: Their design framework for data-driven organizations is based on a taxonomy and does not provide a company with clear steps to take in order to become data-driven. Instead, they define design parameters of data-driven organizations, which companies can utilize in the early phases of planning their data-driven transformation, to model the to-be design of their organization that fits their business context the best. It can therefore be seen as complementing the roadmapping frameworks, instead of competing with them, although some of the other frameworks make assumptions with regards to the dimensions of the design framework. Overall, the practical value of Hagen & Hess (2020) [12] for organizations on the journey to becoming data-driven is somewhat lower compared to the other papers,

instead it provides a different perspective on the various ways data-driven organization can be designed. One valuable insight from this paper, however, is the recommendation to establish a “center of excellence” which centralizes data-related competencies and resources in one place and can be used as a contact point for business users struggling with adapting to the new way of working.

Table 3 lists the papers that were selected to answer the first sub-research question and the frameworks or models they use.

Paper	Framework or Model
[11]	Data Drivenness Process Capability Determination Model (DDPCDM)
[12]	Design framework for data-driven organizations
[15]	Data Science Roadmapping (DSR) framework
[18]	Process model for data-driven decision-making
[21]	Discover-Innovate-Predict-Perform-Sustain (DIPPS) model
[23]	Analytics Driven Business Process Improvement (ADBPI) framework

Table 3. Frameworks or models for becoming data-driven

2.4.2 Challenges, Barriers & Enablers

In total, eight of the selected papers discuss challenges, barriers, and enablers for becoming data-driven, highlighting both general and specific issues that companies on this journey frequently encounter and which are crucial to address when implementing a data-driven transformation. Almost all of the papers categorize their challenges and there is quite some overlap with regards to the categories that are used.

The papers mostly talk about challenges and barriers, but other concepts such as 'enablers' as used by Berndtsson et al. (2018) [4] are also included and discussed. Even though challenges and enablers seem to be opposites, the terms are actually used in a very similar way. They both refer to aspects that need particular attention, and which could be critical to the success of a data-driven transformation project. Other authors use different terminology such as 'issues', which are all included in this discussion. Different authors treat challenges, barriers, and enablers on different levels, e.g., Kayabay et al. (2020) [14] treating data quality and data security as part of data governance, while other authors (e.g., [26]) treat these as individual barriers.

In the papers that use categories to group their identified challenges, barriers, and enablers [4] [6] [14] [22] [26], the most often used categories are Data and Organization, which were used by all five papers.

Data refers to challenges directly related to the data that is used in the decision-making processes. The most frequently mentioned challenges in this category are data governance

and data quality, although data availability and accessibility, data security and privacy, and data integration are mentioned as well.

Organization refers to the challenges related to the organizational transformation that is required to becoming data-driven. The most frequently mentioned organizational challenge is the creation of a data-driven culture, characterized by data-driven decision-making due to trust in the data, especially by upper management, and a culture of acceptance and openness. Many papers highlight this as one of the most important and difficult challenges for companies on the journey to becoming data-driven. Other organizational challenges are the creation of an analytics center, creating short-term wins to sustain the momentum of the data-driven transformation, as well as regulatory compliance and ethical conduct with regards to handling data.

The next most frequently mentioned category is Tools or Technology, referring to the challenges that are the result of using tooling which enables data-driven processes, e.g., tools for data extraction, validation, analysis, or visualization. The most important challenges in this category are the integration of different tools, which is complicated by the limitations of different IT platforms, and the limitations of the tools with regards to their functionality, which may not satisfy business requirements.

Another commonly mentioned challenge category is Management, which also relates to the categories Strategy and Process. The implementation of data-driven decision-making processes is viewed as the cornerstone of being a data-driven organization. To achieve this, organizations need to align the goals of their data initiatives with their data strategy, which needs to be aligned with the overall business strategy. The success of the data initiatives largely depends on having well-managed processes in place, which make sure that the data used for decision-making is well-prepared and validated and that insights are accessible to decision-makers in form of, e.g., visualizations. Having reliable data processes in place will also lead to higher trust in the data capabilities and data-driven decision-making, which facilitates the transition to a data-driven culture.

The communication between managers and employees plays an important role during the transformation. Berndtsson et al. (2018) [4] distinguish between upper management, middle management, and employees, with regards to the management challenges for data-driven organizations. While upper management is responsible for the strategy, they need to lead by example and show that they are willing to make decisions based on data and not intuition. Other papers also note the importance of this top-down approach for creating a sustainable data-driven culture in organizations. Middle management on the other hand may have reservations about the use of data-driven decision-making because they could fear that it will replace them in the long run. These fears need to be adequately addressed. Employees on the other hand often do not want to change their known ways of working, which means that they must be shown the advantages of becoming data-driven first hand to motivate them to learn the new ways.

One additional enabling factor for implementing a data-driven culture and decision-making

process is to encourage experimentation, where failure is not viewed as unprofitable but as learning and progress towards better data use cases.

The last major challenge for organizations trying to become data-driven is People, referring to the acquisition and coordination of data expertise, e.g., through hiring or training. This is made more difficult due to a shortage of analytical and technical skills on the labor market. The coordination of internal data capabilities and expertise is another challenge. Kandogan et al. (2014) [13] highlight that the communication between business and IT can often times lead to problems, for example, due to business users not providing relevant information. If this is a problem, the authors recommend an 'agile', i.e., an iterative interview-style approach to information exchange. Other ideas to improve the integration of IT and business functions are the use of collaboration tools and shared repositories, a shared terminology, and increasing the use of analytics in reporting.

The most important identified categories of challenges, barriers, and enablers can be referred to using the umbrella term “DOTS themes” (Data, Organization (including people), Technology, and Strategy (including management)), proposed by Kayabay et al. (2020). The authors used the DOTS themes as the basis for designing their DSR framework proposed in Kayabay et al. (2022).

Table 4 shows which papers categorize challenges, barriers, and enablers based on the DOTS themes.

DOTS Theme	Papers that Use the Theme as a Category	Challenges, Barriers, and Enablers
Data	[4], [6], [14], [22], [26]	<ul style="list-style-type: none"> • Data governance • Data quality • Data availability and accessibility • Data security and privacy • Data integration
Organization	[4], [6], [14], [22], [26]	<ul style="list-style-type: none"> • Establishing a data-driven culture • Creating a data analytics center • Generating quick wins • Regulatory compliance and ethical conduct with regards to handling data • Hiring and training
Technology	[4], [14], [26]	<ul style="list-style-type: none"> • Integration of different tools • Functional limitations of tools
Strategy	[4], [6], [14]	<ul style="list-style-type: none"> • Data-driven decision-making processes • Aligning data initiatives with data strategy • Communication across the organizational hierarchy

Table 4. DOTS themes as categories of challenges, barriers, and enablers

2.4.3 Tools

Five papers were identified which utilized technical tools to help companies on their journey to becoming data-driven. With regards to tool types, the papers range from technical infrastructure, such as database and data warehousing applications, to visualization or quantitative analysis tools, while many focus on more general discussions of BI tools and their applications. Akbar et al. (2022) [1] is the only example of a case study where a BI application is implemented “from scratch” and highlights the difficulties associated with this approach.

The technical tools that are discussed in the literature include all types of tools that were used throughout the data science lifecycle, to go from data to insights. The two most frequently mentioned types of technical tools are quantitative analysis and visualization tools. Tools used during data extraction, validation and preparation are another important category. Quantitative analysis tools come in a wide range of levels of complexity, from basic spreadsheet applications like Microsoft Excel to sophisticated data analytics tools that are capable of predictive analytics using machine learning models. Integration of various tools can pose a major challenge, especially when more specialized software is involved [13]. According to Kayabay et al. (2022) [15], this issue can be addressed by using platforms that combine multiple tools, but potentially at the expense of functionality.

Visualization tools on the other hand need to be straightforward to use so that reports and presentations can be generated in a quick way. The most frequently mentioned type of visualization tools is dashboarding applications. Biagi et al. (2022) [7] describe their process for developing a dashboarding application based on their BI model. They focus especially on the process of identifying relevant KPIs that will be tracked in the dashboard. Different authors place different value on visualization tools. While most note visualization plays a vital role in data-driven organizations, Kandogan et al. (2014) [13] claim that it is mostly used by upper management, because middle management and employees are usually more interested in numbers.

The last type of technical tools that are mentioned are those that are involved in the data extraction and validation as well as in the data management. Akbar et al. (2022) [1] describe their approach to building their own business intelligence tool “from scratch” by integrating different technical tools into a data pipeline, starting with a data warehouse that integrates raw data from different data sources and makes it usable for further analysis. The authors clearly demonstrate that this is possible for small companies with limited data capabilities, but also show the difficulties inherent to this approach. The larger scope and required maintenance would make the in-house development of data applications very resource intensive in larger organizations.

Table 5 shows in which papers the three types of tools are discussed.

Tool Type	Papers	Examples
Quantitative Analysis	[1], [8], [13]	<ul style="list-style-type: none"> • Spreadsheet applications • Machine learning and predictive intelligence
Visualization	[1], [7], [13], [14]	<ul style="list-style-type: none"> • Dashboards • Reporting
Data Management & Pipeline	[1]	<ul style="list-style-type: none"> • Data warehousing • Data mining and extraction • Data validation

Table 5. *Tool types and examples*

3 Design of the Approach

In this chapter, stakeholder goals and requirements for the approach are identified and connected to design components which were identified in the SLR. Furthermore, an initial design for the Approach for Becoming a Data-Driven Organization (ABDDO) is proposed and discussed.

Figure 5 and **Figure 6** show the stakeholders and their goals, the requirements that realize the goals, as well as the identified design components that make the approach meet its requirements.¹ A larger of version of the combined figures can be found in Appendix C.

Figure 7 shows the initial design for the ABDDO and **Table 8** describes the structure of the individual workshops. An elaboration of the workshops of the final version of the design can be found in chapter 4 Refinement of the Approach.

