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How to Structure a Company-wide Adoption of Big Data Analytics

by

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How to Structure a Company-wide Adoption of Big Data Analytics

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Abstract. Driven by increasing amounts of data and by emerging technologies to store and analyze them, companies adopt Big Data Analytics (BDA) to improve their innovativeness and decision-making. However, adopting BDA across the company in the sense of an insight-driven organization (IDO) is challenging, since it influences the entire company and requires an organizational change. Despite mature knowledge, approaches that provide concrete methods for structuring the company-wide adoption of BDA to fully exploit the benefits of BDA and to reduce the risk of its failure are still missing. Following action design research, we developed and evaluated a method for structuring the company-wide adoption of BDA in a concerted research effort at a German bank. Based on knowledge of BDA and the roadmapping approach, the method structures the adoption along the BDA capabilities. We illustrate how companies can define a target state, identify gaps, and derive a BDA roadmap.

Keywords: Big Data Analytics, Roadmapping, Action Design Research.

1 Introduction

Inspired by big players, such as Google and Amazon, companies increasingly adopt Big Data Analytics (BDA) as an approach to utilize big data and advanced analytics for delivering value, improving efficiency, and establishing competitive advantage [1], [2]. The rapid growth of data generated by social media like Facebook and Twitter, as well as emerging information technologies (IT) like the Internet of Things, advance this trend [2], [3]. Additionally, the market increasingly offers more mature and powerful tools to source, store, and analyze big data, which lay the foundation for adopting BDA. Considering its technological capabilities and the associated high expectations, it is not surprising that BDA is – meanwhile – considered as a game changer, due to its operational and strategic potential [1]. Thereby, adopting BDA across the whole company instead of only using it within individual projects is considered as more beneficial since companies that use BDA as a competitive differentiator, – defined as insight-driven organizations (IDOs), – tend to perform better in terms of financial and operational results [4], [5]. They are champions in implementing BDA and improving the speed and quality of action through data-driven decisions [4], [5].

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However, a company-wide adoption of BDA is challenging as it requires a long-term evolution [3], involves different stakeholder groups, impacts various levels of the enterprise architecture, and needs high investment amounts [6]. Due to this complexity, a structuring approach is important to coordinate the individual measures, taking into account the dependencies in terms of content and time. Prior research has already revealed factors that may be relevant for a structured adoption of BDA. For example, [7] address the need for a clear vision of what companies want to achieve and a roadmap to reach the target. [4] concretize that companies should define the business challenges, identify the organizational changes needed, and derive a roadmap. However, they do not show how companies can apply this procedure. Furthermore, prior studies recommend the development of BDA maturity or capability models that allow companies to assess their current state regarding the required capabilities [8]. However, they fail to illustrate how these models can be used for a coordinated company-wide adoption of BDA. Finally, [5], [9] advise companies to start with seed or lighthouse projects for a few use cases to gain initial experience with BDA, encourage collaboration, and create awareness. Thereby, they do not consider the long-term changes. Thus, despite addressing important issues, approaches that provide concrete methods for structuring the company-wide adoption of BDA are still missing. In order to contribute to this research gap, we study the following research question: *How can developing a roadmap assist in structuring the company-wide adoption of BDA?*

In order to answer this question, we adopt action design research (ADR) and develop a method that aims to assist companies in structuring a company-wide adoption of BDA. In line with ADR, we develop and evaluate our method in a concerted research effort at a German bank [10]. The paper is organized as follows: Section 2 contains a brief overview of the related research. After introducing our methodology in Section 3, we describe our method's design in Section 4 and evaluate it in Section 5. We conclude by discussing implications, limitations, and directions for future research in Section 6.

2 Background and Related Work

Since our research is motivated by a concrete problem in practice, we have first discussed their needs with the end-users to achieve an in-depth understanding of the problem, and then researched the literature for appropriate methods to solve it. Therefore, this section provides a brief overview of the work related to BDA as the main content of the project and to roadmapping as one possible concept to approach the solution of the problem. As already recommended by prior research (e.g. [4], [7]), we focus on roadmapping to structure the adoption of BDA since it allows to define a target state, to identify gaps, and to derive and prioritize measures to reach the target state.

