

The organizational integration of data-based service activities at  
manufacturing companies

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## **Abstract**

In the last two decades, manufacturing companies have increasingly acknowledged the attractiveness of services complementary to their product business. Consequently, they transitioned from pure product providers to companies selling a combination of products and services. While this so-called servitization already entailed several barriers for manufacturing companies, the latest emergence of digital technologies increased the complex environment even more.

Combined, data-based services (i.e., services offered to business customers that rely on data and/or a distinct digital component) promise various benefits but come along with numerous challenges. One of these challenges is the quest for a suitable organizational configuration.

Academia treats the organizational debate mostly by discussing whether a separated or integrated service business is the prime option. However, current literature primarily concentrates on traditional after-sales instead of data-based services. Moreover, precise recommendations for practitioners seeking clarification on potential organizational configurations are lacking.

The thesis at hand, therefore, aims to shed light on organizational structuring possibilities with a focus on the integration of data-based service activities.

To derive valid insights from and for practice, we split the research project into two main parts. The first part seeks to aggregate contingency factors that influence the decision about a new organizational configuration. The second part then strives to provide multiple options for manufacturing companies on how to integrate the data-based service activities. Logically, the organizational configuration theory and the contingency theory mirror the foundation of the research project.

The thesis relies on three different research methodologies, each accounting for a particular research gap. First, we apply a systematic literature review to find relevant, influencing factors. Second, we continue with a mixed-method approach, containing statistical analyses and qualitative case study interviews. It supports validating the real influence of the found factors on the organizational structure and provides cues regarding which direction (i.e., either separation or integration) the factors suggest. Third, we end with the conceptual development of a typology for alternative organizational configurations. The eight types are then enhanced with a methodology to guide manufacturing companies in restructuring their service organization.

## Zusammenfassung

In den letzten zwei Jahrzehnten erkannten produzierende Unternehmen zunehmend die Attraktivität von Services. Folglich wandelten sie sich von reinen Produktanbietern zu Unternehmen, die eine Kombination von Produkten und Services verkaufen. Während diese Servitisierung bereits mehrere Barrieren mit sich brachte, hat das jüngste Aufkommen digitaler Technologien die Komplexität noch weiter erhöht.

Datenbasierte Services, d.h. Services, die auf Daten und/oder einer bestimmten digitalen Komponente basieren, versprechen verschiedene Vorteile, sind aber mit zahlreichen Herausforderungen verbunden. Eine dieser Herausforderungen ist die Suche nach einer geeigneten organisatorischen Konfiguration.

In der Literatur dreht sich die organisatorische Debatte hauptsächlich um die Frage, ob ein separiertes oder ein integriertes Servicegeschäft die beste Option ist. Aktuelle Veröffentlichungen konzentrieren sich jedoch in erster Linie auf den traditionellen After-Sales und nicht auf datenbasierte Services. Darüber hinaus fehlt es Unternehmen an konkreten Empfehlungen für passende Organisationsformen.

Die vorliegende Arbeit will daher mögliche Organisationsstrukturen mit Fokus auf die Integration datenbasierter Serviceaktivitäten beleuchten.

Um valide Erkenntnisse aus und für die Praxis abzuleiten, wird die Dissertation in zwei Fokusbereiche aufgeteilt. Der erste Teil aggregiert Kontingenzfaktoren, die die Entscheidung über eine neue Organisationsstruktur beeinflussen. Der zweite Teil offeriert den Produktionsunternehmen mehrere Optionen für die Integration datenbasierter Serviceaktivitäten. Grundlage des Forschungsprojekts bilden die Theorie der organisationalen Konfiguration und die Kontingenztheorie.

Die Dissertation stützt sich auf drei verschiedene Forschungsmethoden, die jeweils eine bestimmte Forschungslücke adressieren. Zunächst wird eine systematische Literaturrecherche durchgeführt, um relevante Einflussfaktoren zu finden. Anschliessend findet ein mixed-method Ansatz Anwendung, der statistische Analysen und qualitative Fallstudieninterviews beinhaltet. Dieser fokussiert sich auf die Validierung der gefundenen Faktoren und ermöglicht die Überprüfung in welche Richtung (Separation oder Integration) die Faktoren tendieren. Zuletzt wird eine Typologie für alternative Organisationskonfigurationen konzeptionell entwickelt. Die acht gefundenen Typen werden mit einer Methodik ergänzt, die produzierende Unternehmen bei der Umstrukturierung ihrer Serviceorganisation anleitet.

