Utilizing Data and Analytics to Advance Service

Towards Enabling Organizations to Successfully Ride the Next Wave of Servitization

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Abstract. For decades, servitization served as a strategy to gain a competitive advantage over competitors. However, due to its ubiquitous adoption, it is no longer a viable source for differentiation. In this context, data and analytics bear the potential to create new value and, thus, is believed to drive the next frontier of servitization. Yet, the majority of organizations fail to create new innovative services utilizing data and analytics, while research on this topic is also still very limited. Based on a structured literature review, we derive the following contributions to this research field: First, we provide a general overview over the topic, linking single discussions to a larger discourse. Second, we contribute to the fundamental understanding of the research field by pointing out the gaps in the existing literature. Third, we lay the foundation for future research by opening a research agenda to address the highlighted gaps.

Keywords: Servitization · Service advancement · Big data · Data analytics
Literature review · Research agenda · Data- and analytics-based service

1 Introduction

Today, the concept of servitization is widely acknowledged among researchers and practitioners and is broadly discussed in academic literature. The shift from selling products to selling integrated products and services that deliver value in use has been considered a key strategy for manufactures to capture additional value on top of their existing product portfolios [1, 2]. Particularly in markets that are moving towards commoditization, the implementation of a servitization strategy has been perceived a source for differentiation, ultimately leading to competitive advantage [3].

However, servitization seems to have reached its saturation point in terms of differentiation potential. Recent research emphasizes the omnipresence of the concept in practice [4], as it has found its way into almost every industry on every continent [5]. Instead of providing the ground to build competitive advantage, it has rather turned into a strategic necessity for an organization's sustained success [3].

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In this context, recent research identifies data and analytics as a way to advance servitization by developing sophisticated and novel service offerings [3, 5]. Massive amounts of data are collected by organizations across all industries [7]. Using analytics to provide customers with meaningful insights from this amount of data is believed to open up a promising path to increase the level of competitive advantage again [8].

The opportunities to create customer-facing value using data and analytics seem manifold. Daimler, with its subsidiary Fleetboard, manages to enhance existing logistics and time management services for fleet owners of trucks and vans. In cooperation with an insurance company, data and analytics enables them to additionally offer their customers highly individualized pricing models for the insurance based on the driving behavior as well as the intensity of vehicle usage [9]. Marshall et al. [10] highlight how Monsanto, an agricultural biotechnology corporation, gains competitive advantage in their market by increasing the farmer's yield. It combines data and analytics to suggest farmers the most suitable seed for their individual fields.

Gathering, storing, accessing, and analyzing data is not new to organizations and has been widely discussed in academic literature [11]; yet the focus of these practices remained intra-organizational, helping business users making better decisions [12]. Rather new is the approach of utilizing data and analytics to generate additional customer value to gain competitive advantage over competitors. The vast maturity of organizations (78%) state to have started investing in data- and analytics-based innovations [13]. Still, in practice it seems that only few organizations have attained the expected benefit from these investments so far and find it difficult to offer their customers new value (e.g. Monsanto) or amplify the value of an existing core offering (e.g. Daimler). In terms of our previously used terminology, few organizations actually "ride" the next wave of servitization, yet.

Research on customer-facing services utilizing data and analytics remains scarce [14], resulting in a crucial mismatch between the importance of the topic for practice and the guidance offered by academic literature [15]. In this research, we address this gap in academic literature by extending the existing body of knowledge on utilizing data and analytics to advance service offerings. First, we seek to consolidate the extant work to understand the prevailing debates on the topic. Second, we strive to investigate what debates are still missing in literature to create actionable insights for practice. Thereby, our article gives structure to the rather young field of 'utilizing data and analytics to advance service' to help novice researchers position their future work more precisely. Third, we present a research agenda to tackle the identified white spots.

In the remainder of this paper, we first describe the method we used to review the existing body of literature. This is followed by the findings of this review, which we structured along the four central debates we revealed within the literature. Drawing upon these findings, we discuss missing links in the research field and outline possible avenues for future research. Finally, we conclude with a summary and an outlook on the emerging field of 'utilizing data and analytics to advance service'.

2 Research Method

We conducted a systematic literature review to grasp the breadth of the research field and to make sense of the extant knowledge on the research topic [16, 17]. The review aimed to identify the central debates in academic literature discussing 'service advancement through data and analytics' as a unit of analysis and helped us to eventually generate insights concerning the meanings of these debates. Therefore, instead of just providing an exhaustive and descriptive overview of existing work, we are able to present an in-depth overview of the discourses in the field.