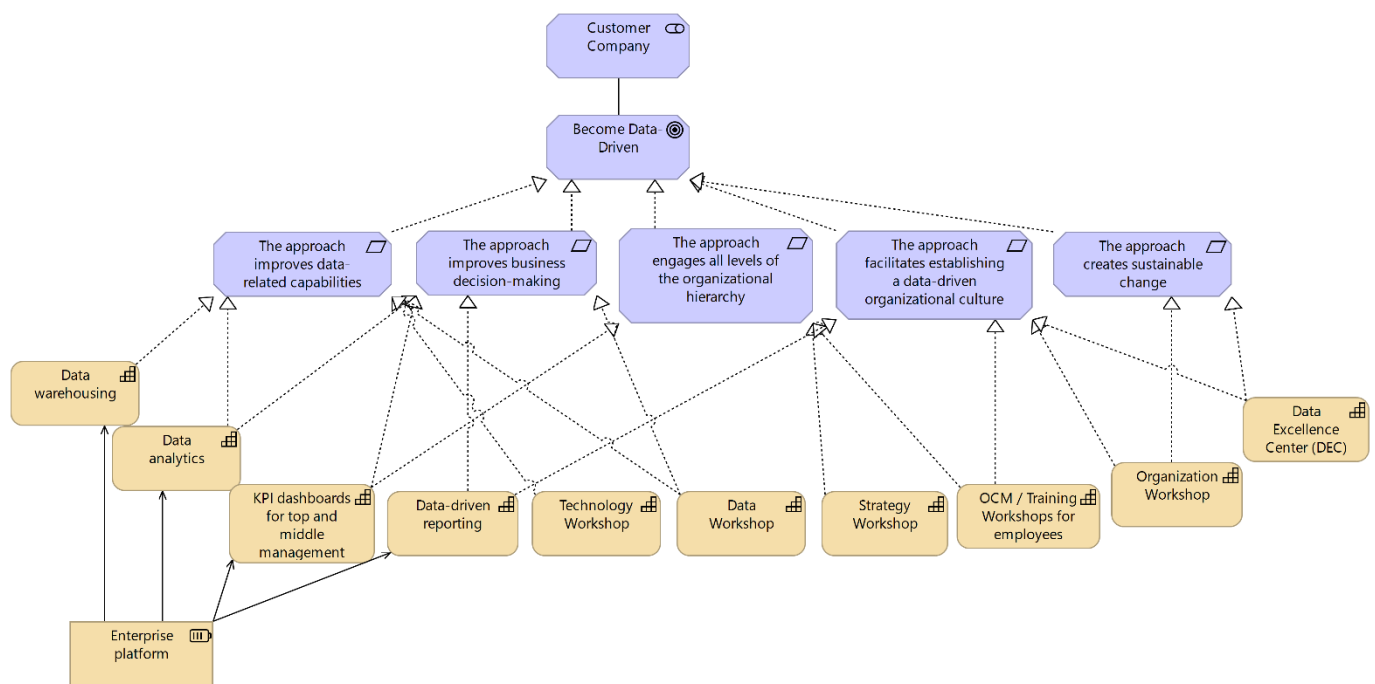


Figure 5. Requirements and design components realizing the goal of the customer company

¹ An explanation of the elements used in the figures can be found in the ArchiMate specification of motivation elements: <https://pubs.opengroup.org/architecture/archimate31-doc/chap06.html>

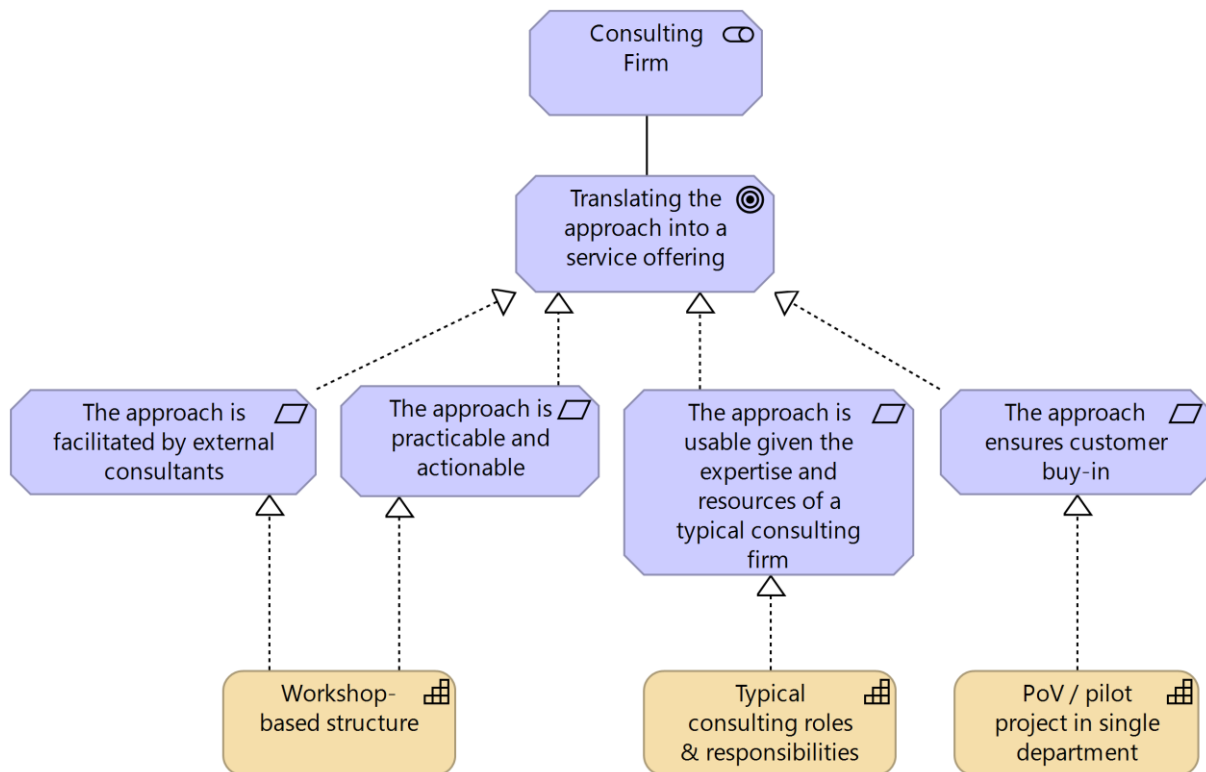


Figure 6. Requirements and design components realizing the goal of the consulting firm

3.1 Stakeholder Goals & Requirements

Two groups of stakeholders can be distinguished with different but related goals: On the one hand, the customer company, whose goal it is to become data-driven. The requirements for realizing this goal are based on insights from the SLR.

On the other hand, the consulting firm, who shares the goal of their customers, but has the additional goal of translating the approach into a service offering. The requirements for achieving the consulting firm's goal were identified through discussions with experts of the case company, Plat4mation.

Five requirements were identified which together realize the customer's goal of becoming a DDO: The approach

- improves data-related capabilities,
- improves business decision-making,
- engages all levels of the organizational hierarchy,
- facilitates establishing a data-driven organizational culture,
- and creates sustainable change.

The first two requirements build the foundation of a DDO, which is distinguished by the use of data to improve decision-making processes. Having developed data-related capabilities is crucial to ensure data quality and accessibility, but the data also needs to be processed and made available to decision-makers to have an impact.

The last three requirements relate to the organizational and cultural change that is required and which must be sustained even after the consulting firm concludes their project. While it is the decision-makers who are ultimately responsible for basing their business decisions on data, the literature is clear that becoming a DDO impacts all levels of the organizational hierarchy. This requirement is closely linked to the establishing of a data-driven culture, which is viewed as one of the most important factors for becoming data-driven, but also one of the biggest challenges, in the reviewed literature. Lastly, to establish a data-driven organizational culture is a long-term goal that cannot be fully achieved within the time of the collaboration between the consulting firm and their client. It is therefore of importance that the approach would enable the customer company to sustain the changes and further develop their data-driven practices even after the consulting firm leaves.

Four requirements were identified for the consulting firm's goal of translating the approach into a service offering for their clients:

The approach

- is facilitated by external consultants,
- is practicable and actionable,
- is usable given the expertise and resources of a typical consultant,
- and ensures customer buy-in.

The approach is targeted at consulting firms who want to help their clients to become data-driven, which sets it apart from most of the scientific literature on the topic of DDOs. It should therefore be designed in a way that emphasizes the role of the external consultants and how they should collaborate with the team of their client. The approach should also be practicable and actionable, which means that it should be easily implementable and result in immediate practical value for the customers. This is in contrast to, e.g., the approach of Kayabay et al. (2022) [15], which facilitates the process of developing a roadmap, but which does not further elaborate on how the roadmap should be implemented. To make the approach useful for a wide audience, it should be usable given resources and expertise that is found in a typical consulting firm, meaning that no extraordinary investments would have to be taken by most consulting firms to implement the approach. Lastly, the approach should ensure customer buy-in, which primarily refers to the buy-in of the customer company's executives. This requirement was highlighted by experts from the case company. Because a data-driven transformation is a time and resource intensive initiative, it is important to ensure that the decision-makers of their clients would be convinced of the usefulness of becoming a DDO, as well as the ability of the consulting firm to realize this goal.

3.2 Design Components

From the SLR, several design components were identified which the design of the ABDDO should include to fulfill the identified requirements. The design components were then

confirmed by consulting experts at the case company, Plat4mation, before they were synthesized and integrated into the initial design.

According to the literature, one of the biggest challenges of becoming a DDO is establishing a data-driven culture [22][4][6][14][26]. While this is a long-term objective, which cannot be immediately realized by following an approach, the literature gives some suggestions for how an approach for becoming data-driven can support the creation of a data-driven organizational culture. For once, the approach needs to address and engage all levels of the organizational hierarchy, i.e., upper management, middle management, and employees [4].

The most important characteristic of a data-driven organization (DDO) is that it utilizes data-driven decision-making (DDDM), i.e., its decision-makers rely on data instead of their own intuition for steering the business. Several papers highlight the importance of KPIs and dashboards to facilitate DDDM among upper and middle management [7][22][14][4][12][21][1].

It is ultimately up to the decision-makers to lead by example and create an open and accepting decision-making culture, in which data, and not the opinion of the highest-ranking person in the room, is considered to be the most important factor. The literature suggests that management buy-in and support can be increased if the approach is able to demonstrate its value by creating quick wins [21][8]. One way of doing so is to start with a pilot project, which creates value in a relatively short time frame and which the organization can later use as a basis to further build their data capabilities [21][18].

Besides management, it is important to have the employees on board as well when aiming for a cultural change in an organization. While the decision-makers are responsible for conducting DDDM, the employees are responsible for analyzing the data and communicating the insights using data-driven reporting [18]. Since becoming a DDO means that many employees will have to change their way of working, it is likely that this will be met with resistance [5][26]. To address this resistance, the literature suggests that it is important for management to lead by example and to clearly communicate the advantages of being a DDO [11][4]. Additionally, it is important to provide employees with sufficient training so that they are capable of meeting their new challenges and to incentivize a data-driven way of working [5].

Another key challenge for organizations on the journey to becoming data-driven is data. For example, ensuring data availability and accessibility, data quality, data security and privacy, as well as data governance and integration [14][22][4][5][6][8][13][26]. Especially organizations with poorly developed data capabilities tend to store their data in isolated "data silos", which complicates data sourcing and analysis [12][18][8]. Data warehousing, i.e., the organized storage of business-relevant data, is therefore a critical capability for any DDO [23][13][18][1].

Apart from managing the data, organizations often struggle with processing and analyzing it. Data analytics tools are important in DDOs to generate the insights based on which business decisions are made [15][1]. Especially the integration of data analytics tools with the other

tooling and reporting capabilities is a common problem [15].

One proposed way of addressing the difficulties that arise when an organization starts to build their own data capabilities is to centralize the new expertise in a centralized team or competence center, which is given access to the required resources and which supports all parts of the organization in the data-driven transformation [21][4][12].

3.3 Designing the Approach

The ABDDO aims to integrate the design components from the literature, which are aligned with the identified stakeholder goals and requirements, into one unified approach.

The workshop-based Data Science Roadmapping approach by Kayabay et al. (2022) [15] was used as a starting point for the design of the ABDDO. One advantage of this approach was the use of dedicated workshops for each of the so-called DOTS themes, i.e., data, organization, technology, and strategy. These themes are reflected in most of the papers which identified barriers and enablers to becoming a DDO and are generally accepted to be the most important themes to address. Additionally, making use of workshops in the approach aligns well with the goal of making the approach suitable to be translated into a service offering for the customers of the case company, because workshops provide a way for consultants and experts of the customer company to come together and collaboratively work out the details of the data-driven transformation.

Aside from the workshop structure, the required roles and responsibilities for both the customer and consulting firm were based on Kayabay et al. (2022) [15], which were further modified in consultation with practitioners of the case company, Plat4mation. It should be noted that during these meetings, the focus was on the roles of the customer company, and as a result, the initial approach uses generalized roles for the consulting firm.