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## List of Abbreviations

B2B	Business-to-Business
cf.	confer
dbS	data-based Services
DOS	Degree of Separation
e.g.	exempli gratia (for example)
et al.	et alii
etc.	et cetera
FTE	Full-Time Equivalents
HR	Human Resources
i.e.	id est (this means)
IIoT	Industrial Internet-of-Things
IoT	Internet-of-Things
IT	Information Technology
MECE	Mutually Exclusive and Collectively Exhaustive
MRQ	Main Research Question
NPD	New Product Development
NSD	New Service Development
RQ	Research Question
R&D	Research and Development
SBU	Strategic Business Unit

# 1 Introduction

Production management is concerned with a plethora of aspects and perspectives related to processes, approaches, strategies, and the organization of manufacturing companies with the impetus to excel in producing compelling products (Zahn & Schmid, 1996). While this description is not conclusive, it is evident that production management is a vital field for the backbone of the German<sup>1</sup> and Swiss capital goods industry (Swissmem, 2019).

Acknowledging the importance of this industry for Western countries, the competition from the Asian-Pacific region demonstrates a danger for margins of Western products and the survival of the respective companies. Innovation is traditionally a strong capability of Western companies and results in competitive advantages against competitors from the Far East (Porter, 2004).

However, product and process-centered innovation are only two paths companies are pursuing (e.g., Ireland & Webb, 2007). Business model innovation creates another option to achieve sustainable advantage (Gassmann, Frankenberger, & Csik, 2014). For instance, by leveraging service capabilities and offering hard-to-imitate, highly profitable services, manufacturing companies change at least part of their business model to be successful (Auguste, Harmon, & Pandit, 2006; Baines, Lightfoot, Benedettini, & Kay, 2009; Grubic, Redding, Baines, & Julien, 2011; Neely, 2008; Quinn, Doorley, & Paquette, 1990). Thus, dedicating a substantial amount of work on service operations and service-related uncertainties is essential.

Manufacturing companies mirror the perception of services as a potentially deciding factor for increasing differentiation and customer satisfaction, as well as loyalty, in turn, leading to superior firm and financial performance (Baines et al., 2009; Bustinza, Bigdeli, Baines, & Elliot, 2015; Oliva, Gebauer, & Brann, 2012; Oliva & Kallenberg, 2003). The evolution of manufacturing companies from a pure product provider to an organization offering a portfolio of products and services is commonly

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<sup>1</sup><https://www.bmwi.de/Redaktion/DE/Artikel/Branchenfokus/Industrie/branchenfokus-maschinen-und-anlagenbau.html>

referred to as servitization (Vandermerwe & Rada, 1988). Concurrently, servitization describes the research field in which the thesis at hand is primarily immersed.

Along with the difficulty of transitioning from a product manufacturer to a solution provider, in recent years, digitalization has affected the complex environment a manufacturing company operates within. Enhancing traditional after-sales services with digitalization elements describes a new type of service offering: data-based services (cf. Allmendinger & Lombreglia, 2005). Introducing data-based services promises a variety of advantages but comes with multiple barriers (Klein, Biehl, & Friedli, 2018). For instance, the internal readiness (e.g., capabilities, organizational structure), corporate strategy, and external factors (i.e., market, competitors, customers, environment, etc.) have to be adapted or managed deliberately to serve the new direction.

Focusing on the organizational configuration of manufacturing companies, the correct alignment of strategy, capabilities, processes, and structure is usually connoted with superior performance (Ambroise, Prim-Allaz, & Teyssier, 2018) and requires appropriate attention.

## **1.1 Practical and Theoretical Relevance**

Today, we see this issue of internal readiness at multiple companies from our projects. Often, an enormous internal effort (especially administrative) has to be undertaken to deliver certain services. The right organizational design and relating processes would, therefore, increase efficiency and effectiveness.