The systematic literature review consists of the search and selection process for relevant literature as well as the subsequent analysis and synthesis process. To make our approach as transparent as possible, ensuring a high level of credibility and confirmability [17], the steps are profoundly described in the following.

2.1 Search and Selection Process

First, we intended to identify a representative set of academic literature focusing on the understanding, conceptualization, or implementation of services that are advanced through the use of data and analytics. For this purpose, five established scientific databases (AISel, Emerald, ScienceDirect, EBSCOhost, SCOPUS) were included in the search process. This allowed us to achieve a comprehensive coverage of the work published in leading IS journals, but also enabled us to consider debates from related disciplines such as manufacturing or computer science. Additionally, we were able to take into account scientific papers from leading IS conferences, thus, including more recent studies in our review that had not reached a journal outlet so far.

It was expected to approach a rather young research field. Therefore, we did not limit our search process to a specific time span. In order to increase the number of potentially relevant papers for the review, different search strings consisting of the words "data", "analytics", and "service" were compiled by the two researchers to form initial keywords that used to search the databases. Subsequently, the search was conducted on title, abstract, full-text. A full-text search was considered necessary, since it was deemed that not all authors had specified the type of service in the title or abstract directly but during their elaboration. While this increased the initial number of potentially relevant candidates, the irrelevant ones could still be excluded during the selection process.

For the selection process, the identified papers were initially judged based on their title, abstract, and keywords if they could be placed in the research field. Otherwise, they were excluded from our dataset. In a second round, the full text of the remaining papers was investigated. In case there were uncertainties if an article had to be considered for our further investigations, the two researchers discussed whether it was to be placed in the research field under investigation. Accordingly, out of 1341 initially considered research articles 84 were identified as relevant for the analysis phase. See Table 1 for a detailed overview of the results from the search and selection process and the number of papers that were found on each database.

Table 1. Search and selection process

Search string	Database					Sum	Relevant
	AISel	Emerald	Science direct	EBSCO	Scopus		
Data-driven service	23	11	27	44	50	155	33
Data-enabled service	2	0	4	0	0	6	1
Data-enriched service	2	0	4	0	1	7	1
Data-enriched product	1	0	0	0	0	1	1
Data-based service	9	3	174	12	35	233	5
Service analytics	34	6	337	54	38	469	13
Analytics-as-a-service	12	0	64	81	74	231	21
Analytics-based AND service	58	21	33	88	39	239	6
			Sum (w/o duplicates)				71
			Added through forward/backward search				13
			Total sum				84

2.2 Analysis and Synthesis of Literature

The analysis and synthesis phase aimed at finding relevant ideas, findings and contributions within the previously selected papers. Afterwards, this research landscape was synthesized into a compact classification of different research streams to present the reader a intelligible layout of the research field [18]. This layout builds the basis to assess the literature and allows to reveal under-researched problems in the academic discourse.

A concept-centric approach was chosen to analyze the literature with regard to the depicted goals [16]. For this purpose, the analysis of the articles was guided by a framework that considered (1) the central concept the article elaborated; (2) the unit of analysis that was researched; (3) the method that was used to conduct the research attempt. Afterwards, we analytically synthesized the different concepts in the framework iteratively to reveal the central debates held in the literature.

The critical reading of the articles also led to new relevant publications which were included in the review's body of literature as well. Thus, the review was conducted iteratively between the search and selection process and the phase described in this section. Eventually, this contributed to the purpose of the review by concentrating on discussions on concepts, ideas, and findings held in the literature rather than on the discussion of individual articles [16].

3 Four Debates Related to Utilizing Data and Analytics to Advance Service

The review unveiled two central topics in the literature related to the application of data and analytics to advance service. That is, *understanding the potential* of using data and analytics to create new value and *leveraging the potential* of data- and analytics-based

services in organizations. First, by understanding the potential, we refer to investigations on new ways of value creation in the era of digitalization and a rapidly transforming ecosystem. Second, by leveraging the potential, we refer to human resources, technical capabilities and new business models that enable organizations to successfully establish data- and analytics-based services.

Again, we did not intend to provide the reader with an exhaustive and descriptive overview of existing work conducted in the field. Instead, we aimed to provide a layout of the research field showing the central debates in the academic discourse. A summary of the four central debates identified in our review and a representative grounding in the literature is depicted in Fig. 1. In the following, each debate is outlined very briefly.