Another recommendation from the literature that is reflected in the approach is to establish a “center of excellence” consisting of data experts [12], which in the ABDDO is called Data Excellence Center (DEC). It comprises a team within the customer company which centralizes data-related competencies and resources, and which closely follows and supports the transformation process. Additionally, it is involved in most of the workshops and coordinates activities with the team of external consultants. The DEC is established at the very beginning of the data-driven transformation by the executive committee (see **Table 7** Roles & Responsibilities) and provided with the necessary resources and support. While it initially should receive a lot of support by the external consultants, its long-term vision is to facilitate and sustain the data-driven transformation even after the team of external consultants leaves the company. Therefore, the DEC needs to coordinate with HR in order to get new talent on board and develop its own capabilities.

To ensure top-level buy-in and support, the ABDDO proposes to begin with a pilot project with limited scope, which is used to demonstrate the value of becoming a DDO by generating short-term wins. This pilot project should be conducted in a department or

business unit which has a high degree of enthusiasm regarding the prospect of becoming data-driven, which has technical experts with a higher degree of data literacy (compared to other departments or business functions), and which has access to high quality data sources that are suitable to be used for data analytics projects. By contrast, if the team of external consultants would have to spend several months sorting out various data silos with low quality data before they could start with the pilot project, top-level management might consider the effort too large and lose interest in becoming a DDO. The department lead of the department project should be especially enthusiastic about the data-driven transformation, as they are going to be highly involved in the activities and are expected to get their team on board by advocating for the transformation.

By following the approach, the customer company will initially transform a single department or business unit to become data-driven. This entails the use of data analytics by employees to analyze business-relevant data, as well as data-driven reporting capabilities integrated with a KPI dashboard of their department lead, who will therefore be able to track important metrics which can be used for decision-making. Additionally, the top-level management will receive dashboards with higher-level KPIs as well, which are aligned and integrated with the KPIs of the selected pilot department.

After one department is transformed this way during the pilot project, top-level buy-in for the transformation project should be ensured, and the cycle can be repeated in another department. This way, one department after the other, the entire organization will be transformed into a DDO.

The estimated time this would take per department is around six months, however, it could potentially take considerably longer depending on the organization size and the current state of their data warehousing and data capabilities. This estimation is based on a tentative timeline, which was established after discussions with practitioners from the case company, Plat4mation. The timeline can be seen in **Figure 8**.

Figure 7 shows the initial approach based on the identified requirements and design components from the literature, and **Table 8** shows the initial content and goals of the individual workshops. **Table 6** and **Table 7** explain the roles that are involved in the workshops, of the external team of consultants and of their customer, respectively, as well as their responsibilities.



Figure 7. Initial design for the ABDDO based on SLR

Consultants	Responsibilities
Project Manager	Responsible for the management of the overall project, including scope and deadlines, as well as coordinating with Data Excellence Center
Business Consultant	Responsible for guiding workshops and assisting customers in business related matters
Technical Consultant	Responsible for assisting the customers in technical matters

Table 6. Roles & responsibilities of the team of consultants

* Roles may be further specified based on existing roles

Customer *	Responsibilities
Executive Committee <ul style="list-style-type: none"> C-level Executives 	<ul style="list-style-type: none"> Responsible for deciding on strategy, scope, and a high-level roadmap for the transformation initiative Responsible for making decisions based on data and not intuition
Data Excellence Center <ul style="list-style-type: none"> Data Excellence Center Lead Data Experts (data scientists, data integration experts, etc.) 	<ul style="list-style-type: none"> Responsible for assisting in the pilot/department and subsequent projects and transferring lessons learned Responsible for developing the in-house data capabilities so that the transformation can be sustained even after consultants leaves
Department Lead - for (pilot) project department	<ul style="list-style-type: none"> Responsible for leading the pilot/department project Responsible for making decisions based on data and not intuition
Domain Matter Experts	<ul style="list-style-type: none"> Responsible for identifying business cases and providing valuable input to the workshops
Technical Matter Experts	<ul style="list-style-type: none"> Responsible for identifying and collecting data sources and preparing data exploration Responsible for performing data analytics

Business Users / Employees	<ul style="list-style-type: none"> • Responsible for attending OCM and training sessions • Responsible for using data-based reporting
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Table 7. Roles & Responsibilities of customer company

** This list describes the core roles involved in the workshops. Additional roles may be added to specific workshops depending on the company structure and the topic of the workshop, e.g., process owners, data owners, etc. If the customer is lacking certain competencies, e.g., technical matter experts, the consulting firm can assist them with additional specialists*

Data-Driven Transformation: Kick-Off	
Goal	<ul style="list-style-type: none"> • Introduce the data-driven transformation process to C-level management, create sense of urgency, ensure buy-in • Establish Data Excellence Center (DEC), discuss their responsibilities and provide them with resources determine how consultants supports the DEC <ul style="list-style-type: none"> ◦ Determine department project department & scope • Create high-level roadmap for the data-driven transformation
Inputs	None
Outputs	<ul style="list-style-type: none"> • Data Excellence Center structure & resources • Department project department and scope • High-level roadmap
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ◦ Executive committee ◦ Data Excellence Center Lead • Consultants <ul style="list-style-type: none"> ◦ Project manager ◦ Business consultants
Data-Driven Strategy & Capabilities Workshop	
Goal	<ul style="list-style-type: none"> • Define the vision and strategy for the data-driven transformation, on different timescales: short-term (~1 year), mid-term (~3-5 years), and long-term (~5-10+ years) • Determine how the C-level executives can be supported by the enterprise platform capabilities <ul style="list-style-type: none"> ◦ Determine KPIs for department project department
Inputs	CxO dashboards demo (dashboards for C-level executives)
Outputs	<ul style="list-style-type: none"> • Long-, mid-, and short-term strategy & vision • Top-level KPIs relating to department project department
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ◦ Executive committee ◦ Data Excellence Center Lead • Consultants <ul style="list-style-type: none"> ◦ Project manager ◦ Business consultants
Department Project: Kick-off & Planning Workshop	
Goal	<ul style="list-style-type: none"> • Introduce the data-driven transformation and the department project • Discuss overall direction of the department project, available resources, etc. <ul style="list-style-type: none"> ◦ Conduct as-is & to-be analysis + gap analysis

	<ul style="list-style-type: none"> • Determine KPIs for department project department (aligned with top-level KPIs) • Create a roadmap for the department project and schedule the upcoming workshops
Inputs	<ul style="list-style-type: none"> • Strategy & Vision • Top-level KPIs
Outputs	<ul style="list-style-type: none"> • Department KPIs • Gap analysis (missing resources and capabilities) • Department project roadmap and workshop schedule
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data Excellence Center Lead ○ Data experts (DEC) ○ Department Lead ○ Domain matter experts ○ Technical matter experts • Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants ○ Technical consultants
Department Project: Pre-Workshop	
Goal	<ul style="list-style-type: none"> • Identify data sources and prepare data for data exploration in the upcoming workshops • Do some preliminary data exploration
Inputs	Top-level KPIs and department KPIs
Outputs	List of data sources (prepared for data exploration in the Data workshop)
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data experts (DEC) ○ Technical matter experts • Consultants <ul style="list-style-type: none"> ○ Technical consultants
Department Project: Data Workshop	
Goal	<ul style="list-style-type: none"> • Realize KPI dashboard using the data sources • Identify opportunities and use cases for data analytics <ul style="list-style-type: none"> ○ Focus on quick wins, especially during the department project
Inputs	List of data sources
Outputs	<ul style="list-style-type: none"> • KPI dashboard based on data sources • Based on this, consultants can design the Department Lead dashboard for the department lead • Data analytics use cases
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data experts (DEC) ○ Department Lead ○ Domain matter experts ○ Technical matter experts • Consultants <ul style="list-style-type: none"> ○ Business consultants ○ Technical consultants
Department Project: Technology Workshop	

Goal	<ul style="list-style-type: none"> • Present the capabilities of the enterprise platform <ul style="list-style-type: none"> ◦ Including Department Lead dashboard for the department lead • Determine how the enterprise platform capabilities can support the data analytics use cases
Inputs	<ul style="list-style-type: none"> • Department Lead dashboard (displaying previously identified KPIs) • Data analytics demo
Outputs	The enterprise platform capabilities for data analytics use cases
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ◦ Data experts (DEC) ◦ Department Lead ◦ Domain matter experts ◦ Technical matter experts • Consultants <ul style="list-style-type: none"> ◦ Business consultants ◦ Technical consultants
Department Project: Organization Workshop	
Goal	<ul style="list-style-type: none"> • Determine missing resources <ul style="list-style-type: none"> ◦ Especially talent & skills • Create communication plan • Plan OCM and training efforts <ul style="list-style-type: none"> ◦ Data analytics ◦ Data-driven reporting
Inputs	<ul style="list-style-type: none"> • Gap analysis • Department project roadmap
Outputs	<ul style="list-style-type: none"> • Communication plan • OCM & training plan • Additional expertise required to implement data analytics use cases? (coordinate with HR)
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ◦ Data experts (DEC) ◦ Department Lead ◦ Domain matter experts ◦ (HR specialist) • Consultants <ul style="list-style-type: none"> ◦ Business consultants
Department Project: Post-Workshop	
Goal	<ul style="list-style-type: none"> • Wrap-up and reflect on previous workshops • Plan implementation of use cases <ul style="list-style-type: none"> ◦ Finalize department project roadmap for remaining activities (OCM/training workshops, data analytics use case implementation) • Identify and address any potential barriers
Inputs	Outputs from all previous workshops
Outputs	Finalized department project roadmap
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ◦ Data Excellence Center Lead ◦ Data experts (DEC) ◦ Department Lead (for the project department) ◦ Domain matter experts

	<ul style="list-style-type: none"> ○ Technical matter experts ● Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants ○ Technical consultants
OCM / Training Workshops	In the background: create CxO dashboards based on the data from the project department
Goal	<ul style="list-style-type: none"> ● Teach business users how to properly use the enterprise platform and capabilities (especially data analytics, based on the identified data analytics use cases) ● Teach business users how to use data in reporting
Inputs	<ul style="list-style-type: none"> ● Communication plan ● OCM & training plan ● Data analytics use cases
Outputs	None
Involved roles	<ul style="list-style-type: none"> ● Customer <ul style="list-style-type: none"> ○ Business users ● Consultants <ul style="list-style-type: none"> ○ Business consultants
Department Project: Review	When the pilot project is completed *
Goal	<ul style="list-style-type: none"> ● Review the department project ● Reflect on lessons learned ● Reflect on alignment with strategic vision ● Revise high-level roadmap based on results of the department project ● Introduce the CxO dashboards to the C-suite
Inputs	Documents from the department project
Outputs	<ul style="list-style-type: none"> ● Lessons learned ● High-level roadmap (revised)
Involved roles	<ul style="list-style-type: none"> ● Customer <ul style="list-style-type: none"> ○ Executive committee ○ Data Excellence Center Lead ○ Department Lead ● Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants

Table 8. Initial structure and content of the individual workshops

**Then repeat from Department Project: Kick-off & Planning for the next department*

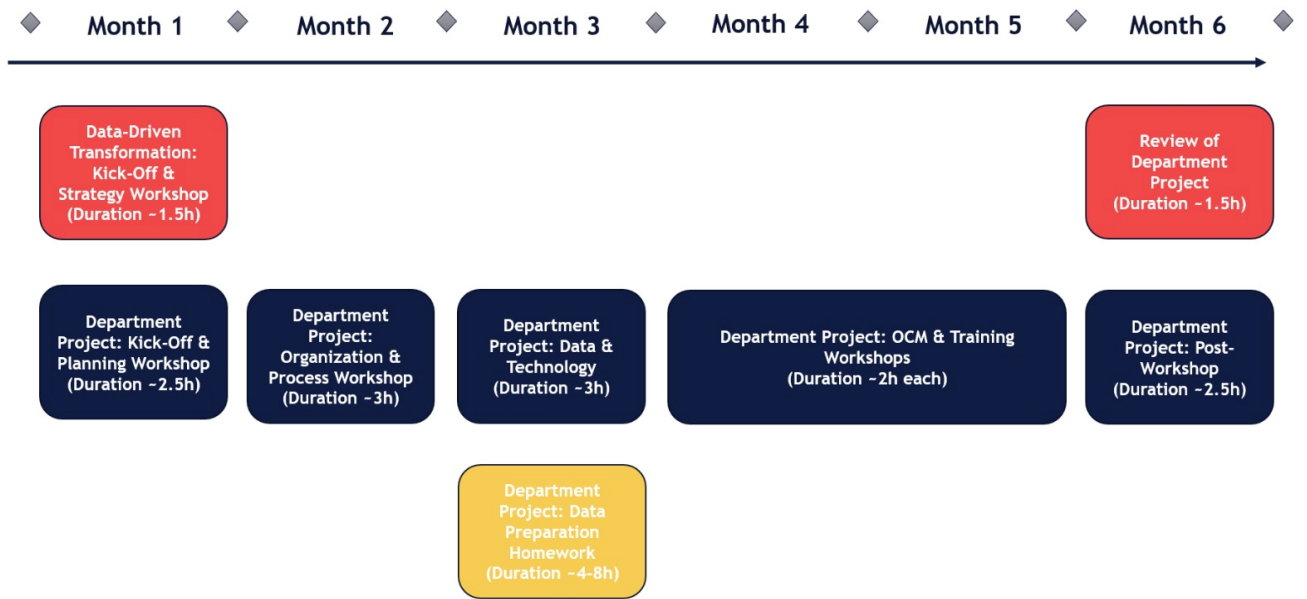


Figure 8. Tentative timeline for the pilot project

4 Refinement of the Approach

In this chapter, the results of two semi-structured interviews are presented which are used to refine the approach. The resulting final Approach for Becoming a Data-Driven Organization (ABDDO) is discussed and elaborated on in detail. **Figure 10** shows the design of the improved approach and **Table 10** describes the content of the individual meetings and workshops.

4.1 Interviews

Two one-hour, semi-structured interviews were conducted with experts of the case company, Plat4mation. The first expert is a Delivery Lead for the Strategic Capability Group of Plat4mation with many years of experience in consulting and the second expert leads the data advisory practice at Plat4mation. Both experts are very familiar with data-related consulting.

The interview questions were designed to cover the design components that were identified from the literature as discussed in the previous chapter, as well as the general structure of the approach and the content of the workshops. Additionally, the difficulty of becoming a DDO and the prevalence of this topic among the customers of the case company were reviewed. Before the interviews, the experts were given an extensive presentation covering all aspects of the approach.

The expert interview questions can be found in Appendix B.

4.1.1 Results

Both experts agreed that becoming a DDO was a topic that was very relevant to their customers. Many of their customers were struggling with making use of their business data and were looking for ways to capitalize on the unrealized opportunities it presented. They agreed that while moving towards becoming a DDO by following the ABDDO was not going to solve all their issues, it would be an important steppingstone towards addressing data issues and generating valuable business insights from data. According to one interviewee, acting on data is becoming increasingly relevant in today's business environments, due to the rapid pace of technological and political developments, as well as the trend of globalization.

However, one interviewee noted that most of their customers were unsure what becoming a DDO would mean for them and that the consulting firm should focus their communication on the capabilities that this transformation would enable.

With regards to the previously identified design components, both interviewees were enthusiastic about the idea of establishing a Data Excellence Center (DEC), which could centralize data-related competencies at the customer organization to support and sustain the transformation efforts in the long term. However, they noted several challenges that

would have to be addressed when establishing a DEC. One of the most important challenges would be guarantee senior management support, because to properly fulfill its role, a DEC would require a certain degree of autonomy as well as access to organizational resources. This includes access to all business relevant data sources, but also the means to expand their team with new talent in order to acquire missing expertise that is required to sustain the data-driven transformation. This would be especially important in the early stages of the transformation, where the DEC would be faced with many challenges, such as ensuring data accessibility and data quality for the departments or business units.

Both interviewees supported the idea of starting with a pilot project that could increase management buy-in and support by creating quick wins. However, they disagreed about the scope and time frame of the pilot project and the entire data-driven transformation. One interviewee argued that the initially estimated six months for the pilot project would be viewed as too lengthy by the top-level management of their customer companies and recommended to keep it within a two-month time frame, with one year being his estimate to roll out the transformation for the rest of the company. The other interviewee disagreed, saying that this would be too short to realize the promised capabilities.

The first interviewee's criticism with regards to the time frame also extended to the structure of the approach, especially with regards to the number of workshops, which he recommended should be consolidated as to not lose buy-in of the management and keep the momentum going. The other interviewee noted that he thinks the order of the workshops should be changed: He argued that it would be more appropriate to start with the organization workshop, where stakeholders and processes would be identified, before moving to the data and technology capabilities in the later workshops.

One interviewee recommended to allow for some iterative improvement of the developed solutions within the approach. He argued that it would be valuable if the approach would leave room for managers and employees of the customer company to voice their opinions on the implementation of the enterprise platform and its capabilities, which could then be improved upon by the consulting firm. By including the opportunity to provide feedback, misunderstandings about how the technical capabilities would support the goals of the data-driven transformation could be cleared up early and the solutions could be tailored better to the needs of their users.

Both interviewees agreed that the capabilities of the enterprise platform were well-utilized in the approach. One interviewee suggested once the approach was successfully implemented across an entire company, additional capabilities, such as process automations and integrations with third party software, could be explored, but noted that this would be beyond the scope of the initial service offering.

The interviewees also agreed with the roles and responsibilities as described by the initial design. However, they recommended the inclusion of additional roles on the side of the team of consultants, which would make their responsibilities per workshop clearer.

Overall, even though they had some suggestions for improvements, both interviewees were very positive about the initial design of the ABDDO.

4.2 Refining the Approach

The most substantial changes that were made to the design of the ABDDO as a result of the expert interviews were the consolidation of some of the workshops as well as their reordering to better reflect the focus on the business processes that were going to be supported by data. It should be noted that no aspects were dropped, but instead workshop activities that were thematically aligned and required similar roles were combined into one, e.g., the Data Workshop and the Technology Workshop were combined into the Data & Technology Workshop. This would make it easier for the customer company to plan the workshops and have everyone involved available at the required time. The initial structure with regards to the order of the workshops was based on the DSR approach by Kayabay et al. (2022) [15]. However, their approach has a different goal, i.e., the creation of a roadmap for developing data capabilities, while the ABDDO is focused on creating practicable change in organizations and developing the data-related capabilities alongside the approach. It was therefore sensible to make it more process-centric, by identifying the processes that were going to be supported by data in one of the earlier workshops.

The first two workshops, i.e., the Kick-Off and the Strategy & Capabilities Workshop, which both involved the executive committee, were consolidated into a single workshop, the Kick-Off & Strategy Workshop. This way, the time demands for the executive committee would be minimized.

Furthermore, the order of the workshops for the department projects (and initially, the pilot project) was adjusted: The Organization Workshop was moved to the beginning (after the department/pilot project Kick-Off & Planning Workshop) and its function was extended to include the identification of relevant stakeholders and business processes that would be supported by data. As a result, it was renamed to Organization & Process Workshop.

The Pre-Workshop was reclassified to be a homework activity instead. These describe activities that are conducted by the customer company or the external team of consultants outside of the scope of the workshops. While most homework activities are done by either the consulting firm or the team of consultants individually, the Data Preparation homework has a special role: Since the customer company is likely lacking the required internal data-related capabilities, especially during the pilot project, they are supported in this activity by the consultants. However, in later iterations, after some departments are already transformed using the approach (i.e., once the DEC has developed their data-related capabilities and expertise), this activity may be conducted without support of consultants.

The Data Workshop and the Technology Workshop have also been consolidated into the Data & Technology Workshop. This allows the consultants to present the capabilities of the

enterprise platform before collaboratively identifying use cases for process improvements using data analytics together with the experts of the customer company.

The OCM/Training Workshops, during which the employees are trained on using the new solutions, were moved before the Post-Workshop. This highlights the Post-Workshop's role of being a retrospective for the entire department project, where potential barriers and lessons learned from the workshops can be shared and addressed. Additionally, the Post-Workshop would now function as a feedback session for iteratively improving the developed solutions, as suggested by one of the expert interviewees. While this is the only feedback session within the context of a workshop, it is assumed that feedback on the improved solutions would still be communicated between the business users and the consultants and that smaller adjustments would still be made based on this feedback.

Additionally, three new roles were added to the side of the consultants: The Transformation Consultant, the Data Analytics Subject Matter Expert, and the Platform Architect.

The refined roles and their responsibilities can be seen in **Table 9**.

The inputs, outputs, goals, and participants of the workshops have been adjusted to reflect the structure of the refined approach. Despite the apprehension of one of the expert interviewees, that a six-month pilot project may seem too long for their customers, it was ultimately decided to stick to the estimated time frame of the initial design. The reason for this was that a shorter pilot project would not have been able to demonstrate all of the most relevant capabilities of a DDO and would therefore not achieve its goal of being a proof of value (PoV).

4.3 Elaboration of the Improved Approach

The ABDDO aims to engage and support all levels of the organizational hierarchy. The upper management is supported by KPI dashboards that show the most important high-level business metrics. These metrics are integrated with the KPI dashboards of the department leads (i.e., the middle management), which break down the high-level metrics into more detailed metrics that are relevant for the respective department. In some cases, these department-level KPIs are directly derived from a company's data, in other cases they are the result of data analytics performed by the employees of the department, who are provided access to and training for data analytics solutions as part of approach.

This is the outcome that customer companies are going to achieve by applying the ABDDO with the help of the consulting firm. In the following, the workshops and intermediary steps of the approach are going to be explained in detail. **Figure 10** gives an overview of the structure of the approach and the content of the workshops is summarized in **Table 10**. The involved roles and their respective responsibilities, for both the customer company and their team of consultants, are elaborated in **Table 9** and **Table 7**. **Figure 9** shows a process view of the ABDDO, which also includes activities of both the customer and the consulting firm that happen outside of the workshops.