Repeating inquiries of manufacturing companies asking about the *right* or *optimal* organizational design, guidelines for coping with the difficulty of simultaneously managing the product, the traditional after-sales, and the new data-based service business was the main impetus for diving into the topic of the organizational integration of data-based service activities. These companies encountered a variety of challenges in bringing the rising number of stakeholders involved in the development, sales, and delivery of data-based services together.

For instance, juxtaposition a simplified description of a service developer's activities. We observe that in the case of offering a new scheme for maintaining a new tool of the focal machine, the responsible person might build upon product knowledge, a product sketch, and talk with product development to define reasonable maintenance steps. Whereas, in the case of a predictive maintenance option, the service developer (i.e., the service product manager or similar) has to cooperate with IT, or special data

analysis teams, and needs to find out whether the product has the right sensors to deliver the right data with the right volume and velocity. In the worst case, he has to feed the information back to product development that the current machine generation might not be capable of using predictive maintenance. While this example might be overly simplistic and very superficial, it demonstrates a practical issue of data-based services: more departments or stakeholders are involved in the development, sales, and delivery.

Naturally found in projects with industry partners and risen at focus group meetings, companies exhibit the need for clarification, as no dominant strategy to organize data-based service activities has yet been discovered. Results from our benchmarking study *Transformation of the Service Organization* between May 2018 and May 2019 underline this insight.

We inquired into how the participating manufacturing companies organize their data-based services today, how they are planned, and what an optimal structure might be. We offered five different options (staff function, decentralized, project/lead team, separated functional unit, and integrated functional unit), and the answers demonstrate a high heterogeneity within and between each time horizon (i.e., current, planned, optimal). Forty-two percent see *separation* as the optimal configuration, while 32% opt for an *integrated structure*. These diverging results demonstrate that coming from a practical point of view, increasing the knowledge about potentially promising organizational configurations incorporating data-based services is of the highest interest.

Academia endorses the vast discrepancy between a separated and integrated structure. One party promotes the separation of the service unit to reach a higher distinction, such as management, as well as customer awareness as a better breeding ground for a service culture (Oliva & Kallenberg, 2003; Turunen & Toivonen, 2011).

The other party defends the opinion that uniting product and service business results in higher synergies, higher customer orientation of the overall value proposition, and should be pursued according to the market rationale (Neu & Brown, 2005, 2008). Adhering to the market rationale means a company should aggregate their activities concerning the market they are supplying (Drucker, 1974).

While considerations of manufacturing companies providing traditional after-sales services (such as repair, maintenance, and spare parts) predominantly drive these discussions, information for organizations engaging with data-based services is scarce (Baines et al., 2017).

In the last several years, scholars have acknowledged that there might not be a black and white perspective on either separating or integrating the service business by stating that these boundaries increasingly blur (Gebauer, Pütz, Fischer, & Fleisch, 2009). Nevertheless, in practice, a plethora of companies decided to pursue a separate service business unit. This phenomenon may be explained by the fact that service activities commonly succeed the product development, thus adding services to existing and new products afterward.

Considering data-based services, though, a clear separation of work packages based on, for instance, competencies and timely aspects, is no longer possible. As we saw in the example above, at least product development, service development, and IT specialists have to collaborate to deliver data-based services successfully. Consequently, we acknowledge the fact that where the progress of research concerning data-based services at manufacturing companies is generally still in its beginnings, it is especially true for discussions around the organizational structure (Ambroise, Prim-Allaz, & Teyssier, 2018; Böhm, Eggert, & Thiesbrummel, 2017; Pereira, Rocha, Nunes, Borchardt, & Viegas, 2018).

## **1.2 Research Gap and Research Questions**

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020a).*

Again referring to the simplified juxtaposition above, Ostrom et al. found in 2010 that an organization needs to be able to include different stakeholders into the service development process, as research has still not discovered the right organizational structures for this problem (Pereira et al., 2018). Ambroise, Prim-Allaz, and Teyssier (2018) highlight that perspectives on the optimal organizational configuration are still disunited. Going in the same direction is Fliess and Lexutt (2017), who leave the question as to which point the service business requires separation unanswered.