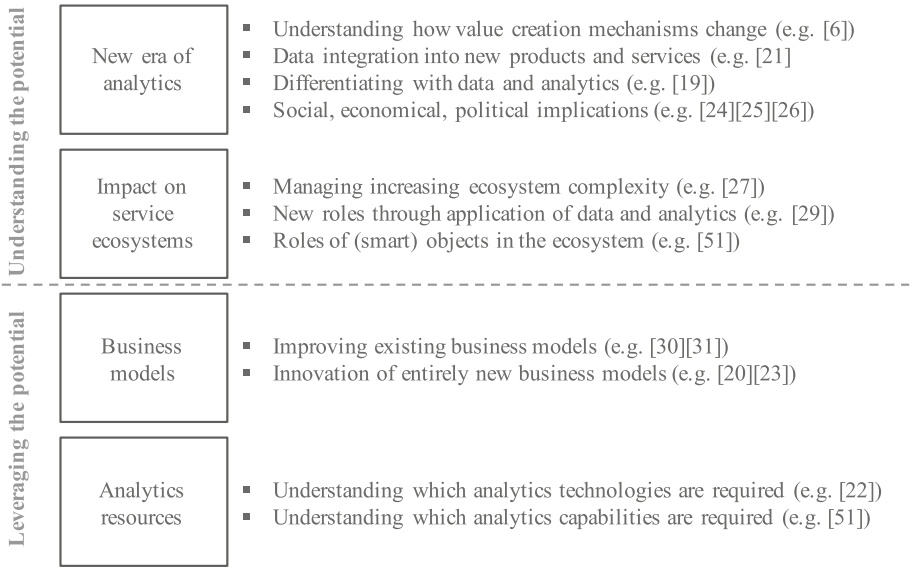

Fig. 1. Summary of the results from the analysis and synthesis process.

3.1 Understanding the Potential

New Era of Analytics. Arguably, the corporate world has reached a new age which is driven by analytics rooted in enormous amounts of data [19, 20]. While preceding research concerning data and analytics focused on the analytical support of internal decision making and mastering to collect and process big data [12], the third wave of analytics concentrates on analytics supporting customer-facing products, services, and features, thus, marking a new era of analytics ("Analytics 3.0" in [19]).

In this context, literature strives to understand how the mechanisms of organizations and whole industries creating value change. Huberty [21] emphasizes the necessity to build data- and analytics- based services in order to live up to the expectations of the (big) data revolution, as so far very few companies managed to transform data into new

products or services. Similarly, Alvertis et al. [22] identify the successful development of services building on data and analytics as a key factor of differentiation in the future. Thus, literature agrees, that it is essential to understand how the mechanisms of creating value function in this new era of change [23].

Scholars also investigate social, economic and political implications that come with the exploitation of data and analytics. For instance, Heiskala et al. [24] and Lopez et al. [25] point out how smart city applications based on citizens' location and motion data can contribute to safer, cleaner and less stressful living conditions. Similarly, a game-changing potential is detected in the global food supply chain through a utilization of data and analytics in the agricultural sector [26].

Impact on Service Ecosystem. Another debate focuses on the impact of a data and analytics application on service ecosystems. Specially, new and ambivalent roles customers, organizations but also machines and smart objects can now adopt, increase the ecosystem's complexity [27].

For instance, early work establishes two novel roles in a service ecosystem when using data and analytics, namely Data-as-a-Service (DaaS) and Analytics-as-a-Service (AaaS) [28]. The former is referred to as a provider of raw and aggregated content, whereas the latter service offers a rich set of common analytics components and infrastructure. Additionally, more recent research reports the emergence of multi-sided roles in an ecosystem merging both roles in a single one [29]. In this case, organizations aggregate data from one group of customers and create additional value for another group of customers by gaining insight from the collected data through analytics.

3.2 Leveraging the Potential in Organizations

Business Models. There exists some considerable acknowledgement in the literature of data and analytics holding the potential to leverage an organization's business model. Business models are commonly referred to as representations describing how an organization creates, delivers and captures value and thereby reflect the organization's business strategy [30]. Research related to this debate concentrates on services utilizing data and analytics by investigating how the business model representing the organization's attempt to create value changes.

Two fundamental discussions arise in this context [9]. On the one hand, scholars point out a possible business model improvement of the existing one [31, 32]. This is achieved by assessing existing data sources and analytics techniques with the goal of improving existing processes. The organization still pursues the same business strategy but more effectively. On the other hand, business model innovation is seen as appropriate to create new value from data and analytics [21, 24]. This is achieved when data and analytics lead to new value propositions, ultimately altering the organization's business strategy.

Analytics Resources. At the organizational level, scholars stress the importance of new resources and capabilities necessary to create value in services using data and analytics. Based on our review, we identified this debate to consist of two streams, analytics technology assets and analytics capabilities [33].