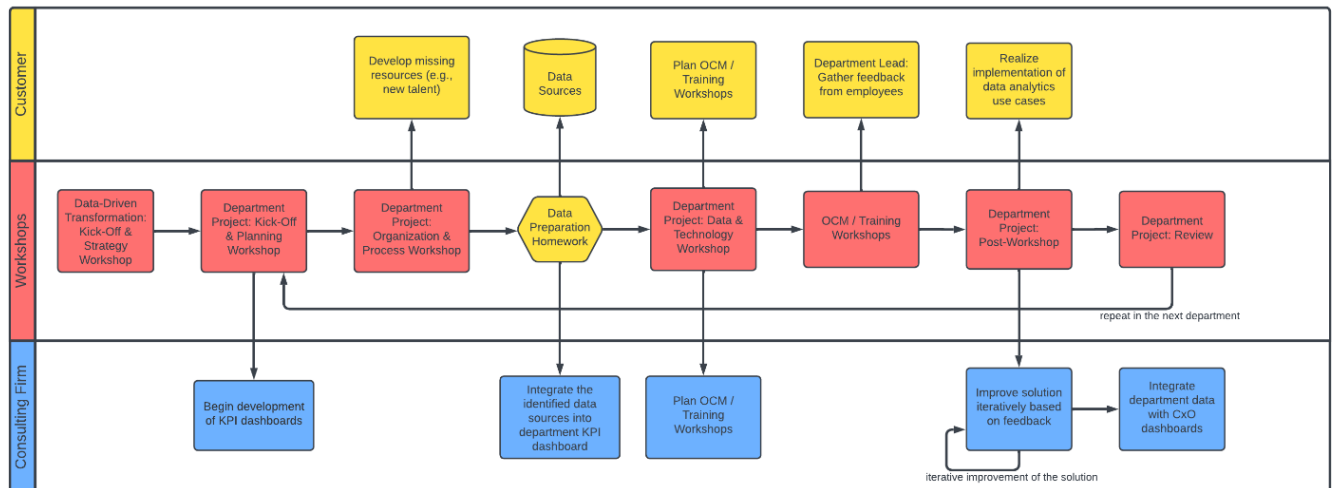


Figure 9. Process view of the ABDDO

4.3.1 Data-Driven Transformation: Kick-Off & Strategy Workshop

The approach begins with a kick-off between the executive committee, which consists of the C-level executives of the customer company, the Data Excellence Center Lead, the project manager of the team of consultants, and supporting business consultants.

In this workshop, the data-driven transformation is introduced to the executive committee, in order to ensure their buy-in and support. Afterwards, the Data Excellence Center (DEC) is officially established. As a preparation for the meeting, the executive committee has selected an expert from within the company, ideally someone from middle management with a technical background, to become the lead for the DEC. It is decided which resources and authorities the DEC is going to have, how they are going to follow and support the transition process, and how they are going to develop their own capabilities and expertise in the long term. Additionally, it is laid out how the team of consultants is going to support the DEC and communication lines are established.

Afterwards, the department for the pilot project is decided. Ideally, the executive committee has already scouted a department which fulfills the criteria of having an enthusiastic department lead, technical experts with a higher degree of data literacy (compared to the other departments), and well-maintained data sources. In practice, however, it is unlikely that a department which fulfills all these criteria is found. It is therefore up to the top-level executives to decide which department is the most suitable.

A high-level strategic vision for the data-driven transformation is defined, which should cover a short-term, mid-term, and long-term time frame. This allows for the involved parties to discuss and manage expectations and create a framework by which to measure the progress and success of the transformation. In case the executive committee is still skeptical about the transformation and wants to wait for the results of the pilot project before committing further, this step can be delayed until the Department Project: Review.

In the second part of the workshop, the capabilities of the enterprise platform are presented to the executive committee, with emphasis on the high-level KPI dashboards. This is followed by a discussion to identify the most relevant KPIs that would need to be further broken down into department-level KPIs for the pilot project. By determining the relevant KPIs at the highest level, it is ensured that the outcomes of the department projects are aligned with the highest-level business needs of the customer company.

4.3.2 Department Project: Kick-Off & Planning Workshop

This is the first workshop as part of the department project (or pilot project if it is the first department). It is used to break the ice and familiarize all participants with each other, as they are going to work together closely over the upcoming months. The general conditions of the project, such as its overall direction, the involved parties, and available resources, are discussed, a roadmap is developed, and the upcoming workshops are scheduled. For each workshop, the requirements and potential homework, i.e., tasks that the customer company needs to prepare, are defined and clearly communicated.

Another important aspect of the Kick-Off & Planning Workshop is the discussion of the high-level KPIs that were identified by the executive committee in the previous workshop. They are further broken down into the relevant department-level KPIs with the help of the department lead and the domain matter experts.

As homework, the consulting firm starts to develop the department KPI dashboard using the identified department-level KPIs.

4.3.3 Department Project: Organization & Process Workshop

In this workshop, the relevant stakeholders (inside and outside of the department) as well as the most important business processes, which are going to be supported by data, are identified and mapped. Based on an as-is and a to-be analysis of the current and future processes, a gap analysis is conducted to determine missing resources. Especially missing talent and skills are important to identify early, as they can be the most difficult to acquire. This is why, ideally, an HR specialist should attend the meeting as well. In the short-term, however, data experts from the DEC and the technical experts from the team of consultants should be able to bridge the gap in expertise and allow the department project to resume without any problems.

Another important aspect of the Organization & Process Workshop is the development of a communication plan which the customer company can follow to structure their transformation-related communication efforts towards their employees. Apart from management buy-in, it is crucial to ensure support from the employees as well, as they are required to change their familiar ways of working, which will likely result in some resistance. One of the most important aspects of ensuring employee support is to clearly and

repeatedly communicate the benefits of the data-driven transformation, which a well-thought-out communication plan should make sure of.

As a homework for the customer company, the missing resources that were identified in the gap analysis should be developed. However, it should be noted that this is a long-term goal that can likely not be realized immediately. The hiring of new talent with expertise in data-related subjects should be coordinated between the HR department and the DEC.

The consulting firm on the other hand prepares the data analytics workspaces for the employees of the customer company based on the identified processes.

4.3.4 Department Project: Data Preparation (Homework for the Data Workshop)

The Data Preparation refers to an extensive homework activity for the customer company, during which all relevant data sources for the department project are identified and prepared. Additionally, some initial data exploration is conducted to better prepare the technical matter experts for the upcoming workshops and ensure a smooth Data & Technology Workshop.

Additionally, the data sources that are going to be used for the department KPI dashboard are identified and made available to the consulting firm.

This homework is different to the other homework activities because it requires a close collaboration between the customer company and the team of consultants, at least in the first few iterations (i.e., in the first few department projects). It could therefore be seen as a mini-workshop. This is because early into the data-driven transformation, especially during the pilot project, the customer company lacks the data-related capabilities and expertise to conduct this homework on their own. Of course, this is where the external team of consultants needs to support them. However, the task should not simply be outsourced to the consultants, because in the long term, the goal should be that the department's technical matter experts with support from the data experts of the DEC are capable of this task without the support of the external consultants. Once this is the case, it serves as proof that the DEC and the customer company were able to develop the required data-related capabilities themselves, which means that they are likely able to sustain the data-driven transformation once the team of consultants is done with the project.

Afterwards, as a homework, the consulting firm can integrate the identified data sources with the department KPI dashboard.

4.3.5 Department Project: Data & Technology Workshop

In the Data & Technology Workshop, the enterprise platform capabilities that are relevant to the department project, i.e., the KPI dashboard and the data analytics workspace, are presented to the department lead and the domain and technical matter experts. The

department lead gives feedback on the KPI dashboard, so that it can be improved iteratively. Afterwards, opportunities and use cases for the application of data analytics to improve the identified processes are identified. This step is supported by a demo of the data analytics workspaces, so that the department lead and his team of experts have a clear picture of what is possible. Especially during the pilot project, the focus should be on creating quick wins and on demonstrating the capabilities of the platform and the value that can be generated for the business. Once the customer develops their own data-related capabilities and expertise in later department projects, more sophisticated use cases for data analytics can be considered.

As a homework, the team of consultants improves the KPI dashboard based on the feedback of the department lead.

Additionally, the customer company and the consultants together plan and schedule the upcoming OCM/Training Workshops for the employees of the department.

4.3.6 Department Project: OCM/Training Workshops

The OCM/Training Workshops are a series of workshops intended to teach the employees of the department the proper use of the data analytics workspaces, as well as the basics of data-driven reporting. The number of workshops would depend on the scope of the data analytics use cases and potentially the number of involved employees, but in most cases, one workshop for data analytics and one workshop for reporting should suffice.

The communication in these workshops should follow the previously established communication plan, as it is important to get the employees on board and ideally get them excited for the new opportunities to improve their process workflows.

Since this is the first time the employees are going to interact with the enterprise platform workspaces, it is important for the consultants to gather feedback on the implementation, during the workshop and afterwards. This feedback should then be used to iteratively improve on the solutions until they reach an optimal version that best serves the needs of the business users.

4.3.7 Department Project: Post-Workshop

The Post-Workshop wraps up the department project. It is used to reflect on the previous workshops, to identify and address potential barriers, and to record lessons learned so that future iterations in other departments will proceed more smoothly.

Furthermore, this workshop is used as a feedback session for the iterative improvement of enterprise platform solutions. While the team of consultants should always be receptive for feedback from the customer company and its end users, setting aside time in a dedicated workshop allows for in-depth discussions about potential changes that could further increase the value of the provided solutions. The Post-Workshop presents the perfect opportunity to do so, because it will be scheduled some time after the OCM/Training

Workshops, so that the department will have had some time to work with the solutions in their day-to-day workflows.

As a homework, the team of consultants further improves the provided solutions based on the feedback that was discussed during the Post-Workshop.

Additionally, they implement the KPI dashboards for the executive committee, using the data from the department project.

4.3.8 Department Project: Review

In the Review, the outcomes of the department project are presented to the executive committee. Lessons learned are reflected upon and it is discussed how the identified barriers could be addressed in future iterations, i.e., in the other departments. Additionally, the outcomes of the department project are evaluated with regards to their alignment with the strategic vision and high-level roadmap, which were created as part of the Kick-Off & Strategy Workshop, and both may be revised. Then, the next department which should undergo the data-driven transformation is decided.

In the second part of the Review, the team of consultants presents the high-level KPI dashboards, which utilize the data from department project, to the executive committee and gather their feedback, so that the dashboards can be further improved.

After the Review, another department project cycle begins with the Kick-Off & Planning Workshop in the chosen department.

It is estimated that each department project would take about six months, however, this time frame may change substantially depending on the organizational context, the company/department size, and the scope and quality of their data sources.