The latter especially requires further elaboration since, for instance, Gebauer, Fleisch, and Friedli (2005) concluded that an organization should opt for separating the service business to overcome barriers in servitization. Connected to this article is the call of Böhm et al. (2017) to treat the issue of separation against integration. Between Gebauer et al. (2005) and Böhm et al. (2017) might lie twelve years of significant progress; however, we still see room for research scrutinizing the organizational configuration of manufacturing companies, especially in the era of data-based services (Baines et al., 2017). Emphasized most recently by Raddats, Kowalkowski,

Benedettini, Burton, and Gebauer (2019), their literature review endorses the existing gap concerning the *optimal* organizational configuration.

Considering the field of digitalization, Yoo, Boland, Lyytinen, and Majchrzak (2012) explain that the emergence of digital technologies unveils new organizational designs.

Kuusisto (2017) argues that increased digitalization efforts result in readily available and distributable information. Hence, more informed decisions can be accomplished at lower hierarchical levels, leading to higher autonomy of project groups and supporting the shift towards a higher degree of agility (Kuusisto, 2017). Alavi, Abd. Wahab, Muhamad, and Arbab Shirani (2014) describe similar findings. In their perception, digitalization provides the potential for flatter hierarchies, decentral information flows, and higher flexibility, such as the agility of formerly rigid processes (Alavi et al., 2014; Dewett & Jones, 2001). Furthermore, Bilgeri, Fleisch, and Wortmann (2018) investigated, for example, the positioning of IT responsibilities due to the presence of new Internet-of-Things (IoT) capabilities. The findings of Fuchs, Barthel, Herberg, Berger, and Hess (2019) are in the same vein, as they found five different solutions for structuring digital units at manufacturing companies, encompassing all relevant digital activities.

Voith Digital Solutions is one example. Once Voith decided to establish a new digital unit, they moved all activities to the new division that had the slightest impression of being *digital*.

Coming back to Bilgeri et al. (2018) and Fuchs et al. (2019), their conclusions provide attractive cues for potential organizational types, but they are not conclusive concerning integration alternatives of data-based services at manufacturing companies.

Nevertheless, focusing on the intersection of IoT and servitization, several authors already provide evidence that digital technologies can accelerate the service transition of manufacturing companies (Bustinza, Gomes, Vendrell-Herrero, & Tarba, 2018; Coreynen, Matthyssens, & van Bockhaven, 2017; Kowalkowski, Kindström, & Gebauer, 2013; Rymaszewska, Helo, & Gunasekaran, 2017). Yet, it is essential to note the difference between supported servitization by digital technologies and data-based service transition. While the latter one describes the evolution of manufacturing companies to provide real data-based services, the former includes organizations offering after-sales services, where digital technologies sustain the necessary steps to reach this stage.

Acknowledging the fact that research, especially in the intersection of digitalization and servitization, is very recent (Paschou, Adrodegari, Rapaccini, Saccani, & Perona, 2018), little is known about the influence on the organizational structure.

Thus, the purpose of the dissertation project is to shed light on the organizational integration of data-based service activities at manufacturing companies, where data-based service activities encompass the development, sales, and delivery activities related to data-based services at manufacturing companies (Kindström & Kowalkowski, 2014; Posselt, 2018). The following main research question (MRQ) consequently guides the thesis at hand:

*How can manufacturing companies structure their organization to integrate data-based service activities strategically?*

Mintzberg (1991) found that the optimal organizational configuration depends upon the individual contingencies of the focal company. Building upon this notion, the ultimate target of this thesis is to derive patterns, or types, of organizational structures focusing on the strategic configuration of data-based service activities. The overall strategic purpose of the data-based service business guides the strategic configuration of the focal company. Depending on the strategic intent, for instance, as a lever for financial growth, market differentiation, or branding, we assume altering organizational configurations (cf. Raddats & Burton, 2011).

Essentially, the MRQ suggests that more than one possible organizational configuration exists. Hence, the result should provide manufacturing companies insights into different types to make them decide themselves which configuration might be suited best for their setup. Therefore, we divided the MRQ into the following four sub-research questions:

*RQ1: What factors exist influencing the organizational configuration of data-based service activities?*

*RQ2: How do these factors affect the organizational configuration of data-based service activities?*

*RQ3: What types of organizational configurations exist?*

*RQ4: What are the characteristics of the derived types?*

With a focus on manufacturing companies in a business-to-business (B2B) environment mainly selling capital goods, the first question copes with the

aggregation of factors potentially affecting the decision of a manager, whether one or the other organizational configuration of the data-based service activities are more purposeful according to their strategy (RQ1).