2.1 Big Data Analytics (BDA)

Prior research states that developing appropriate BDA capabilities can help companies to successfully adopt BDA in order to become an IDO. Thereby, studies define different BDA capabilities. For example, [11] identify culture, data management, and skills as

the main dimensions of a BDA capability, whereas [1] define BDA infrastructure, personnel, and management capability as the key components. [8] identify thirty four generic capabilities, which they assign to eight capability fields (e.g. customer relationship management, strategy development, and transformation competence). Thereby, they state that the relevance of the capabilities might vary, depending on the scenario. Despite differences about the identified components and the level of granularity, all studies have a multidimensional perspective and address the need to develop BDA capabilities to successfully adopt BDA. Further, [4] provide an approach that could be the first step toward a BDA maturity model. They consider people, processes, and tools as the necessary building blocks for BDA and define three levels of BDA capability: aspirational, experienced, and transformed. Whereas aspirational organizations focus on process efficiency or process automation to cut costs, experienced organizations aim at optimizing their organizations by developing new ways to use BDA. Transformed organizations (i.e. IDOs) focus on using BDA as a competitive differentiator to expand their market position [4]. During the transformation, BDA expands from use in only selected business units toward organization-wide adoption [4], [9]. Further studies highlight the need for managing transformation effectively [5] and structuring it by defining a clear vision, identifying required changes, and deriving a roadmap to achieve the target state [4], [7]. Since the company-wide adoption of BDA might require a long-term evolution, companies can start with lighthouse projects for selected business units to gain initial experience with BDA [5], [9] and provide initial results by using prototyping.

2.2 Roadmapping

The roadmapping approach is a widely used management concept for supporting strategy and innovation [12]. It has been widely adopted at various levels of granularity from product to industry sector and also across various industries [6], [12]. Thereby, roadmaps can be used to communicate visions, to explore the development of the business and its components, to coordinate activities and resources, and to monitor progress [12], [13]. They also enable the alignment of different functions and perspectives within an organization, particularly business and technology [12]. The roadmaps are also very flexible and scalable, and can be customized to suit different strategic and innovation contexts [14]. The most general approach delivers a framework that addresses three key questions: 1) Where do we want to go? 2) Where are we now?, and 3) How can we get there? [12]. The first key question refers to the definition required for a target vision, the second one aims at covering the gaps between the status quo and the target vision, and the third one includes identifying, as well as structuring, the measures for achieving the target vision. The roadmap architecture consists of two dimensions: 1) timeframes, as well as 2) layers and sub-layers [12]. Timeframes are usually the horizontal axis and include short-, medium-, and long-term perspectives, as well as the past and vision. The layers and sub-layers are usually the vertical axis and show different levels of a hierarchical taxonomy. Since roadmaps can be used at various levels of granularity, the roadmap architecture should be customized to suit the aims and scope of the contemplated effort [12].

3 Research Method

In order to answer our research question, we relied on Action Design Research (ADR) to build, intervene, and evaluate our method. ADR involves the construction of an artefact, its intervention in the organization, and its evaluation by means of a concerted effort [10]. The developed artefact reflects, therefore, not only the theoretical precursors and the researchers' intent, but also the users' influence in organizational contexts [10]. Using ADR enabled us to design and fine-tune our method such that we could provide both academic insights and practical value. We implemented the four ADR stages. According to the first stage, – problem formulation, – we studied the research gap in the existing knowledge and outlined our research question in the introduction [10]. The second stage involves building, intervention, and evaluation activities. During this stage, we designed and evaluated our method at a German bank. In the third stage, – reflection and learning, – we continuously reflected on our method's design and analyzed the intervention results in context of our method's goals by integrating the feedback received from practitioners and end-users. In the fourth and last ADR stage that aims to formalize the learning gained throughout the project, we identified general insights about activities and techniques (cf. introducing our method below). In order to ensure that our method includes the relevant attributes and elements needed to design a new method, we further relied on the mandatory method components provided by [15] as shown in Table 1.