With regard to analytics technology assets, literature refers to the infrastructure, software and tools an organization requires to actually offer a data- and analytics-based service [23]. As different types of services require different assets, scholars aim to develop distinction-frameworks in order to classify the assets used in particular services. While software and tools are commonly described as supporting either descriptive, predictive or prescriptive analytics [34, 35], a common framework to distinguish the assets required for data and analytics applications has not yet been acknowledged [35].

Analytics capabilities refer to the employee's competencies organizations need to build in order to perform data- and analytics-based services [36–38]. Thus, literature strives to identify strategic and structural design options, common processes, best-practices of how to cultivate analytics capabilities.

4 Discussion

In this section, we want to critically discuss the literature on 'using data and analytics to advance service', presented in the previous section. Eventually, we aim to shed light on missing links between the existing knowledge in the literature that still hinder organizations to create new services utilizing data and analytics in a systematic manner. By identifying white spots in the research field, we seek to propose a research agenda addressing open topics, thereby laying the foundations for research enabling organizations to establish data- and analytics-based services.

4.1 A Critical Analysis of the Findings

The review of the literature shows that the research field on utilizing data and analytics to advance service is still in a nascent stage. Much of the work we reviewed did not emerge before 2015. Consequently, the literature still seeks to gain a common understanding of how organizations realize value from services that build upon data and analytics.

A number of papers focus on understanding the inherent opportunities organizations can seize. This "path to value" is investigated both from a conceptual [e.g. 3] and an empirical perspective [e.g. 9]. Moreover, research supports the effort to increase the knowledge on the application and, eventually, monetization of data and analytics in organizations by discussing the benefits of data and analytics in service in empirical studies [e.g. 32]. Several positive relations have been identified based on real-world cases between newly build analytical capabilities in organizations and the ability to gain competitive advantage through data and analytics in services (e.g. [23, 39, 40]). Herterich et al. [23], for instance, point out key capabilities for harnessing data streams in an industrial context and link them to specific business benefits they were able to observe.

Yet, from a practitioners' perspective little attention has been paid to bridge the gap between fundamentally realizing the substantial value of data and analytics as a new source of competitive advantage and the implications derived from several studies showcasing the successful application. In particular, we argue that more attention needs

to be paid to the integration of data and analytics into the design process to advance service (cf. Fig. 2). Although service design studies have contributed to developing systematic approaches to new value creation in services in general [41], little is known about the design principles when service advancement is fostered through the use of data and analytics [42, 43]. In fact, our literature review did not reveal any methodology or framework that would guide the process of creating a new data- and analytics-based service. We argue, that future research needs to focus on filling this gap in order to provide organizations with the necessary guidance that enables them to systematically create such services for their customers.

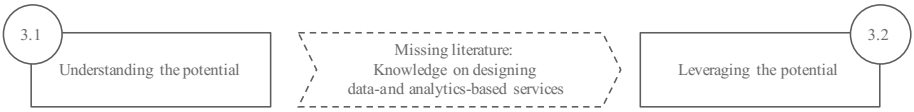

Fig. 2. Missing link of existing literature from a practitioners' point of view.

In this sense, we can confirm findings that there is a mismatch in service science between the knowledge to advance service and its importance for practice [15]. In addition, we take a step further towards the root cause for this mismatch and point out the necessity to increase the foundations of service design and innovation in the context of service advancement through utilizing data and analytics. Drawing on this perception, a research agenda tackling this gap in literature is proposed in the following section.

4.2 Avenues for Future Research

Based on the outlined motivation to foster service advancement through data and analytics (cf. Sect. 1) and the identified gap in academic literature concerning its application (cf. Sect. 4.1), a research agenda addressing this issue is proposed. The primary objective of this agenda is to foster a theorizing process regarding the understanding and design of customer-facing services that draw upon data and analytics to generate value. Such a foundation should bridge the existing gap and provide practitioners with the necessary guidance to systematically establish data- and analytics-based services. Below we propose three research streams addressing this objective.

(1) Value creation in data- and analytics-based services. We claim that the design of services utilizing data and analytics differ from previous design genres as the advent of data and analytics results in dramatic changes ranging from the organization's ecosystem to its own required capabilities (cf. Sect. 3). Thus, the objective of this research stream would be to investigate data- and analytics-based services as a unit of analysis to deepen the understanding of the concept's distinctiveness.

Future research should investigate how value creation mechanisms look like in customer-facing services drawing upon data and analytics. A fundamental understanding of the value creation mechanism is essential before investigating the design of

such services [44]. The underlying mechanisms are well understood with regard to internal services using data and analytics to support better decision making [12]. However, as depicted in Sect. 3.2 literature points out additional capabilities and practices required to perform such customer-facing services utilizing data and analytics. Thus, it is necessary to understand how services utilizing data and analytics create customer value along key enabling organizational capabilities.