We then assess if these factors have an impact at all, to answer how they influence the organizational integration of data-based service activities in the second question. The second part continues with a validation of the found influence factors and the endeavor to unveil tendencies within these factors, whether a separation or an integration is favored (RQ2). Potentially, clusters of factors will show similar trends. By adopting the principle analogous to Altshuller (1996), and more recently, Gassmann et al. (2014), the ultimate goal is to find ideal-typical patterns of organizational configurations (types) with a focus on data-based service activities in the third part of the research project (RQ3). The last step emphasizes type characteristics, such as attributes, advantages, and drawbacks of each type (RQ4).

Poured into a handy visual representation and implemented into a methodological approach, manufacturing companies might then use these types when seeking insights on how to reorganize their current structure. Finding the right design is essential insofar as only an organizational setup fitting the individual contingencies of a company may lead to higher performance, or put the other way around, an unsuitable structure may hinder success (Hax & Majluf, 1983).

All four research questions follow the purpose of telling one story, while the story is split into three parts reflecting each research phase. The subsequent paragraphs detail the scientific approach towards the dissertation project at hand, including the three research phases.

### **1.3 Scientific Setting**

First, we need to clarify the scientific setting and philosophical worldview in which we conduct the research project. Following predominantly a qualitative research design (on which we elaborate later in Chapter 3), we think that meaning is created through social interaction, reflecting a constructivist ontology (Bryman, 2016). Further, we strive to immerse ourselves in a particular research context with the impetus to understand the underlying rules, approaches, and unveil insights, equaling action-based research.

In this sense, the research aligns with an interpretivist epistemology (Bryman, 2016). Qualitative research is mostly inductive, while we enhance the findings of this dissertation project with quantitative elements in the second part (Bryman, 2016;

Creswell, 2014). Consequently, the overall approach has an abductive nature. Tightly interlinked with a mixed-method approach, we adopt a pragmatic worldview with elements of constructivism (Creswell, 2014). Pragmatism means we focus on the *how* and *what* through building upon different sources of data and applying different research methods to solve the problem we face (Creswell, 2014). Pragmatism acknowledges the fact that we live in a historically grown social system, yet, elements of constructivism explain the approach of creating meaning out of subjective views through social interaction (Creswell, 2014). Interviewing experts to extract their perspectives, information, and experience on the questions we impose (cf. Kubicek, 1977) is a component of the second and third parts of the dissertation project.

In addition to explaining the socio-philosophical worldview, we also want to mark the management philosophy in our context. We adopt the perspective of business economics as application-oriented social science (Ulrich, 1984). Additionally, we acknowledge the complexity of social systems and dismiss the point of view of total control over it (Bleicher, 2011; Ulrich, 1984). Models are used to reduce the complexity to a manageable level. However, the simplified version of the reality induces that the application of essential findings needs to be executed with care, respecting the simplification (Ulrich, 1984).

Following the view of Bleicher (2011), we describe the management theory as a system-oriented integrated approach, due to several paradigms that changed over time. For instance, organizations and their organizational theories alter them from seeking stability to flexibility, closeness turns into openness, isolated considerations change to a holistic perspective, and connectedness replaces linearity (Bleicher, 2011).

Coming from general business economics, we sharpen the context to production management as specific business economics (Zahn & Schmid, 1996). Its objective is to reach high practical relevance (Zahn & Schmid, 1996), being in line with the invocation of Tomczak (1992) to strive for reality-oriented management research from and for practice.

Therefore, the focus of our research project is not to test theory-based hypotheses in the first place. Instead, we aim at developing a scientific design approach, founded on a theoretical heuristic framework that is continuously and iteratively improved (Kubicek, 1977; Tomczak, 1992). Visualized in Figure 1, we first construct an initial conceptual framework with the consultation of the relevant literature (Kubicek, 1977). In the ongoing research, questions based on the initial framework are empirically and exploratively processed, answered, and further developed (Kubicek,

1977). We continue with the interplay between data collection, data analysis, and the derivation of further questions until the initial framework is sufficiently understood (Kubicek, 1977). We then use these findings to derive a method and related types for structuring data-based service activities by seeking high practical relevance.