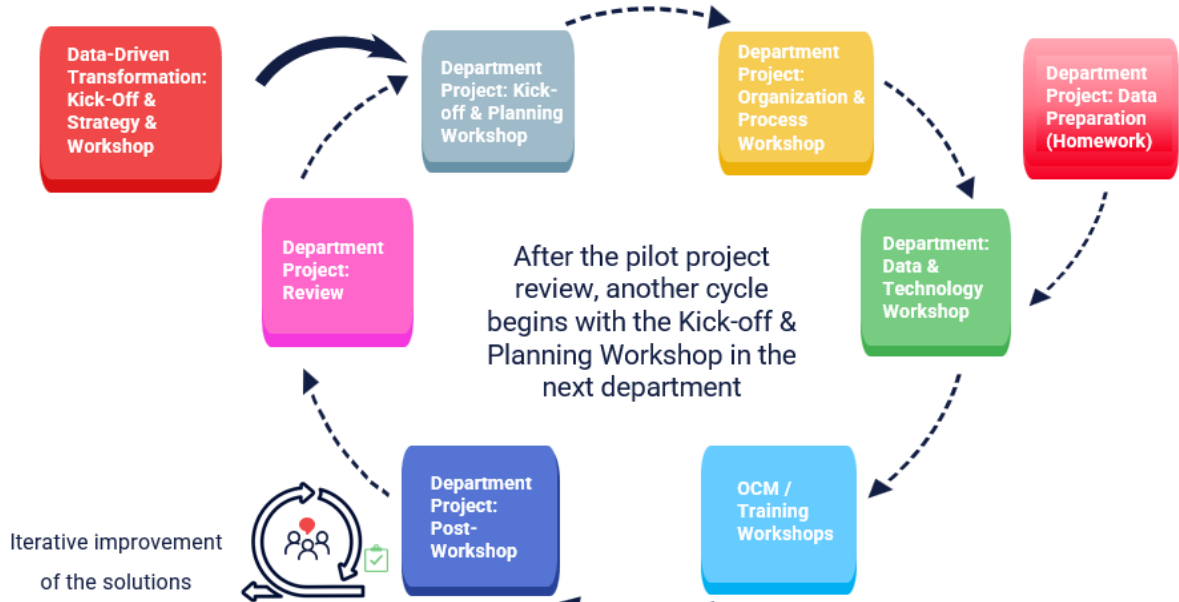


Figure 10. Design of the improved approach

Consultants *	Responsibilities
Project Manager	<ul style="list-style-type: none"> Responsible for the management of the overall project, including scope and deadlines, as well as coordinating with Data Excellence Center
Business Consultant	<ul style="list-style-type: none"> Responsible for guiding workshops and assisting customers in business related matters
Technical Consultant	<ul style="list-style-type: none"> Responsible for assisting the customers in technical matters
Transformation Consultant	<ul style="list-style-type: none"> Responsible for developing communication plan, creating training materials and supporting the OCM training workshops
Data and Analytics Subject Matter Expert (SME)	<ul style="list-style-type: none"> Responsible for defining KPIs & metrics, building and supporting creation of dashboards and workspaces
Platform Architect	<ul style="list-style-type: none"> Responsible for designing and implementing the enterprise platform solutions

Table 9. Refined Role & Responsibility of the team of consultants

* Roles may be further specified based on existing roles

Data-Driven Transformation: Kick-Off & Strategy Workshop	
Goal	<ul style="list-style-type: none"> Introduce the data-driven transformation process to C-level management, create sense of urgency, ensure buy-in Establish Data Excellence Center (DEC) and provide them with resources <ul style="list-style-type: none"> Determine how consultants support the DEC Determine department project & scope Define the vision and strategy for the data-driven transformation and create a high-level roadmap on different timescales: short-term (<1 year), mid-term (1-3 years), and long-term (3-5+ years) Determine how the C-level executives can be supported by the enterprise platform capabilities <ul style="list-style-type: none"> Determine KPIs for department project
Inputs	CxO dashboards demo
Outputs	<ul style="list-style-type: none"> Data Excellence Center structure & resources Project department and scope Defined strategy and vision along short-, mid-, and long-term (high-level) roadmap Top-level KPIs relating to project department
Involved roles	<ul style="list-style-type: none"> Customer <ul style="list-style-type: none"> Executive committee Data Excellence Center Lead Consultants <ul style="list-style-type: none"> Project manager Business consultants

Department Project: Kick-off & Planning Workshop	(Repeated for other departments at later point) Homework for consultants: Start with the development of the department KPI dashboard
Goal	<ul style="list-style-type: none"> • Introduce the data-driven transformation and the department project • Discuss overall direction of the department project, available resources, etc. • Determine KPIs for project department (aligned with top-level KPIs) • Create a roadmap for the department project and schedule the upcoming workshops
Inputs	<ul style="list-style-type: none"> • Strategy & Vision • Top-level KPIs
Outputs	<ul style="list-style-type: none"> • Project department KPIs • Department project roadmap and workshop schedule
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data Excellence Center Lead ○ Data experts (DEC) ○ Department Lead ○ Domain matter experts ○ Technical matter experts • Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants ○ Technical consultants ○ Transformation consultants ○ Data and Analytics Subject Matter Experts (SME) ○ Platform architects
Department Project: Organization & Process Workshop	Homework for customer: Develop the identified missing resources (this is a long-term goal and can likely not be realized immediately). Coordinate the introduction of new talent between HR and the DEC.
Goal	<ul style="list-style-type: none"> • Identify stakeholders • Identify relevant business processes (which are going to be supported by data) • Conduct as-is, to-be, and gap analyses to determine missing resources <ul style="list-style-type: none"> ○ Especially talent & skills • Create communication plan (for getting employees on-board)
Inputs	Department project roadmap
Outputs	<ul style="list-style-type: none"> • Stakeholder map • Business process maps • Gap analysis (missing resources and capabilities, such as talent) • Communication plan
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data experts (DEC) ○ Department Lead ○ Domain matter experts ○ (HR specialist) • Consultants <ul style="list-style-type: none"> ○ Business consultants ○ Transformation consultants
Department Project: Data Preparation (Homework for the Data & Technology Workshop)	Homework for consultants: Integrate the identified data sources in the department KPI dashboard
Goal	<ul style="list-style-type: none"> • Identify data sources and prepare data for data exploration in the upcoming workshops

	<ul style="list-style-type: none"> Do some preliminary data exploration
Inputs	Top-level KPIs and project department KPIs
Outputs	<ul style="list-style-type: none"> List of data sources (prepared for data exploration in the Data & Technology workshop) <ul style="list-style-type: none"> Consultants can prepare the department lead/KPI dashboard (for the department lead) and the enterprise platform workspaces for the employees based on the identified data sources (homework) <ul style="list-style-type: none"> Result: Realized KPIs in Department Lead dashboard using the data sources)
Involved roles	<ul style="list-style-type: none"> Customer <ul style="list-style-type: none"> Data experts (DEC) Technical matter experts Consultants <ul style="list-style-type: none"> Technical consultants Data and Analytics Subject Matter Experts (SME)
Department Project: Data & Technology Workshop	Homework for consultants & customer: Plan OCM and training efforts for employees (data analytics and data-driven reporting)
Goal	<ul style="list-style-type: none"> Present the capabilities of the enterprise platform <ul style="list-style-type: none"> Including Department Lead dashboard for the department lead and data analytics capabilities Gather feedback from the Department Lead on how to improve the dashboard Identify opportunities and use cases for data analytics <ul style="list-style-type: none"> Focus on quick wins, especially during the department project Determine how the enterprise platform capabilities can support the data analytics use cases
Inputs	<ul style="list-style-type: none"> List of data sources (prepared for data exploration) Department lead/KPI dashboard (displaying previously identified KPIs) Data analytics demo
Outputs	<ul style="list-style-type: none"> Feedback for improvement of the KPI/Department Lead dashboard (iterative approach) Data analytics use cases <ul style="list-style-type: none"> Consultants can prepare the data analytics workspaces for the employees based on the identified use cases (homework)
Involved roles	<ul style="list-style-type: none"> Customer <ul style="list-style-type: none"> Data experts (DEC) Department Lead Domain matter experts Technical matter experts Consultants <ul style="list-style-type: none"> Business consultants Technical consultants Data and Analytics Subject Matter Experts (SME) Platform architects
OCM / Training Workshops	Homework for Department Lead: Gather feedback on the solutions from the business users
Goal	<ul style="list-style-type: none"> Teach business users how to properly use the enterprise platform and capabilities (especially data analytics, based on the identified data analytics use cases) Teach business users how to use data in reporting
Inputs	<ul style="list-style-type: none"> Communication plan OCM & training plan

	<ul style="list-style-type: none"> • Data analytics use cases
Outputs	None
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Business users • Consultants <ul style="list-style-type: none"> ○ Business consultants ○ Transformation consultants
Department Project: Post-Workshop	<p>Homework for consultants: Improve the solutions based on the feedback. Additional iterative improvement cycles are possible outside of the workshops if they are required (in this case, they should be coordinated by the department lead, the DEC, and the team of consultants).</p> <p>Homework for customer (supported by consultants): Realize the implementation of identified use cases.</p> <p>Homework for consultants (in the background throughout the department project): Create CxO dashboards based on the data from the project department</p>
Goal	<ul style="list-style-type: none"> • Identify and address any potential barriers, record lessons learned • Gather feedback on the solutions (department lead/KPI dashboard, data analytics workspaces) to iteratively improve them • Wrap-up and reflect on previous workshops
Inputs	Outputs from all previous workshops
Outputs	Lessons learned
Involved roles	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Data Excellence Center Lead ○ Data experts (DEC) ○ Department Lead (for the project department) ○ Domain matter experts ○ Technical matter experts • Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants ○ Technical consultants ○ Transformation consultant ○ Data and Analytics Subject Matter Expert (SME) ○ Platform architect
Department Project: Review	When the pilot project is completed *
Goal	<ul style="list-style-type: none"> • Wrap up and review the department project with the executive committee • Reflect on lessons learned <ul style="list-style-type: none"> ○ Identify and address any potential barriers in the upcoming implementation cycles • Reflect on alignment with strategic vision • Revise high-level roadmap based on results of the department project • Present the CxO dashboard to the executive committee and gather their feedback
Inputs	Documents from the department project
Outputs	<ul style="list-style-type: none"> • Lessons learned • High-level roadmap (revised)

Involved roles	
	<ul style="list-style-type: none"> • Customer <ul style="list-style-type: none"> ○ Executive committee ○ Data Excellence Center Lead ○ Department Lead • Consultants <ul style="list-style-type: none"> ○ Project manager ○ Business consultants

Table 10. Structure and content of the individual workshops

**Then repeat from department Project: Kick-off & Planning Workshop for the next department*

5 Validation of the Approach

In this chapter, the refined version of the ABDDO is validated using a survey questionnaire.

5.1 Validation Survey Questionnaire

The validation survey questionnaire was designed based on the widely used Technology Acceptance Model (TAM) [10], using a paper by Turner et al. (2008) as a starting point [24].

Initially, two of the most widely accepted models that predict a person's attitudes towards a new technology were considered: TAM and the Unified Theory of Acceptance and Use of Technology (UTAUT) [25]. Of these, TAM was considered to be the more relevant framework for the validation of this research, because UTAUT involved multiple constructs which were not applicable to the problem context. For example, Social Influences and Voluntariness of Use are not relevant because the users of the ABDDO are not individuals but a team of experienced business consultants, who will apply the approach to help their customers in their consulting practice and who cannot freely choose which approach to use for their job. Another advantage of TAM was the availability of an established questionnaire which could be used as a starting point for developing the validation survey questionnaire [24].

According to the original TAM, the Usage of a technology (such as an approach), i.e., whether a person actually ends up using a new technology, is primarily predicted by the Behavioral Intention to Use, i.e., whether the person intends to use the new technology. The Behavioral Intention to Use is influenced by both the Attitude Toward Use, i.e., how the person feels about using the new technology, and the Perceived Usefulness, i.e., whether the person believes the new technology to be of practical use to them. The Attitude Toward Use is also influenced by the Perceived Usefulness, as well as the Perceived Ease of Use, i.e., how easily the technology is understood by the person and how much training or effort they think is required to learn how to use it. Both the Perceived Usefulness and the Perceived Ease of Use are influenced by external variables (which are not further specified in the original TAM). Additionally, the Perceived Ease of Use of a technology influences its Perceived Usefulness.

Figure 11 shows the original TAM [9].

