Designing Analytics-Based Services – Exploring Design Requirements for Methodological Tool Assistance in Service Design Teams

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Abstract. Analytics-based services (ABS) apply analytical methods to data in order to enable customers to make better decisions and solve more complex problems. While it is widely acknowledged that ABS pave the way for new value creation opportunities, surprisingly little is known about their systematic design. Service design teams still struggle to create ABS solutions systematically, i.e. to define what is to be done, how this is going to be achieved and how decisions are taken during ABS design projects. In this research, we report on the first iteration of our design science research project which aims to build design knowledge on methodological tools that can support service design teams in this particular context. We derive and evaluate four meta-requirements and four design principles – thus contributing to a more profound design knowledge base that can support researchers in developing new methodological tools in the field of ABS in the future.

Keywords: Analytics-Based Services, Service Design, Methodological Tool Support, Design Science Research.

1 Introduction

In the wake of business changes enabled by the digital transformation [1], large amounts of data accompanied with advances in analytics technology provide companies with novel opportunities to create meaningful value for their customers [2–4]. Analytics-based services (ABS), a new type of services, are introduced to the market that leverage analytical methods ('analytics') applied to data in order to help their customers make better decisions and solve more complex problems to ultimately reach their goals more effectively [5, 6]. Researchers and industry experts agree that ABS provide a promising path for companies to gain new competitive advantages [7, 8] by enabling a much deeper customer connection [9], by allowing a broader role in supporting the customer's value creation [10], or even by opening up entirely new

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markets [11]. Thus, systematically realizing new ABS opportunities has received research priority [7] and is being actively explored by companies [12].

Service design is a formalized, multi-disciplinary approach that helps innovate service offerings. Thus it could potentially serve as a means to guide and stimulate the development of new ABS [13]. Surprisingly, little research has been reported to advance service design literature in this regard and actionable insights to better manage ABS design are still lacking [14]. As a result, service designers in practice still struggle to develop services that appropriate the expected value from data and analytics in novel service offerings [14, 15]. In particular, creating and refining the service concept remains a challenge in ABS design. At the core of service design processes, the service concept serves as a means of specifying the nature of the service to be provided [16]. As such, it provides a detailed description of a service idea with regard to its value creation and delivery processes [17]. Thus, a clear and shared understanding of the service concept within service design teams, which we refer to as service concept comprehension, is crucial in order to ensure consistent decision making during the course of a service design project – yet, actionable insights on ABS-related service concept comprehension remain scare.

Methodological tools assisting service design have the potential to solve this issue. Prior research has found that creative and interdisciplinary tasks can particularly benefit from tool-support by promoting a better comprehension through visualization, communication, and documentation [18]. This could positively influence the performance of service design teams during ABS-concept development in practice. However, design knowledge which helps researchers to build tools specifically assisting service concept comprehension is scarce. Researchers lack theoretically sound guidance through clear principles for designing such tools in general terms. To this end, we propose a design science research (DSR) project seeking to address this literature gap by tackling the following research question: *How to design methodological tools assisting ABS design in order to increase service concept comprehension?*

In this research, we report on the first iteration of our project and present initial design requirements which are meant to serve researchers as a more profound design knowledge base when building new methodological tools in the specific field of ABS design. In the remainder of the paper, we first provide necessary foundations and related work relevant to our research. This is followed by our research methodology in section 3. The findings of our research are reported in section 4 and 5, structured chronologically reaching from the design requirements derived to their instantiation and evaluation. We then discuss our findings in section 6 before we briefly summarize our results, acknowledge limitations, and provide an outlook on future research in Section 7.

2 Foundations and Related Work

This paper aims to discover design knowledge for methodological tools supporting the systematic development of ABS concepts during service design. For that purpose,

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we first review prior research that contributes to conceptualizing the use of data and analytics in services. Second, we provide an overview of the service design discipline and the role of methodological tools within it.