Table 1. Mandatory Method Components [15]

	Name	*Description*
Attributes	(A.1) Goal orientation	Methods must strive for achieving specific goals
	(A.2) Systematic approach	Methods must include a systematic procedure model
	(A.3) Principles orientation	Methods must follow general design guidelines and strategies
	(A.4) Repeatability	Methods must be repeatable in different contexts
Elements	(E.1) Activity	Task that creates a distinct (intermediate) output
	(E.2) Technique	Detailed instruction that supports the execution of an activity
	(E.3) Tool	Tool (e.g. method) that supports the application of a technique
	(E.4) Role	Actor that executes or is involved in the execution of an activity
	(E.5) Defined output	Defined outcome per activity (e.g. artefact, documents)

4 The Method Design

4.1 Design Principles

In line with ADR, we derive design principles for our method [16] from the existing theory and knowledge gained during the project [10]. As detailed above, a company-wide adoption of BDA is challenging as it affects various levels of the enterprise architecture and involves different stakeholder groups [6]. Thus, the company-wide adoption of BDA needs a clear vision of the target state, as well as a concept to capture the status quo, and to identify the changes needed to reach the target [4], [5], [7]. Thereby, a BDA capability model can provide guidance on which capabilities an organization should develop to become an IDO [4], [8]. This leads us to define the following design principle: *(DP.1) The method should allow for a precisely defined target state to be achieved by the adoption of BDA and identification of measures to close the gaps between the status quo and the target state*. *It should further take into account BDA capabilities needed as well as various levels of the enterprise architecture and stakeholder groups.* Besides, organizations also need guidance on how to proceed to reach the target state [4], [7] by prioritizing and structuring the identified measures [6] to coordinate the initiatives with regard to limited resources and predecessor-successor dependencies. As the company-wide adoption of BDA requires a long-term evolution [3] and high investments [6], definition of milestones might help to reevaluate and terminate the transformation project, if necessary. We therefore define the following design principle: *(DP.2) The method should allow for prioritizing and structuring the implementation measures according to the BDA capability developed by them and to the time of their implementation. It should further enable defining the milestones for reevaluation.*

4.2 Method Procedure Model

In keeping with [15], our method consists of activities (E.1), each of which includes techniques (E.2), tools (E.3), roles (E.4), and output (E.5) as summarized in Table 2. Our method comprises three activities: defining the target state, identifying and prioritizing the gaps, and deriving a BDA roadmap. Although tools can be defined as IT tools only, we use a broader definition of [15], [16] and focus on tools that support the application of one or more techniques.

Activity 1: Defining the target state

Technique: According to [12], activity 1's purpose is to address the question "Where do we want to go?" and to define the target state to be achieved by the adoption of BDA. First, the method user needs to define a target vision to have a common understanding of the target state. For companies that aim at using BDA as a competitive differentiator, becoming an IDO can be an appropriate target vision. In order to avoid a target vision being almost unattainable or only achievable with a great deal of effort, the method user can derive a second target vision as an intermediate step positioned between the status quo and an IDO. Furthermore, the intermediate step might allow a reevaluation of the targets and even a termination of the project, if necessary. Based on

the defined target vision, the method user should define requirements that need to be fulfilled at the target state and group them according to appropriate dimensions to conceptualize the target state. Later on, these dimensions will be visualized as layers in the BDA roadmap. Since development of BDA capabilities can be an appropriate way to become an IDO, we recommend that selected BDA capabilities be used as roadmap layers. After conceptualizing the target state, the method user should operationalize it by breaking down the requirements into fields of action and group them into roadmap layers or sub-layers. The number of sub-layers should meet the appropriate degree of granularity. While too many sub-layers lead to a very detailed and overloaded roadmap, too little sub-layers would make it difficult to derive effective measures to close the gaps [12]. We recommend deriving a maximum of 5 – 8 sub-layers for any layer [12].

Tool: We recommend that all the activities of our method should be based on the roadmapping as a structuring approach [12] and techniques such as brainstorming and moderated group discussions [15] to generate and evaluate ideas. In order to derive layers and sub-layers of the roadmap, the method user can base on BDA capability models (e.g. [1], [8], [11]).