Essentially, we cycle multiple times through the iterative learning approach shown in Figure 1. Based on the thoughts of Kubicek (1977), Tomczak (1992) created a first visualization, which was then further developed by Baumbach (1998) and Gassmann (1999). Helping to construct valid and practically useful theory (Corley & Gioia, 2011), we account for this approach by slicing the dissertation projects into three parts, as already indicated before.

Thus, the following sub-chapter provides details about the structure of the dissertation project and the thesis at hand.

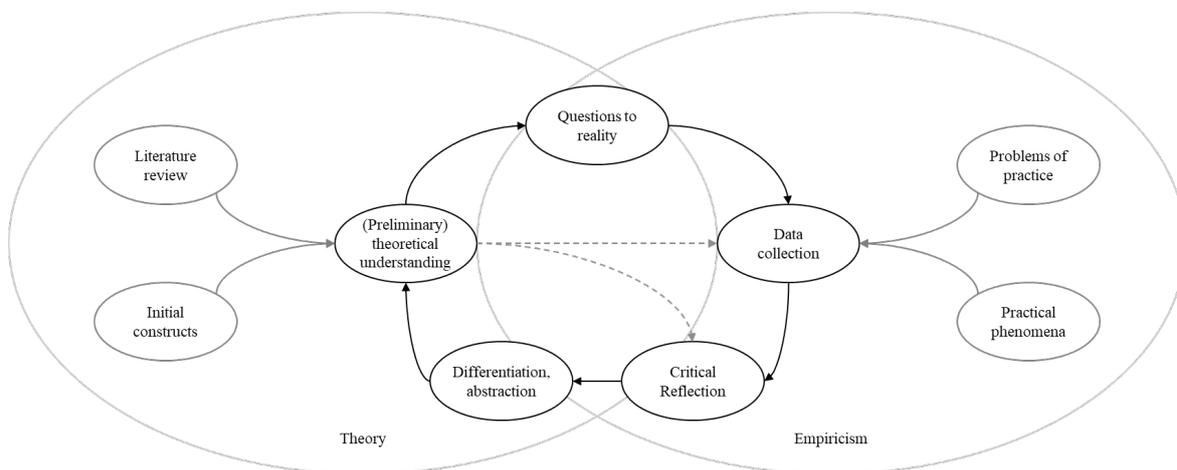


Figure 1: Iterative learning cycle based on Baumbach (1998), Gassmann (1999), and Tomczak (1992).

## 1.4 Thesis Structure

The subsequently described five main chapters compose the dissertation at hand.

### Chapter 1 – Introduction

Chapter 1 closes out by elaborating on the thesis structure, where we introduced the general topic of this dissertation, its practical and theoretical relevance, the detected research gaps, as well as the overall scientific context.

## Chapter 2 – Theoretical Foundations

In Chapter 2, we lay the foundation for the following content by explaining essential terms and describing current literature. Here, we focus on the data-based nature of services and the differences with traditional after-sales services, as well as on the dominating debate between a separated and integrated service organization. Revealing the underlying theory is also part of this chapter.

## Chapter 3 – Methodology

To enhance the validity and rigor of the conducted research, we provide insights into the applied research methods in Chapter 3. Each sub-chapter presents the methodology followed in each of the mentioned research phases. Connected to the pragmatic nature of our research (cf. Creswell, 2014), we apply different research methods to each stage to be able to answer the research questions in the best manner possible.

## Chapter 4 – Findings

Chapter 4 presents the main results of the dissertation project. First, we describe the findings of the systematic literature review (Study 1, RQ1, Chapter 4.1.1). Afterward, we offer insights into the results of the second study (RQ2, Chapter 4.1.2). We continue with an elaboration of the outcomes connected to RQ3 and RQ4 (Chapter 4.2.1) of the third study. The chapter closes with the presentation of the typological theory (Chapter 4.2.2), the developed methodology (Chapter 4.2.3), and a discussion about the derived insights (Chapter 4.3).

## Chapter 5 – Conclusion

The last part of the thesis summarizes the gathered information, delineates the practical and theoretical contributions, as well as provides suggestions on the related limitations and future research possibilities.