2.1 Data and Analytics as Drivers for Customer-Oriented Value Creation

Researchers increasingly strive to understand how data and analytics contribute to new customer value creation. The application of statistical methods ('analytics') to data has been investigated quite intensively as a means to streamline organizations' internal business processes and to derive insights for managerial decision making (e.g. [19–21]). Yet, we increasingly observe how companies offer novel, customer-facing services that build upon data and analytics to create new, meaningful value to its customers [14]. Such ABS enable customers to make better decisions and to solve more complex problems to ultimately achieve their goals [5, 6].

The proliferation of data provides companies with numerous opportunities to infuse their service offerings with data [22]. Huang and Rust stress that customer data hold the potential to "figure out […] why customers make decisions they make and why they behave in a certain way" [[23], p. 255]; thereby facilitating a much deeper access to the customer. Further, tangible products are increasingly equipped with sensor technology which enables them to sense their own condition and their external environments and thus allows for real-time data collection [24]. Based on these increasingly 'smart' objects, organizations can use information from this collected data to offer contextual and preemptive services, predominantly referred to as smart services giving them the opportunity to strategically differentiate themselves in the market [25]. These services allow for a value-add based on data and analytics by 'wrapping' information derived from collected data around the core product [26]. Yet, smart services require an intelligent object and some ABS service do not (e.g., using medical insurance data [14]).

However, extant research mainly describes the utilization of data and analytics in customer-facing services from a phenomenological perspective [14]. Despite the priority it has received in service research [7], we still lack sufficient knowledge from a service design perspective that would systematically guide the conceptualization and design of new analytics-based services in practice [14].

2.2 Service Design and the Role of Methodological Tools

As described above, a number of studies have investigated the use of data and analytics to create new customer value in services. Service design, a formalized approach that helps innovate service offerings, could serve as a means to guide and stimulate the development of new ABS [13]. Various researchers have developed process models in which they define the necessary steps for the development of new services (e.g. [17, 27]). In essence, these processes consist of five elementary activities [28]: 1) opportunity identification, 2) customer understanding, 3) concept development, 4) process design, and 5) refinement and implementation. Particularly, the literature stresses the importance of the service concept, whose refinement during

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the service design process ultimately leads to the desired service innovation [29]. A service concept describes and tangiblizes the specific features of a service idea [28]. It identifies the benefits the service is intended to provide to customers, indicates how to offer the service [17], and mediates between customer needs and the strategic intent of the company [16].

Service design is described as a multi-disciplinary approach in which service design teams are composed of members who contribute to problem solving with their different backgrounds, areas of knowledge, and competencies [13]. To manage this diversity and channel it for problem solving, team collaboration is increasingly supported by methodological tools. These tools support collaboration in different ways, such as aligning distributed information, improving idea generation, or increasing the understanding of the problem [30]. Depending on the stage of the project, service design teams use a variety of tools to augment their capabilities. For instance, the Team Alignment Map helps teams to better plan and more effectively coordinate their joint efforts during projects [31]. The Business Model Canvas helps teams to define appropriate business models for the service to be provided [32].

Methodological tools assisting service design teams determine how team members (visually) frame a problem. Thereby, they contribute to problem solving as all participants can refer to the same structure of the problem [30]. Thus, they play a critical role in service design as they use a common visualization as the problem space to create a basis for collaboration in which team members can apply their diverse knowledge, experience, and insights to create innovative services [33]. Despite the emergence of various tools in the past, formalized design knowledge is very limited. So far, there is a lack of clear principles for the design of such tools in general terms documenting how methodological tools have to be built to achieve the desired outcomes. Further research is needed to drive the rigorous development of such tools in the future – particularly in the field of ABS design.

3 Research Methodology

This paper aims to generate design knowledge for methodological tools which support service design teams by increasing service concept comprehension of ABS among its team members. For that purpose, we conduct a design science approach. DSR aims to systematically design and develop artifacts to solve real-world problems following a "build-and-evaluate loop" in order to iteratively arrive at an optimized artifact instantiation [34]. Following the approach suggested by Kuechler and Vaishnavi [35], this research project is conducted in five steps consisting of a problem awareness, suggestion, development, and an evaluation phase.