Roles: In order to carry out all activities of our method, we recommend that a project team, which can consist of internal and / or external experts in BDA and developing roadmaps, be assigned. The project team prepares and moderates discussions, interviews, and workshops. They also consolidate and analyze the input, and provide outputs. Since management support is a well-known success factor for projects with high transformation potential like the company-wide adoption of BDA [4], [6], activity 1 involves (senior) managers who are familiar with the organization's strategy.

Output: Activity 1's output is the target state(s) as well as fields of action grouped into layers and sub-layers.

Table 2. Overview of Method's Activities and Elements

Activity	*Technique*	*Tool*	*Role*	*Output*
Activity 1: Defining the target state	Define the target state based on selected dimensions	Roadmapping, BDA capability model, discussion	(Senior) Managers, project team	Target state, layers, sub-layers, fields of action
Activity 2: Identifying and prioritizing the gaps	Capture the status quo, identify and prioritize the gaps	Semi-structured interviews, fulfillment-importance matrix	Stakeholder, (senior) managers, project team	Fulfillment-importance matrix with prioritized gaps
Activity 3: Deriving a BDA roadmap	Derive and structure measures to close the gaps	Roadmapping	(Senior) Managers, project team	BDA roadmap with structured measures

Activity 2: Identifying and prioritizing the gaps

Technique: Consistent with [12], activity 2 aims at addressing the question "Where are we now?" as well as identifying and prioritizing the gaps between the status quo and

the target state. In the first step, the method user needs to identify the experts who can give input on the derived fields of action (cf. *Roles* below). In the next step, they need to collect quantitative and qualitative data for further analysis to identify and prioritize the gaps by, for example, using the tools described below.

Tool: We recommend using semi-structured interviews [17]. The method user can include selected follow-up questions that match with the interviewees' areas of expertise to gain more insights. They can also include overarching questions to bring out the interviewees' expectations concerning their perceived challenges and opportunities regarding the company-wide adoption of BDA. In order to assess the status quo of fields of action in terms of their relevance and degree of fulfilment, we recommend using five-point Likert scales with 1 = irrelevant / not fulfilled at all and 5 = highly relevant / completely fulfilled. For identifying and prioritizing the gaps, the method user can adapt the fulfillment-importance matrix, which slightly resembles a mirrored version of Gartner's Magic Quadrant [18]. Therefore, they need to assign the fields of action according to their assessment of the matrix's four quadrants: "Invest!", "Manage Excellence!", "Reprioritize! or Disinvest!", and "Ignore!". The fields of action in the "Invest!" quadrant are the most important gaps and need to be closed by moving the associated requirements to the "Manage Excellence!" quadrant.

Roles: We recommend that the project team prepares, conducts, and analyzes the interviews. In order to gain sufficient information for a comprehensive report on the status quo, experts from different management layers and stakeholder groups should be interviewed (e.g. IT, finance, risk management, and sales departments). If necessary, the project team should consult the (senior) managers to identify the appropriate experts. Internal experts from projects with a similar focus (e.g. data quality projects) as well as external experts (e.g. consultants) that accompany these projects can also be interviewed. Each interview should be conducted by at least two project team members to avoid subjective interpretations of the answers.

Output: Activity's 2 output is a fulfillment-importance matrix with prioritized gaps.

Activity 3: Deriving a BDA roadmap

Technique: Following [12], activity 3 aims at addressing the key question "How can we get there?", as well as identifying the measures to close the gaps and structuring them in a roadmap. Method user should derive the measures and assign them according to the roadmap's sub-layers and layers. In terms of timeframe, the measures need to be structured according to their short-, medium-, and long-term perspective. Since the company-wide adoption of BDA requires a long-term evolution [3], a BDA roadmap might have a timeframe that spans over several years. Thus, the method user should consider intertemporal and scheduling interactions between the measures [6].

Tool: For identifying appropriate measures to close the gaps, method user can rely on knowledge about IDO, BDA, and BDA capabilities as well as brainstorming and discussions within the project team. For the latter, method user should be aware of limitations of relying on existing personal knowledge of the involved practitioners. A close collaboration between researchers and practitioners can help to reduce this bias if an intensive and reflective discussion process is ensured to combine the perspectives and insights from researchers and practitioners. For structuring the measures, we recommend deriving a roadmap as an established planning tool [12]. Thereby, the

layers and sub-layers are based on the BDA capabilities derived in activity 1. The timeframe includes short-, medium-, and long-term perspectives.