## **2 Theoretical Foundations**

Describing the theoretical foundation is a vital activity with the idea to create a mutual understanding and set the baseline for the research. It is not only essential to provide information on the research context (i.e., literature streams and environment) for the readers but also to demonstrate rigor in preparing the heuristic frame of reference and prior understanding (cf. Kubicek, 1977).

Therefore, we start by describing the most important terms to define which elements are part of the research project, and which may not be. We continue by setting the boundaries of data-based services from two sides. First, we present existing service types, or categories, before we seek to explain the difference between physical, smart, digital, and data-based services. The focus on manufacturing companies in a B2B environment offering or intending to provide data-based services is one essential characteristic of the dissertation project. The second vital part is its localization within the separation against the integration debate of the data-based service organization. Hence, we condense existing perceptions in the context of this discussion before unfolding the theoretical layer of our research. Describing the theory is essential insofar as the theoretical lens depends upon the perspective in which we are looking at the present problem.

### **2.1 Terms and Definitions**

The following five terms describe the most critical aspects in the realm of the thesis at hand, which we want to discuss in more detail. Chapter 2.2 introduces the sixth term.

*Servitization* – is a term coined by Vandermerwe and Rada (1988) and describes the transformation of a manufacturing company formerly concentrating on producing products, to a state of complementing their product with a service business. Often, it refers to a change of the business model, where manufacturing companies add services to their portfolio (Lightfoot, Baines, & Smart, 2013). Along with

servitization, authors introduced different expressions, including service transition (e.g., Kowalkowski, Windahl, Kindström, & Gebauer, 2015), service infusion (e.g., S. Brax, 2005) or more recently digital servitization (e.g., Vendrell-Herrero & Wilson, 2017). In principle, all expressions mean the same evolution of a manufacturing company from a pure product provider to offer a combination of products and services, or solutions (Windahl & Lakemond, 2010). Yet, the latter term, digital servitization, implies the involvement of digital technologies or digital components within the process of offering services (Holmström & Partanen, 2014; Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017; Vendrell-Herrero & Wilson, 2017). It is “formally defined as the provision of digital services relying on digital components embedded in physical products” (Vendrell-Herrero & Wilson, 2017, p. 4).

Although our research project is coping with new data-based services, we adhere to the general term servitization in the remainder of this thesis. We opt for the general terminology, as authors repeatedly use *servitization* to express the process of a manufacturing company offering or intending to provide services (Baines et al., 2009; Baines et al., 2017; Vandermerwe & Rada, 1988). Since *service* in this context is the overarching term for all services, it also includes digital services (cf. Vendrell-Herrero & Wilson, 2017). Consequently, digital servitization is part of servitization from our perspective.

*Organizational Structure* – is “defined as the formal allocation of work roles and the administrative mechanisms to control and integrate work activities including those which cross formal organizational boundaries” (Child, 1972, p. 2). It describes the continuous focus on data-based service activities (described below) throughout the dissertation project. Besides the formal definition, we have to note that we will not challenge the organizational structure of manufacturing companies in general. Instead, we focus at first on the package of data-based service activities and follow these within the organization. Later, we deepen the level of analysis and discuss potential organizational configurations for each of the main activities related to data-based services. Thus, we mostly neglect other activities (e.g., by the corporate IT or product development) than those of or essential for data-based services in the scope of our research project. Chapters 4.3 and 5.3 then discuss potential shortcomings concerning the practical application of our findings arising from this simplification. Consequently, when we debate the organizational structure of a manufacturing

company in the remainder of this thesis, we concentrate on the localization of data-based service activities and not on the whole organization.

*Organizational Configuration* – while the organizational structure accounts for the overall structure consisting of several sub-elements, such as the Finance and Sales department, the organizational configuration is an expression applied to describe a specific set and composition of these sub-elements. Thus, it is the concretization of the organizational structure. However, multiple organizational configurations are possible, which is why the dissertation project at hand tries to find feasible solutions for the treated problem. Particular organizational configurations are, in turn, specified as ideal types.

*Ideal Type* – following the view of Weber (1949) and Bailey (1994), an ideal type is the quasi-fictional representation of a type's version that may be found empirically but is likely not to be existing in its pure form. It demonstrates the accentuation of specific characteristics to support the differentiation between these types. Ideal types are abstract forms of real-world evidence that should enable the user to focus on particular traits. Even though the typology introduced in Chapter 4.2 encompasses eight ideal types, we will apply the simplified form “type” for the expression “ideal type” throughout the thesis at hand.