For the first cycle which we focus on in this paper, we started by conducting a systematic literature review on existing research addressing the use of data and analytics to advance service to gain a deeper understanding of the academic discourse (reported in [36]). Unveiling that existing literature falls short in guiding a systematic design of ABS, we decided to build a taxonomy which helped us to conceptualize the nature of ABS (reported in [6]). To also gain insights from the real-world

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environment, i.e. actual service design teams that struggle to develop ABS in practice, we also conducted a series of interviews with practitioners that are currently involved in ABS development projects. With service design being a multi-disciplinary approach that incorporates contributions from several disciplines, such as 1) service marketing and operations, 2) information technology, and, in the context of analytics-based services, 3) data science [13, 37], we purposively sampled our interview partners along these three expert domains [38]. Our main focus was to understand how service design teams currently tackle ABS development and what problems they perceive during their projects. To this end, we asked our interview partners about their history of ABS-related projects, their role within service design teams, and about working practices they had established over the course of their ABS-related projects. The interviews were recorded and transcribed. In total, we collected eleven interviews which lasted 50 minutes on average. We applied a qualitative content analysis to analyze the interviews [39] and used an open coding approach to ensure openness towards any aspects unveiling problems in the context of ABS design and development [40].

The results of these research activities – a literature review, a taxonomy development, and an interview series – served as a basis to generate initial design knowledge for methodological tools increasing service concept comprehension of ABS among service design teams. For that purpose, we first identified meta-requirements which comprise generic requirements that must be fulfilled by an artifact [41]. In a second step, we derived design principles that encompass generic capabilities of designed artifacts to comply with the identified meta-requirements [42].

4 Meta-Requirements and Design Principles

This paper derives four initial meta-requirements (MR) and four associated, initial design principles (DP) to contribute to design knowledge for methodological tools increasing service concept comprehension during ABS design. In the following, we provide a more detailed description of the MR and DP.

4.1 Meta-Requirements

For service design teams, the service concept is a key driver for their decision-making and thus an essential instrument for their work during the service design and development process. The service concept defines the nature of a service by providing a "detailed description of what is to be done […] and how this is to be achieved" [16, p. 149]. It helps teams to mediate between the organization's strategic intent and customer needs. Service concepts serve service design teams to specify a service idea by deconstructing it into its relevant components that need further attention and require design decisions. In the context of ABS, practitioners stressed during our interviews that they are still inexperienced with regard to the role of data and analytics in services and that they still suffer from a lack of data-centricity in their

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work. Thus, MR1 imposes the following requirement on methodological tools assisting their design process: *The methodological tool should conceptualize analytics-based services from a data-driven perspective (MR1).*

Following the notion on the service concept in the literature, it is key to a successful service design process. Yet, identifying relevant components that require further decisions is by no means sufficient. Only if decisions are made consistently among team members and in line with the service idea throughout the design process, service design teams are able to take a new service from the idea stage through the evolving design phases to a deliverable service [16, 28]. Thus, a shared and clear understanding of the service idea is a necessary prerequisite of successful service design and the basis for targeted communication among team members. In line with that, our interviews also agreed that an interdisciplinary service design team is perceived as a key to success in ABS design. Yet, the experts also stressed that communication between the various actors is often inadequate, e.g. because they are not informed about challenges outside their specific field of expertise. Therefore, MR2 imposes the following requirement on tools assisting the design of ABS: *The methodological tool should serve as a communication construct and enable ABS design teams to establish a shared understanding (MR2).*

While the literature on service design gives practitioners a general overview of the key activities they should focus on in their projects, we identified in our interviews a fundamental uncertainty regarding the approach to design ABS. Particularly, practitioners stressed that they still lack the maturity and experience to clearly decide which aspects to focus on. Accordingly, we MR3 addresses this issue: *The methodological tool should provide guidance in the ABS design process (MR3).*

Service design also is a creative and iterative approach [13] and our interview partners highlighted the multitude of service concept variants that are created in the course of a service design project. In line with a "fail often and fail early" mentality [43], service concepts are quickly ideated, tested and refined or even discarded. A tool supporting service concept comprehension within service design is required to reflect this mutability. Thus, MR4 becomes: *The methodological tool should support agile routines of service design practices (MR4).*