Roles: The project team derives the measures to close the gaps from the literature, structures them in a roadmap, and evaluates the results with the (senior) managers.

Output: The output is a BDA roadmap with structured measures.

5 Evaluation

5.1 Case Study Setting

We conducted our study in the strategic department of one of the leading universal banks in Germany. Since the banking industry is exposed to increasing innovation pressure through changing client behavior [19] and new market players like FinTechs [20], financial service providers need to innovate their current value delivery and interactions with clients [21] through providing data-driven services, for example. As a financial service provider, the case-study bank particularly had a large volume of client data such as details on repayment behavior and outstanding loans or credit lines. However, the bank failed to systematically get value from its data and it also failed to provide data-driven services to its clients. Thus, the bank aimed at adopting BDA across the whole company to develop it towards an IDO and to capture BDA potentials like strengthening innovative power and improvement of decision-making. However, the bank faced various challenges for this project. For example, a lack of end-to-end processes, a lot of manual work involved in the processes and thinking in silos led to frequent breaks in information flows. In addition, the bank had a partially outdated IT architecture and outsourced IT. Finally, the bank put a lot of effort into regulatory-driven projects and thus had rather limited human and financial resources for innovation projects. This led to a lack of awareness for innovation projects in general and for a company-wide adoption of BDA in particular.

The objective of the case study was therefore to develop a method for structuring the company-wide adoption of BDA to shift the company toward an IDO. Thereby, the head of the strategy department and the CIO, who recognized the market relevance of BDA, were looking for a method that would allow them to show the potentials of BDA to create awareness and to include the entire organization as well. With regard to the challenges highlighted above, the new method should consider various perspectives (e.g. people and processes) to enable including different stakeholder groups and levels of the enterprise architecture. Since the board of directors would have to approve the new initiative, the new method should also allow to assess what exactly they want to achieve with the company-wide adoption of BDA, what the status quo looks like and how they aim to achieve the target state. Due to the high complexity of the project, the new method should provide guidance in covering which adoption measures are necessary, how long the adoption will last, whether there are dependencies between the measures and which resources will be necessary for their implementation.

The project team consisted of five academic members from the authors' institutions (two research fellows and three professors) with expertise in developing digital

roadmaps and in the financial services industry. In addition, the project team included four members of a consulting company (two consultants and two senior consultants) with BDA expertise and experience in regulatory-driven projects conducted at the case-study bank. The head of the strategy department and his assistant were also part of the team. The external project team's role was to prepare and conduct workshops, as well as interviews, and to develop the BDA roadmap. The project lasted three months in total. The external team members mostly worked in the back office and were on site for workshops, interviews, and other meetings. The external project team predominantly worked three to four days a week on the project and spent the rest of the time synchronizing with colleagues who were working in similar areas.

5.2 Method Application

Activity 1: Defining the target state
In order to create a common understanding of the target vision, we first discussed the meaning of an IDO with the head of the strategy department and the CIO. Thereby, we defined an IDO as follows: An IDO anchors data-based decision-making processes throughout the company and classifies big data as a core capability with the aim of making value-creating insights available at the right place and at the right time. According to the feedback of the bank end-users, we derived a second target vision as an intermediate step on the way from the status quo to an IDO to take into account the current challenges of the bank (e.g. a lack of resources and awareness). Since a company-wide adoption of BDA requires high investments, this step was also defined as a milestone for reevaluating the targets and the project to adjust the resource allocation or to determine the project, if necessary. In order to better express the focus of both target visions, we named them "Lab" and "Factory". Following the recommendations of prior research (e.g. [4], [5], [9]), the target vision "Lab" aimed at using BDA in selected business units – mostly in the form of lighthouse projects, – which should serve as enabler of strategic corporate goals. The target vision "Factory" focused on a group-wide use of BDA as a competitive advantage and unique selling proposition in an IDO context. In the next step, we conceptualized the target states by deriving the roadmap layers based on five BDA capabilities of strategy, people, process, data, and technology. Since a company-wide adoption of BDA influences different levels of the enterprise architecture, the BDA capabilities should be oriented at these levels. With this in mind, we first drew up a list of possible BDA capabilities based on literature research and selected the most important ones for the bank in a workshop with the head of the strategy department. For example, developing strategy and people capabilities might help to increase company-wide awareness for BDA, whereas process capabilities would allow accelerating innovation and decision-making processes. Since BDA requires an excellent handling of data and advanced technologies to collect, store and analyze it, the bank finally needed to develop data and technology capabilities. In close collaboration with the head of the strategy department, we assigned the defined target visions to the layer strategy. We then derived requirements to be fulfilled at the target states and grouped them into the remaining layers as summarized in Table 3. Thereafter, we specified the requirements by breaking them