Additionally, this research stream should investigate key characteristics of data- and analytics-based service. We argue that a theoretical framework explaining the general key components of such a service would contribute to enabling a systematic creation of services that leverage data and analytics in practice. Particularly, a taxonomy describing services utilizing data and analytics may help both researchers and practitioners to fill the void unveiling relevant design principles. Taxonomy building is well known in IS research and a legitimate method to obtain a classification scheme for services that are already observable in the market [45]. The contribution of such a taxonomy is twofold. First, it entails central design principles for the service design and therefore constitutes a design space for possible solutions of services utilizing data and analytics. Second, based on the classification scheme, further research can be pursued, e.g. cluster analysis identifying patterns of distinct service types (e.g. [46, 47]).

(2) Design of data- and analytics-based services. As stated above, we believe the design of services utilizing data and analytics differs from previous attempts. Thus, this research stream should focus on the design of such services in organizations. Studies need to investigate which key activities are required to systematically develop customer-facing services drawing upon data and analytics. The service design literature provides a useful basis of generic knowledge. Researchers have developed process models that define key activities required to develop new services [48, 49]. Future research should investigate the unique nature of service design in the specific context of data- and analytics-based services to extend the existing body of knowledge. This would eventually provide practitioners with the necessary guidance needed to systematically develop such services systematically.

Building on an understanding of key activities for a service design process, it might be also interesting to tap into new tools supporting these activities. Tool support guiding a development process has already been applied in related areas such as business model innovation (e.g. [32]). In practice, the development of data- and analytics-based services is a highly interdisciplinary process as project teams often consist of members with a data science, engineering, or business background [36]. Building a common understanding of the team's aspired service solution often is a challenge during such projects. Hence, the development of tools supporting practitioners during distinct design steps is an aspired contribution.

(3) Strategies for data- and analytics-based services. Let us consider Fleetboard and Monsanto, the two introductory examples (cf. Sect. 1), once again. Fleetboard is able to provide an insurance pricing model based on driving behavior and vehicle usage by analyzing vehicle data from Daimler Trucks and Vans. No third party is involved during the value creation process and Fleetboard strictly keeps its data internally. Only the analytically derived insights are forwarded to the insurance company Fleetboard works together with. On the other hand, Monsanto actively drives an open platform

approach, where farmers are able to access data and analytics services from third party providers. Even though Fleetboard and Monsanto provide a similar service in terms of aggregating, analyzing and providing additional value to their customers through insight generation, both pursue different strategies within their organizational network with regard to the degree of openness towards third party data and analytics providers.

We could not find any literature during our review addressing strategic considerations with regard to services utilizing data and analytics that could serve as a starting point for this research stream. Data- and analytics-based services allow to create value in organizational networks in novel ways. Especially multi-sided platforms have gained increased popularity in the literature providing valuable insights on their key mechanisms [50]. Research on strategies for services utilizing data and analytics should extend this knowledge by providing insights on how organizations can benefit from applying different strategies in an inter-organizational context.

5 Conclusion

This paper addresses the emerging field of service advancement through data and analytics integration. Using data and analytics to advance service is seen as a key strategy to gain competitive advantage in the future, forming the next frontier of servitization [3, 15, 27]. However, recent research points out that, so far, few organizations actually manage to establish services that use data and analytics to provide new value to their customers and, thus, actually "ride" the next wave of servitization [9].

A structured literature review is conducted to gain a better understanding of the research field, addressing the topic of utilizing data and analytics to advance service. Four central debates dominate the literature in this field, namely required analytics resources, changes in business models, implications on service ecosystems, and general implications from a new era of analytics. Building on these finding, we show that a systematic design of services building on data and analytics constitutes a crucial gap in the literature. Consequently, we propose a research agenda to fill this void, aiming to enable organizations to establish services utilizing data and analytics.

Hence, our research provides three vital contributions to the research field of service advancement through data and analytics. First, having identified the central debates in the literature, we are able to link and map related research to the larger discussion of advancing service through data and analytics. Second, based on our findings, we are able to point out the underdeveloped topic of service design within the research field which needs to be addressed in order to enable practitioners to actually advance service through data and analytics. Third, this paper lays the foundation for future research and opens a research agenda in order to seize the white-space in the research field. Particularly, we point out possible avenues for future research fostering to understand the value creation mechanisms, the design, and strategic implications of customer-facing services using data and analytics.

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