4.2 Design Principles

These meta-requirements are translated into initial design principles which are meant to serve as a blueprint conceptualization of methodological tools assisting in ABS design. To this end, we heavily build on research previously conducted to conceptualize the nature of ABS which introduced a taxonomy identifying commonly shared characteristics of this service type [6]. Taxonomies are a well-established instrument to describe and analyze new phenomena using a unified classification schema [44]. The ABS taxonomy consists of six dimensions – data generator, data origin, data target, analytics type, portfolio integration, and customer role – each represented by a distinct set of generic characteristics. In the following, these six dimensions and their respective characteristics, key to conceptually describing ABS, are briefly explained.

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Data generator specifies the entities that generate relevant data for an ABS. Data may be generated by customers consuming the service or by non-customers who generate relevant data but have no direct links to the service provider (e.g. data from social media). Apart from that, physical objects increasingly equipped with sensor technology and networking capabilities allow organizations to draw on different kinds of data that result from objects' operations. Further, with digitalization actively transforming organizations, this accounts for business processes (e.g. production processes within manufacturing) indicating key process indicators as well.

Data origin specifies where the generated data comes from. An internal origin refers to data the service provider has direct access to ranging from its machine data to event-based data. Opposingly, external data refers to data that comes from outside the company, i.e. publicly available data, private data provided by the customer, or purchasable data (e.g. weather data) which requires to have a third party to be involved in the service.

Data target specifies about whom or what the generated data contains information. The most obvious perception would be that data generating entities produce data about themselves respectively about their state or operations. Yet, data might also contain information related to other 'targets' of interest. For example, objects might also generate data containing information about their environment (e.g. surroundings' weather conditions). Thus, in addition to the data generator characteristics, environment is also accounted as a possible data target.

Analytics type specifies the analytical methods applied to deliver ABS. Descriptive analytics process past data resulting in aggregated reports or accumulated visualizations. Diagnostic analytics also work on past data aiming to deductively derive from data why certain events occurred. In turn, predictive analytics follow an inductive approach focusing on predicting what will happen according to past and current data. Prescriptive analytics take it a step further and investigate what should be done based on available data and the resulting predictions; thereby, prescriptive analytics heavily build on simulation - and optimization techniques.

Portfolio integration specifies how the ABS relates to the service provider's business. The literature distinguishes between services that accompany another product or service (value-added service) and those that are offered independently from other products or services (stand-alone service). Stand-alone services predominantly create a self-sufficient value for the customer such that a coupling with other products or services is possible, but not mandatory. Value-added services, on the other hand, serve to increase the customer's benefit from a product or service by 'wrapping' additional value created from data and analytics around them. Accordingly, value-added services are further divided into wrapped around product and wrapped around service.

Service User Role refers to the customer's role within the ABS concept. The recipient role describes customers simply consuming the service. The customer is not involved during value creation. Using a weather forecast is such an example, where the customer is neither required to provide data nor to participate in the analysis process. The provider of data role requires the customer to actively provide data for the ABS. This allows the service provider to gain knowledge about the customer to

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deriver insights from that data (e.g. predictive maintenance services). The interactor role requires the customer to integrate the service provider into his processes. The service provider is empowered to make decisions and changes in customer processes and practices.

As pointed out earlier, conceptual work on the nature of ABS remains limited in academic literature making service design teams struggle to systematically develop a service concept. Thus, building on our research results unveiling six key dimensions to conceptually describe ABS, this knowledge may function as affordances in the sense of generic design options for service concepts and may highlight the ABS-specific aspects service designers should focus on. Therefore, we specify the aforementioned MRs and formulate the following DPs for methodological tools: *Conceptualize the purpose and core design decisions of the ABS from a data-driven perspective (DP1)*; *Provide affordances for designing an ABS concept (DP2)*.