down into the fields of action and grouping them into roadmap sub-layers. In sum, we derived twenty four fields of action (e.g. specialists, research environment, idea generation, and agility) and seven sub-layers (team structure, broad knowledge, innovation process, project management, data quality, data access and trust, and toolkit). Due to the challenges described above, several fields of action aimed at improving innovation processes (in particular increasing their speed) and promoting interdisciplinary collaboration to counter silo thinking.

Table 3. Target States at the Case-Study Bank with Selected Requirements

Layers	*"Lab"*	*"Factory"*
Strategy	Use of BDA in selected business units in the form of lighthouse projects which serve as enabler of strategic corporate goals	Group-wide use of BDA as a competitive advantage and unique selling proposition in the sense of an IDO
People	Specialists in selected functions	Specialists in all functions
Process	Focus on lighthouse projects to create awareness	Integration into daily processes
Data	Data standardization within the lighthouse projects	Data lifecycle management
Technology	Focus on visualization software	Use of advanced BDA tools

Activity 2: Identifying and prioritizing the gaps

We conducted eleven semi-structured interviews with heads and members of different departments (e.g. finance and IT), as well as internal and external experts involved in regulatory-driven projects (e.g. AnaCredit and BCBS#239). The interviews followed the fields of action defined in activity 1. In close collaboration with the head of the strategy department, we excluded the strategy capability from the questionnaire, because it was defined through the target visions. Each interview was conducted by at least two external project team members and lasted roughly one hour. The interviewed experts answered the questions for each field of action and assessed the relevance, as well as degree of fulfilment, on a scale of 1 to 5 with 1 = irrelevant / not fulfilled at all and 5 = highly relevant / completely fulfilled. We also included follow-up and overarching questions to gather qualitative data for further analysis.

In the next step, we aggregated the quantitative results for each field of action and assigned them to quadrants of a fulfillment-importance matrix as shown in Figure 1. According the five-point Likert scale, we defined the quadrants of the fulfillment-importance matrix by interpreting fulfillment values less than or equal to 3 and importance values less than 3 as low. We treated all fields of action located in the "Invest!" quadrant as gaps with a high priority and the fields of action assigned to the "Manage Excellence!" quadrant as gaps with medium to low priority. Based on our analysis, there were no fields of action assigned to the "Reprioritize! or Disinvest!" and "Ignore!" quadrants. This is reasonable, because evaluating the fields of action with practitioners and end-users in activity 1 already ensured that the most relevant fields of action were identified, also considering the organizational idiosyncrasies. We further evaluated the matrix by analyzing the qualitative insights from the follow-up, as well

as overarching questions, and discussing our results with the head of the strategy department. Our first result was that the bank did well in a few central topics of the company-wide adoption of BDA, since many fields of action were located in the "Manage Excellence!" quadrant. For example, the bank made an effort to establish a data quality awareness within regulatory-driven projects. Most interestingly, the fields of action located in the "Invest!" quadrant were distributed almost equally across the four BDA capabilities. Therefore, deriving a BDA roadmap as a purely IT-driven effort would have neglected a substantial share of the relevant gaps. The gap analysis revealed that the first step was laying the foundations for an IDO by, for example, establishing a team of specialists, introducing an explicit research environment, and adopting basic technologies. On this basis, the bank could then begin with the more culture-oriented shift toward an IDO by focusing on generating innovative ideas, agility, and speed when it comes to the implementation of ideas.