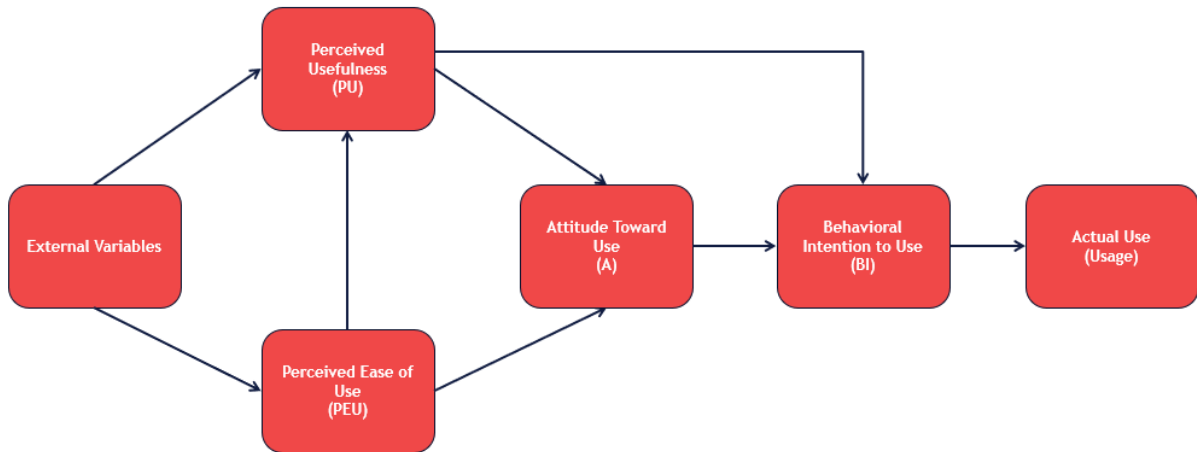


Figure 11. Original TAM based on [9]

Later iterations of TAM, such as TAM2 and TAM3, expanded on the external variables but simplified the original model to only include the Perceived Ease of Use, the Perceived Usefulness, and the Behavioral Intention to Use, cutting the intermediary variable Attitude Toward Use [10]. This simplified version of TAM (without the external variables) was later used by Turner et al. (2008) to develop the Basic TAM Questionnaire [24]. This questionnaire was used as a starting point to develop the validation survey questionnaire with which the result of this research, the ABDDO, was validated.

Figure 12 shows the simplified version of TAM [10].

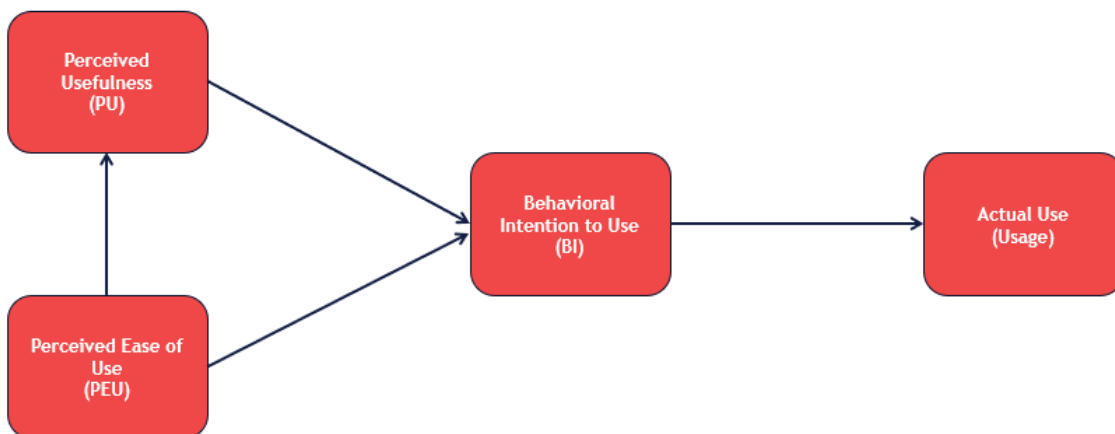


Figure 12. Simplified version of TAM based on [10]

Like the Basic TAM Questionnaire, the validation survey questionnaire uses the three TAM constructs Perceived Usefulness, Perceived Ease of Use, and Behavioral Intention to Use.

Each questionnaire item is a statement that is answered using a 5-point Likert-scale ranging from "strongly disagree" (1) to "strongly agree" (5), with a '3' referring to neutral sentiment. The questionnaire consists of 13 items in total, with six items for the construct Perceived Usefulness, four items for Perceived Ease of Use, and three items for Behavioral Intention to Use. The respondents were also given the opportunity to share any additional remarks they had at the end.

The questionnaire items were designed based on the requirements identified in the goal trees (see 3 Design of the Approach), which were assigned to the appropriate TAM constructs.

The items in Perceived Usefulness correspond to the requirements that were identified for becoming a DDO because helping the customers of the consultancy to become data-driven is the primary objective of the approach (PU2, PU3, PU4, and PU5). Additionally, two items were included that would assess the experts' opinion on whether the two high-level goals, i.e., the customer becoming a DDO and the suitability of the approach to be turned into a service offering, were achieved (PU1 and PU6).

Perceived Ease of Use includes items that concern the usability of the approach from the perspective of the team of consultants (PEU3 and PEU4). Two additional items were included to assess the comprehensibility of the approach (PEU1 and PEU2).

The first item in Behavioral Intention to Use addresses the consultancy's intention to translate the approach into a service offering (BI1). The remaining two items concern whether the approach will increase customer buy-in and enthusiasm for becoming a DDO (BI2 and BI3).

The validation survey questionnaire (in Google Forms) was sent to the two experts that were consulted for the approach refinement. They were suitable respondents to answer the questionnaire due to their experience in data advisory, business consulting, and developing customer-facing approaches for business transformations. They were also already familiar with the approach from the detailed presentation they had received during the previous interviews, meaning they understood the topic and the ABDDO well and would be able to give informed feedback. In addition to the questionnaire, the experts received updated slides from the previous presentation highlighting the changes made during the approach refinement.

5.2 Results

Table 11 shows the questionnaire items as well as the Likert-scores given to each item by the two experts and **Table 12** shows the experts' additional remarks.

Construct	Code	Survey Item	Expert 1	Expert 2	Average	Average per Construct
Perceived Usefulness	PU1	By following the approach, P4M can help their customers to become data-driven.	4	4	4.0	

	PU2	The approach engages and supports all levels of the organizational hierarchy (top management, middle management, and employees) in becoming data-driven.	4	5	4.5	4.5
	PU3	Customers who implement the approach with the help of P4M are likely going to see improvements with regards to their decision-making capabilities.	5	5	5.0	
	PU4	Customers who implement the approach with the help of P4M are likely going to see improvements with regards to their data-related capabilities.	5	4	4.5	
	PU5	Customers who implement the approach with the help of P4M are more likely going to establish a data-driven organizational culture in the long term.	5	4	4.5	
	PU6	The approach is suitable to be turned into a service offering by P4M.	4	5	4.5	
Perceived Ease of Use	PEU1	The structure of the approach is clear and easy to follow.	4	5	4.5	
	PEU2	The language and terminology that is used to describe the approach is clear and understandable.	4	5	4.5	
	PEU3	The team of P4M is likely going to view the approach as actionable and practicable.	4	5	4.5	
	PEU4	P4M has the resources and expertise to apply the approach in the context of a service offering for their customers.	5	5	5.0	
Behavioral Intention to Use	BI1	P4M is likely going to translate the approach into a service offering for their customers.	5	5	5.0	4.33
	BI2	The approach is likely going to increase customer buy-in and their intention to become data-driven.	4	4	4.0	
	BI3	Customers of P4M who want to become data-driven are likely going to be enthusiastic about utilizing the approach.	4	4	4.0	

Table 11. Results of the validation survey questionnaire

	Do you have any additional remarks? (Open question)
Expert 1	Thanks for your hard work and dedication.
Expert 2	The approach is in line with the expectation and will be used to draft an actual service offering. In order to make it fully useful for a service offering, some additional effort will be put in to make the slides more customer facing and useable in a proposal. Other than that, the approach is something that will be adopted as the approach that we will pitch to our customers.

Table 12. Additional remarks from experts

As **Table 11** shows, the feedback from the two experts was very positive. Since every item (and therefore, every construct) was answered with at least a '4', indicating the experts' agreement, it can be said that the ABDDO achieved its goals.

Perceived Usefulness and Perceived Ease of Use were both rated very highly with an average of 4.5 and 4.625 respectively, while Behavioral Intention to Use was rated slightly lower with an average of 4.33. The lower score was the result of both experts giving a comparatively lower score of '4' for both items that regarded their expectations for their customers' perspective on the approach (BI2 and BI3). This is in line with the additional remarks of one of the experts, who said that some additional work would have to be put into creating a pitch deck that would appear appealing to their customers. However, both experts strongly agreed when asked about whether the approach would be translated into a service offering (BI1), with one expert confirming this in the additional remarks, saying that the approach was "in line with the expectations".

The first item of the construct Perceived Usefulness, which addressed whether following the approach would allow customers to become data-driven (PU1), was rated comparatively low. This result is aligned with fact that becoming a DDO is a long-term endeavor that requires sustained efforts. However, the results of the validation survey questionnaire indicate that following the ABDDO can build the foundations for becoming data-driven. Both experts strongly agreed that following the approach would result in improved decision-making capabilities at their customers (PU3). This assessment can likely be attributed to the components of the approach that directly support business decision-making, i.e., the KPI dashboards for upper and middle management.

The last item of the construct Perceived Ease of Use also received strong agreement from both experts (indicated by a '5'), indicating that the approach would be usable given the current expertise and resources at their consultancy, which was a requirement for it being suitable to be translated into a service offering. It was assumed that the case company, Plat4mation, would be representative of consulting firms in general. Since the approach did not consider any capabilities specific to Plat4mation, it can be assumed that it can be implemented at other consulting firms (with competence in enterprise platforms) as well. All remaining items received an average rating of 4.5, indicating that one expert agreed ('4') and the other expert strongly agreed ('5') to the statements. Therefore, it can be concluded that the requirements were satisfied, and the approach achieves the goals of both consultancies and their customers. This means that the approach achieves the research goal of being suitable to be translated into a service offering with which consultancies can help their customers to become data-driven.

6 Discussion & Conclusion

In this chapter, the contribution this thesis makes to science and to practice are reviewed and a conclusion is reached by answering the main research question as well as the sub-research questions. Additionally, limitations as well as potential directions for future research are discussed.

6.1 Contribution to Science

The existing scientific literature regarding the topic of becoming a DDO covers various different methodologies, frameworks, process- and maturity models. However, most papers fall into one of two categories: Some authors focus on a specific aspect of becoming data-driven, such as establishing a data analytics pipeline or implementing a KPI dashboard application, while disregarding the greater organizational context and the cultural changes that are required to create sustainable change towards a data-driven way of working. While many papers exist that discuss the challenges, barriers and enablers to becoming data-driven in-depth, few prescriptive models consider these fully. The other category of papers considers the data-driven transformation holistically, but does not offer actionable insights, and instead only high-level recommendations. This research aims to address this gap by synthesizing insights from the existing literature, thereby providing a holistic approach that engages all levels of the organizational hierarchy, utilizes technical data analysis and visualization tools, and facilitates the establishing of a data-driven organizational culture, while still being actionable and practicable.

Another aspect that is not reflected in any of the reviewed papers and therefore represents a novel contribution is the focus on consulting firms. How consulting firms can support their clients is a topic that appears to be underrepresented in the scientific literature in general. This research aims to contribute to the literature by providing a framework within which consultants can collaborate with their clients in a workshop setting.

6.2 Contribution to Practice

This research was conducted in close collaboration with expert practitioners of the case company. Previously, no standardized approach existed based on which consulting firms could support their customers on a data-driven transformation. The ABDDO was designed such that it can be followed step-by-step and immediately be put into practice, by relying on standard consulting practices, typical business roles, and by using technical tools that are part of most enterprise platforms or business tooling packages.