Service design requires many domain-specific experts in service design teams ranging from business strategists to user-experience designers or IT specialists [13]. Consequently, the team is characterized by heterogeneously distributed knowledge that leads to many different opinions and perceptions within the team. In order to establish a commonly shared understanding of a service idea in a service concept, it requires support to facilitate communication among the team members. In similar contexts, frameworks such as the Business Model Canvas [32] have already demonstrated that visual tools are effective and result enhancing in this respect. While the visual stimulus is only one aspect of these frameworks, it is considered essential to the success of developing a commonly shared understanding by structuring the most important conceptual elements logically [30]. Further specifying MR1 in this regard, the third DP becomes: *Visualize ABS in a pre-defined template and provide a common language to address ABS (DP3).*

In addition, the documentation of these agile iterations, their key learnings and ideas are crucial to provide traceability and ensure service concept comprehension at later stages. From our interviews we had learned, that the success of service design projects often depends on tacit knowledge from experienced team members. In order to solve this problem and make lessons learned from ABS design projects available in the long term, we formulate the fourth DP as follows: *Enable the documentation and communication of the developed individual service concept (DP4).*

5 Instantiation and Evaluation

In order to evaluate the elaborated DP, we instantiated them in an initial prototype (cf. Figure 1). As we had learned, service design – being a creative and interdisciplinary approach – often takes place in workshop settings. Thus, we decided to use a canvas format. In similar contexts, tools like the Business Model Canvas [32] have already shown that such frameworks are effective and result enhancing in this respect. To implement a pre-defined template (DP3), we built on the previously developed taxonomy of ABS and used the identified general dimensions to visually materialize ABS along predefined key factors. This also allowed us to provide possible users with

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the core design dimensions of an ABS concept (DP1). In addition, we used the dimensions' underlying characteristics to provide possible affordances for designing ABS for users (DP2). A service concept is now developed by formulating concrete specifications for each design dimension (cf. Figure 2). The characteristics from the taxonomy of the ABS are used as generic guidelines within the framework.

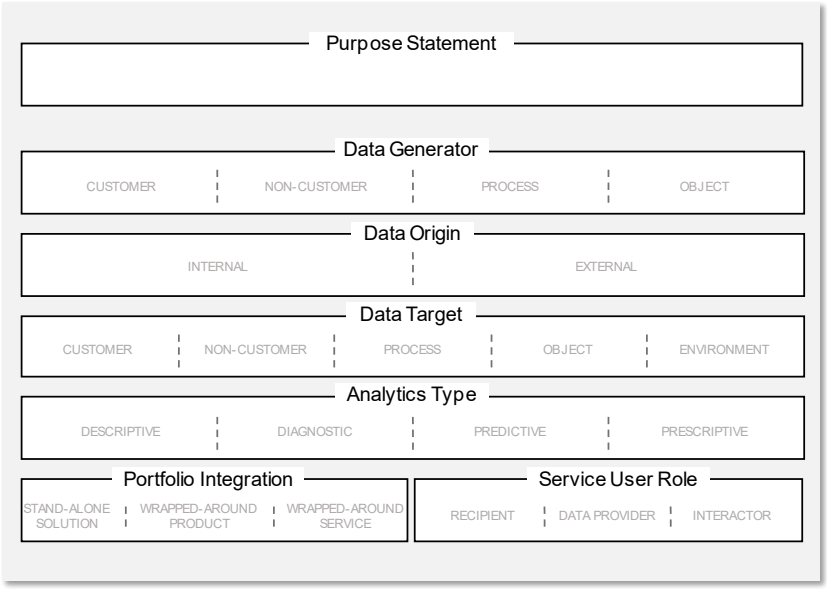

Figure 1. Instantiations of the DP in an initial prototype.

5.1 Evaluation Approach

In order to evaluate our prototype respectively its underlying DP, we conducted exploratory focus group interviews [45, 46]. In sum, twelve potential users participated in three workshops. The participants' age ranged from 23 to 26, five participants were female and seven were male. They were recruited in their capacity as students attending a master level university course "Service Design Thinking". This course follows a unique ten-month teaching concept, in which students are grouped in teams, each receiving the challenge to design a new service for a real-world challenge from a business partner. At the time of the evaluation, these teams were involved in ongoing service design projects developing digital services. Hence, they were experienced in service design within our application domain, familiar with its routines, and thus were perceived appropriate as focus group participants.