Figure 1. Fulfillment-Importance Matrix at the Case-Study Bank

Activity 3: Deriving a BDA roadmap

We derived measures to close the gaps based on the literature review, as well as discussions with the head of the strategy department and the CIO. In the next step, we structured the measures in the BDA roadmap in terms of sub-layers and timeframe-dimensions. We also delivered a comprehensive documentation with a detailed description of each measure. For anonymization reasons, Figure 2 shows only a high-

level BDA roadmap with selected measures structured into five layers (i.e. strategy, people, process, data, and technology) and three timeframe-dimensions (i.e. short-term phase 1, medium-term phase 2, and long-term phase 3). The target vision "Lab" should be reached at the end of phase 2, and the target vision "Factory" at the end of phase 3. Thereby, the planning reliability and granularity of measures are greatly reduced in phase 3 due to its long-term focus. We also included phase 0, which indicates the project start in the current year, as well as two evaluation loops at the end of phase 1 and phase 2 as a reevaluation or termination option.

In order to reach the target "Lab", within phase 1 and phase 2, we structured the measures aimed at creating BDA awareness and initiating a data-driven culture via lighthouse projects. These measures include, for example, recruiting internal and external specialists, as well as providing a research environment and technologies to carry out initial lighthouse projects. Further, measures like conducting lighthouse projects, providing the first prototypes through agile methods, and design thinking should foster idea generation, organizational agility, and speedy ideas implementation. The measures in phase 3 aimed at closing the gaps to reach the target vision "Factory". Measures like organization-wide training programs in BDA or agile (innovation) project management approaches should ensure innovativeness and speed. Organization-wide data quality measures need to enable a high-quality data as basis for BDA. Further, measures like the implementation of a data lake architecture and a central sandbox should provide a flexible and scalable technological base that e.g. allows for adopting various BDA technologies. In close collaboration with the head of the strategy department, we also included strategy-related measures in our roadmap (e.g. change management, as well as strategic alignment between BDA measures and ongoing IT and regulatory-driven projects).

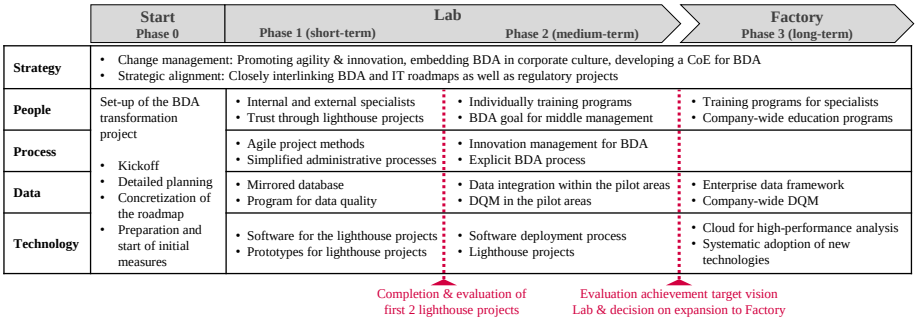

Figure 2. High-Level BDA Roadmap at the Case-Study Bank

5.3 Method Evaluation

Regarding the evaluation of design artefact, we can state that the new method that we co-developed and applied at a German bank provides an initial proof-of-value, since it fulfills the requirements of the bank outlined in Section 5.1. In particular, the new method enabled the bank to structure the company-wide adoption of BDA by deriving a roadmap that considers various perspectives (i.e. strategy, people, process, data, and technology) and prioritizes measures to close the identified gaps. Furthermore, the end-