The value of the approach for the case company (and therefore hopefully for other consulting firms as well) was demonstrated by validation using expert opinion, and the feedback was generally very encouraging.

6.3 Answering the research questions

This research set out to answer the following main research question:

What is a suitable approach that consulting firms can apply to help their customers become data-driven and thereby improve business decision-making?

The ABDDO is a suitable approach with which consulting firms can help their customers become data-driven and improve business decision-making. This conclusion was reached after validating the approach against the identified requirements using the opinions of expert practitioners of the case company.

To arrive at this result, several sub-research questions were addressed, which are going to be discussed in the following.

SQ1: Which models and frameworks exist in the literature that companies can utilize to become data-driven?

Six models and frameworks relating to the topic of becoming data-driven were identified in the SLR, five of which can be categorized as roadmap approaches. Of these five roadmap approaches, two also qualify as capability or maturity models. Three of the roadmap approaches prescribe a series of steps or phases that an organization should go through in order to become data-driven. The number of steps or phases differs slightly between the papers, with two proposing four steps, and one proposing three steps. One of the three papers considers its four steps to be just one part of a greater process improvement methodology, while the other two are standalone approaches. The focuses of the papers differ somewhat, with one paper being focused on business processes, one on developing data-related capabilities, and one on the organizational transformation at a higher level, which is more closely related to the two capability models.

The paper by Kayabay et al. (2022) [15] differs from the other roadmap approaches, as it does not prescribe a fixed roadmap but instead describes a methodology with which organizations can create their own "data science roadmap". It is the most comprehensive approach, which is based on a series of workshops facilitated by external consultants and was used as the basis for the ABDDO. However, it is not very actionable, as its only output is a roadmap for developing data-related capabilities.

The last paper is not prescriptive, but instead offers a taxonomy based on which DDOs can be categorized, thereby providing an overview of the different design dimensions and considerations that are relevant when making the transition to becoming a DDO.

SQ2: *What are challenges, barriers, and enablers to becoming a data-driven company?*

Numerous challenges, barriers, and enablers to becoming a DDO could be identified in the literature, with one paper describing as many as 31 different barriers. However, most challenges, barriers, and enablers could be grouped into one of the following categories:

The most often described category is **data**, which includes challenges such as data quality, accessibility, and security, followed by the category **organization**, with the biggest challenge being the establishing of a data-driven culture. **Tools and Technology** is another often-discussed category, with the biggest challenge being the integration of tooling. **Management** (sometimes referred to as strategy or process) was the next most often mentioned category, with challenges such as the alignment of data and business strategy and making insights available to decision-makers. The last category is **people** (although some papers would consider these challenges as part of organization). The biggest challenges in this category are the acquisition of new talent and the coordination of internal data capabilities and expertise.

SQ3: *Which tools can companies use to support their data-driven decision-making?*

The technical tools that are discussed in the literature for supporting data-driven decision-making can be broadly categorized into three categories.

Tools involved in the **data pipeline** include technical infrastructure tools, such as database and data warehousing applications, as well as applications used for data mining and data processing. They are the foundation of any DDO, as they allow the companies to collect and process large amounts of relevant business data. **Quantitative analysis tools** are then used to turn this data into insights, using data analytics and machine learning approaches. Lastly, **visualization tools** such as dashboard applications allow decision-makers to view KPIs and complex business data at one glance, supporting their decision-making processes.

SQ4: *What requirements should the approach meet so that it satisfies the stakeholder goals?*

The ABDDO addresses the goals of two groups of stakeholders: The consulting firm and their clients. The clients' goal is to become a DDO. Five requirements for the approach were identified from the literature and in discussion with experts of the case company:

The approach should improve data-related capabilities at the client, improve their business decision-making, engage all levels of the organizational hierarchy, facilitate establishing a data-driven culture, and create sustainable change. By meeting all of the requirements, the approach would ensure that clients achieve their goal of becoming data-driven.

While the consulting firm shares the goal of their clients, they have an additional goal of translating the approach into a service offering. Four requirements were identified that the approach would have to meet in order to make it usable as a service offering for consulting firms: The approach should be facilitated by external consultants, it should be practicable and actionable (i.e., have immediate impact and generate immediate results), it should be

usable given the expertise and resources of a typical consulting firm, and it should ensure customer buy-in (i.e., the buy-in of decision-makers at the client companies).

SQ5: What design components should the approach implement so that it meets the requirements?

Several design components were identified in the literature and subsequently validated in discussions with the experts of the case company.

The approach should implement a number of data-related capabilities that support business decision-making, most notably a data warehouse, data analytics tools, data-driven reporting tools, and KPI dashboards for top- and middle management. These capabilities could be provided by an enterprise platform.

Furthermore, the approach should have a workshop-based structure that is facilitated by external consultants, and which uses typical consulting roles and responsibilities. The workshops should be based on the DOTS themes (data, organization, technology, and strategy) to cover the most important aspects of a data-driven transformation. Additionally, OCM and training workshops should be organized for the employees to train them in the use of the data-driven tools.

Lastly, the approach should begin with a pilot project in a single department, which would function as a proof of value for decision-makers.

6.4 Limitations

Several assumptions were made in this research which may limit its applicability to other contexts.

Firstly, it assumes that the case company, Plat4mation, is representative of consulting firms at large. This assumption underlies the validation of the requirement that the approach should be usable given the expertise and resources present at a typical consulting firm (with competence in enterprise platforms). However, it was not further defined what a typical consulting firm is and what expertise and resources could be expected. While the approach was not designed with any specific characteristics of the case company in mind, it could potentially be the case that they possess unique expertise and resources that allow them to implement the approach.

Secondly, the ABDDO assumes the use of an enterprise platform to realize the data-related capabilities. However, the use of an enterprise platform is not a strict requirement. A company that wants to implement the ABDDO without relying on an enterprise platform could find other solutions that provide the required capabilities, i.e., data warehousing, data analytics, and KPI dashboards. The advantage of using an enterprise platform is that these capabilities are already integrated into one solution, so if a company were to rely on third party software or on their own in-house solutions, they may encounter difficulties with data

and tooling integration. On the other hand, using an in-house solution would make them less dependent on a single vendor and offer greater flexibility with regards to tool functionality.

Thirdly, it is assumed that a company which implements the ABDDO is supported by external experts, i.e., consultants. This is the most fundamental assumption, because the approach is focused on the perspective of consulting firms. However, this assumption excludes a large part of the potential audience for this research, because not every company has the resources to work with external consultants. In theory, it should be possible for a company to follow the approach on their own, as long as they possess the required expertise to fill the proposed roles and responsibilities for each workshop. However, since the approach is targeted at companies which currently do not possess data capabilities, it is doubtful whether these companies would be up to the task, as their in-house expertise is likely limited. It is therefore highly advisable to work together with external experts.

Lastly, the ABDDO was only validated using expert opinion of two expert practitioners of the case company. This is a methodological limitation, as the usefulness of the approach has yet to be proven in practice, for example in a case study.

6.5 Future research

Due to the time limitations that this research was subject to, it was decided to only follow the design cycle as proposed by Wieringa (2014) [27] and exclude the treatment implementation that is part of the engineering cycle. As a result, the ABDDO still needs to be evaluated in practice. Future research could therefore closely follow an actual implementation of the approach in a consulting firm, evaluate the results it achieved for their client, and further refine the approach based on an implementation evaluation.

With regards to the scientific research of data-driven organizations in general, an interesting and relevant topic could be the investigation of large language models (LLMs) in data-driven decision-making. Since the rapid developments in LLMs is a relatively recent phenomenon, it was not explicitly discussed in any of the papers that were reviewed in the SLR. However, it can be assumed that LLMs such as ChatGPT are going to play an increasingly important role in the decision-making processes of businesses in the coming years and the scientific research should reflect this trend. An important aspect of this research could be how the quality of information from LLMs can be validated, so that the output of these tools can be trusted.

Another opportunity for future research could be the investigation of how organizations can quickly and sustainably adopt a data-driven culture. While many of the reviewed papers referred to this as one of the biggest challenges for companies on the journey to becoming data-driven, the recommendations for how a data-driven culture can be established are limited in detail and applicability. There appears to be an opportunity to combine insights from data-driven research with research results from organizational psychology to help organizations and their employees to adopt a data-driven mindset.

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Appendix

A. Overview of Selected Papers for SLR

Paper	Found	Methodology	Purpose of study
[15]	SLR	Design Science Research	Develop a novel roadmapping framework for helping business become data-driven
[8]	SLR	Case study	Manufacturer's journey to become data-driven
[14]	SLR	Roadmapping approach (customized)	Develop a novel roadmapping framework for helping business become data-driven
[6]	SLR	Semi-structured interviews	Identify the challenges and benefits when becoming a data-driven organization
[5]	SLR	Case studies, documents and interviews	13 organizations' journey to become data-driven
[7]	SLR	Case study	Case-study research for the relevant KPIs to support data-driven decision making
[18]	SLR	Consolidated methodology	Propose a process model for data-driven decision making
[22]	SLR	LR & authors' expertise	Identify the challenges related to becoming a data-driven organization
[4]	SLR	LR & expert interviews	Describe research in progress with how organizations adopt the strategy of becoming data-driven
[26]	SLR	Delphi study & interviews	Identify the challenges faced by managers when becoming a data-driven organization
[23]	SLR	Combination of methods from literature	Propose "Analytics Driven Business Process Improvement (ADBPI) Framework" for embedding analytics within business process
[1]	SLR	Case study	Describe a case study for implementation of a BI application
[13]	Snowballing	Expert interviews	Investigate work practices of data analysts
[11]	Snowballing	ISO/IEC 330xx standards	Develop the Data Drivenness Process Capability Determination Model (DDPCDM)
[21]	Snowballing	LR & Delphi method	Propose discover-innovate-predict-perform-sustain (DIPPS) model for sustainable business excellence
[12]	Snowballing	multi-case research	Propose a design framework for data-driven organization

Table 13. Overview of selected papers for this research

B. Expert Interview Questions

Introduction

1. Permission to record the meeting
2. The data will be anonymized and treated confidentially
3. Introduce the approach (PPT)

Questions

1. Could you shortly introduce yourself and your professional background?
2. From your experience, is this a problem that is faced by many companies?

- a. Is the problem presented in an understandable way?
 - b. Which aspects of the problem do you think are underrepresented in the presentation?
3. What are your thoughts on becoming a DDO to deal with the aforementioned problem(s)?
 - a. How do you think the customers of P4M will react to this proposal?
4. What are your thoughts on the establishment of a Data Excellence Center?
 - a. Which challenges could you foresee regarding the establishment of a Data Excellence Center?
5. How do you think the ServiceNow capabilities could be utilized to greater effect in the approach?
 - a. Are there any other ServiceNow capabilities that you think could be useful?
6. What would you add or change with regards to the roles and responsibilities as defined in the approach?
7. What are your thoughts on starting with a pilot project / PoV in a single department, and repeating this cycle for each of the other departments?
8. What are your thoughts on the sequence and content of the workshops?
 - a. What would you still add or change regarding the content of the workshops?
9. Which aspects would you like to see reflected in the high-level timeline?
 - a. Do you think the proposed timeline is realistic?
10. What do you think I should still change about my approach or is there anything else you believe is worth sharing with me at this point?

C. Full Goal & Requirements Tree