For each focus group, we asked the participants to independently read a "typical" case of an ABS we had purposefully selected [47], i.e. the description of an ABS that had been successfully established in the market. Table 1 provides the respective case vignette highlighting the fundamental aspects of the ABS. Afterwards, we asked the team to establish a commonly shared understanding of the ABS concept using our

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prototype. Through the independent reading assignment, we achieved that each participant gained an individual understanding of the underlying service concept described in the case. The subsequent team assignment required the team to build a shared service concept comprehension. After that, we conducted the focus group interviews and did a Strength-Weakness-Opportunities-Threats (SWOT) analysis which led the participants to discuss with each other.

Table 1. Case vignette of the ABS used during the focus group interviews.

Case vignette: Cochlear's ABS to create customer value around hearing aid solutions
Cochlear is an Australian-based, market-leading company that develops, manufactures and sells hearing aid solutions. The products combine a surgically inserted implant and an external sound processor worn behind the ear. The latest generation of the "Nucleus 7" product line features a scene classifying service which analyses the user's environment (e.g. quiet living area vs. busy road) and automatically adjusts the settings of the processor to ensure the best performance for the environment. In previous generations of products, such adjustments to the hearing aids had to be made manually by the client. However, Cochlear realized that patients did not always select the optimal settings for the situation, which meant that the product potential was not fully exploited. The current product now uses an embedded ABS to identify different situational contexts and automatically makes customer-specific adjustments in real-time. [48, 49]

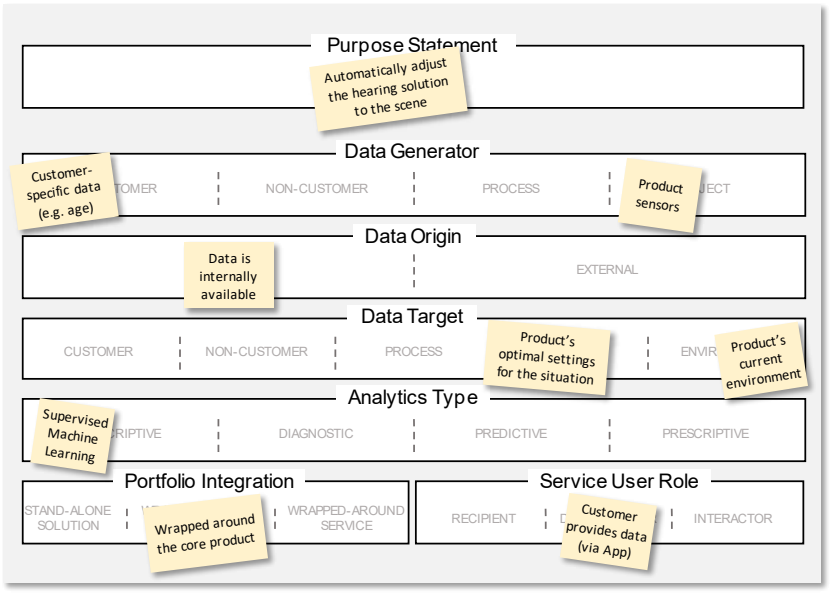

Figure 2. Illustrative application of the prototype to the evaluation case from a focus group.

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5.2 Evaluation Results

In sum, we received promising feedback on our approach to assisting service design teams with methodological tools for ABS design. Regarding the proposed DP, the participants acknowledged the importance of all four. Table 2 summarizes the aggregated feedback we received during the SWOT analysis of the DP.

The participants perceived the given dimensions as valuable for structuring their approach in the service design process in general (DP1). The selection options in each dimension also helped them to provide a "shared vocabulary" in the comprehending process (DP2). It was emphasized that the visualization in the shape of a predefined template helps to capture the "big picture", i.e. a holistic service concept (DP3). To this end, visualizing ideas in a common structure was perceived as an asset during service design projects. The participants also stressed the possibility in using the tool as a communication channel to mediate ideas during creative ideation sessions and they agreed that such a tool helps to document developed service concepts and to make them available to the team at later stages in the project (DP4).

Table 2. Summary of SWOT-analysis results.