users evaluated the new method as understandable and practicable. Moreover, the board of directors accepted it and the bank has already started initiatives to implement first projects proposed in the roadmap. From a more abstractive point of view, our method fulfills the content and domain-specific requirements defined by the two design principles (DP1 and DP 2) in Section 4.1. According to DP1, our method allows defining one or more target states and their operationalization by considering selected BDA capabilities as shown in activity 1. In activities 2 and 3, it enables identifying gaps and deriving measures to close these gaps by involving different stakeholder groups (e.g. through interviews). Finally, the new method considers various levels of the enterprise architecture when defining the layers and sub-layers of the BDA roadmap. According to DP 2, our method allows prioritizing and structuring the implementation measures in a BDA roadmap as illustrated in activity 3. It also enables considering dependencies between individual measures and defining the milestones for the project reevaluation. Finally, our method meets general requirements for a new method because it contains the mandatory method components summarized in Table 1. In terms of goal orientation, our method aims at structuring the company-wide adoption of BDA. As for principles orientation, our method is geared toward two design principles derived from the literature and fine-tuned with practitioners and end-users within an ongoing method evaluation by incorporating requirements outlined in Section 5.1. Repeatability and systematic approach are achieved by describing the method procedure model in detail and demonstrating its applicability at the case-study company.

Regarding the evaluation of design process, our method design follows the seven ADR principles. Within the first stage, we followed the ADR principle of practice-inspired research by illustrating that practice pays a lot of attention to BDA adoption. As for the ADR principle of theory-ingrained artefacts, our method bases on the existing knowledge related to BDA and roadmapping. During the second stage, we followed the ADR principles of reciprocal shaping and mutually influential roles, as well as authentic and concurrent evaluation by co-developing and evaluating our method in an iterative manner with the practitioners and the bank end-users. Through a continuous reflection on our method's design within the third stage, our method does not only reflect the preliminary design, but also the organizational shaping, as well as the practitioners' and end-users' feedback, thereby meeting the ADR principle of guided emergence. For example, activity 1 initially included defining one target state. After an evaluation with the bank end-users, we added the opportunity of defining more target states including a short explanation when it might be useful. In the fourth stage, we followed the ADR principle of generalized outcomes by providing general insights about activities for structuring a company-wide adoption of BDA.

6 Conclusion

In this study, we investigated how organizations can structure the company-wide adoption of BDA. Using ADR, we developed a new method for structuring the company-wide adoption of BDA by deriving a BDA roadmap. Based on knowledge of roadmapping and BDA, our method includes three activities: 1) defining the target

state, 2) identifying and prioritizing the gaps, and 3) deriving a BDA roadmap. Consistent with ADR, we developed and evaluated our method in a concerted research effort at a German bank.

Our work contributes to both research and practice. From an academic perspective, we enrich the body of knowledge related to BDA by linking the concept of BDA capabilities with the roadmapping approach when developing a new method for structuring the company-wide adoption of BDA. In particular, we show how companies can develop a BDA roadmap by considering BDA capabilities. Furthermore, we extend prior research on BDA capabilities by applying the concept of BDA capabilities to a concrete use case and illustrating how this concept can help to structure the company-wide adoption. Thus, our work can serve as a starting point for developing BDA maturity models and investigating their application in practice. Practitioners can use our method as a guideline for structuring the company-wide adoption of BDA. They can customize our method by extending our dimensions based on the BDA capabilities or by using other dimensions. Moreover, our research might help to develop company-individual methods for structuring other complex efforts like innovation and business transformation projects.

Our research has limitations that can serve as further starting points for future studies. First, we derived a customized BDA roadmap and noticed a lack of holistic BDA capability models that can be addressed by further research. Further, our method focuses on deriving a BDA roadmap as a planning tool and neglects the implementation phase. Research based on successfully carried out but also failed BDA adoption projects could be helpful for ex post analyses of success factors and development of key performance indicators to manage the adoption. Developed and evaluated at a German bank, our method is to a certain extent company-specific. Nevertheless, many aspects of our method can be generalized. As in our case, organizations should ensure a multidimensional view of the BDA adoption. Our experience also corroborates the importance of a close collaboration between strategy department, IT department, and business units, as well as the roadmap alignment to ongoing IT and regulatory-driven projects. Conducting further case studies might provide further valuable insights and outline possible differences along industries or the type of adoption projects. Despite its limitations, our research postulates a method for structuring the company-wide adoption of BDA and serves as a basis for further research aimed at closing the outlined research gap.

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