	Strength	Weakness
DP1:	• Enables a shared understanding of the ABS concept within the team • Provides a good entry point to the concept development phase	• Still requires an initial idea
DP2:	• Forces to actively think about specific/alternative ABS features • Helps to explore initial ideas • Allows to further enrich initial ideas	
DP3:	• Enables to create a high-level overview of the ABS concept without going into technical details • Enables a deeper communication between team members • Allows to easier articulate ABS concepts to higher management • Helps to structure the service concept development phase	• Dedicated entry-point unclear
DP4:	• Provides the basis for a common terminology which fosters and improves communication	• Requires manual effort to document workshop results • Digital documentation preferred
	Opportunities	**Threats**
DP1:		
DP2:	• Support intelligently by guiding service design teams in the service creation process through “success stories”	• Danger of team members being satisfied with the first-best solution
DP3:	• Ability to portray existing ABS for inspiration and analysis • Foster further discussions on more detailed topics	• “One might forget to look over the edge of one's plate”
DP4:	• Visualize iterations of service concept evolvement • Allows to receive feedback from relevant stakeholders	• Too abstract to receive customer feedback

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6 Discussion

Using data and analytics in service offerings as a means to create new customer value has recently become a much-regarded strategy by companies [8] and is now being actively explored by academics [7]. Despite the growing interest in ABS from research and practice, their systematic design is still in its infancy. As a result, service design teams struggle to systematically create service concepts that would enhance a more effective design process of ABS in practice. Tackling this issue, we are able to capture initial design knowledge for methodological tools generally supporting during ABS design. It consists of four meta-requirements and four generic principles for the design of such tools in general terms. This design knowledge may serve future research for the development of new methodological tools assisting service design teams in the specific field of ABS as it provides prescriptive knowledge for designing such tools [34, 50]. The evaluation of the proposed DP through a first prototype implementing them suggests that they facilitate to empower ABS concept development during service design. Thus, we provide a promising base for IS researchers to further investigate methodological tools supporting the systematic design of ABS.

Nevertheless, the evaluation also unveiled several opportunities for further refinement of our DP. Participants from all focus groups highlighted the manual effort required for post-processing the application of a tool to digitize the results. As we learnt, the documentation and communication of service concepts is preferably done digitally within service design teams; hence we modify the existing DP4 to: *Enable the digital documentation and communication of the developed individual service concept (DP4).*

In addition, the focus group participants identified the benefits of a systematic, pre-defined visualization of the ABS concept in order to request feedback from key decision-makers at an early stage. Thus, we formulate a new design principle as follows: *Enable service design teams to obtain early feedback to quickly evaluate different ABS concepts and investigate improvement activities (DP5).*

7 Conclusion

ABS are a novel type of service in which the application of analytics to data provides ground for new customer value by delivering context-relevant insights or making valuable decisions for the customer – thus, enabling customers to reach their goals more effectively or efficiently. They provide companies with new opportunities to create customer value and to achieve competitive advantages in the market. Despite the growing interest among researchers and practitioners on ABS, academic literature surprisingly lacks actionable insights to assist their systematic design. This research presents the results of the first iteration of an ongoing DSR project that aims to build generalizable design knowledge about methodological tools that support service design teams during their ABS design project. To this end, four MRs and four DPs are derived in this research that provide an initial design knowledge base. The

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instantiation of the design principles in a prototype enables us to evaluate them with domain experts. The results of the exploratory focus group analysis are promising and provide substantial feedback for further improvements in subsequent design cycles. Thus, this research contributes to the community by advancing design knowledge that can guide researchers in developing new methodological tools in the field of ABS in the future and we encourage researchers to build future work on our design requirements.

We are aware that our research comes with some limitations. In particular, the results from the explorative focus group interviews are limited in their generalizability at this point as we only evaluated the users' feedback using an ex-post concept development. Still, we believe that the evaluation's results indicate the MR' and DP' usefulness when building methodological tools to assist during ABS design and provide a promising base for future research. As discussed in the previous section, we identified the need to adjust DP4 and to formulate a new DP. Thus, we intend to refine our prototype in a second design cycle.

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