*Data-based Service Activities* – include the development, sales, and delivery of data-based services, according to Kindström and Kowalkowski (2014) and Posselt (2018). Here, we integrate the innovation process of deriving new data-based service ideas into the development phase (cf. Kindström & Kowalkowski, 2014). As indicated before, we examine data-based service activities as a black box in the first study. Throughout the second and third research phases, we lower the level of analysis to development, sales, and delivery activities. Yet, in the scope of the dissertation project, we are not providing advice to the necessary steps, phases, or detailed tasks of each of the three core activities.

It became apparent that multiple terms concerning *services* exist. Hence, to create a mutual understanding of what we define as data-based services, we dedicated the following sub-chapter to their demarcation.

## 2.2 Demarcation of data-based Services

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2018).*

To provide a better understanding of service types and especially data-based services, we follow a two-step approach. First, we provide insights into selected existing categorizations of service types. Second, we elaborate on the different perceptions and varying attributes of physical, smart, digital, and data-based services.

Mathieu (2001) introduced a typology of services, which many authors apply repeatedly. She differs between two generic sorts of services: (1) services supporting the actual goods sold and (2) services supporting the customer. The first group encompasses all traditional after-sales services, such as spare parts, repair, and maintenance. In contrast, the latter group describes sophisticated services (e.g., training or optimization services), which require a higher amount of process knowledge about the customer's production (Mathieu, 2001).

Gebauer (2008) suggests another approach to classify service types, embracing four different forms of services. (1) After-sales services, being similar to the first group of Mathieu (2001); (2) Customer support services, including product-oriented services, to prevent downtime and increase efficiency; (3) Development services, (accounting, for example), for services that support or replace the development of new products for the customer. And the last group, (4) outsourcing services, which incorporate, for instance, engineering or simulation activities performed as a service for the original equipment manufacturer (Gebauer, 2008).

While the categorization of Gebauer (2008) is rather sharp, Baines and Lightfoot (2013) and Bustinza, Vendrell-Herrero, and Baines (2017) propose a distinction between basic, intermediate, and advanced services. Here, advanced services are primarily associated with contracts ensuring a certain level of availability or a particular outcome (Baines & Lightfoot, 2013). Often, the manufacturing companies take over more risks for their equipment, but their customers reward them for meeting the negotiated values (Baines & Lightfoot, 2013).

Moreover, Turunen and Toivonen (2011) offer a three-class differentiation of industrial services (services supporting the product, services supporting the customer's process, and services supporting the customer's businesses) based on work from Kotler (1997) and Mathieu (2001).

These generic service types demonstrate that besides traditional after-sales services, also new data-based service may be distributed among them. Cusumano, Kahl, and Suarez (2015) specifically controlled for the possible integration of data-based services among their general distinction between complementary services and substituting services. Here, complementary services embrace services that ease the product usage or sale (smoothing service) and services significantly enriching product functionality (adapting services) (Cusumano et al., 2015). Substituting services are predominantly seen as services replacing the actual purchase of an asset (i.e., products sold as a service) (Cusumano et al., 2015).

Consequently, it is difficult to distinguish data-based services from traditional after-sales services by concentrating on the presented service classifications. To clarify the difference between known after-sales services and new data-based services, as well as to other existing terminologies, we elaborate a little further on their attributes.

Nonetheless, how a traditional after-sales service may be categorized, they share the characteristic of being mostly independent of the product the company is selling. Independent in a sense that such services (which we define as *physical services* cf. Cusumano et al., 2015, e.g., spare parts, repair instructions, training plans) are adapted and built upon a final product, but characteristics of the service itself do not shape the product predominantly (Brown & Eisenhardt, 1995; Zirger & Maidique, 1990). From some physical services, insights can influence future product development, such as recurring defects due to unexpected mechanical effects on the product, or better access to certain parts when performing repair operations. However, among other things, customer and performance requirements mainly influence product development (Ernst, 2002).

Traditional after-sales services, or physical services, consequently share the fact of being manually conducted, *offline*, and analogous. On the opposite end, the connected and digital nature of data-based services offers a rather sharp differentiation.

In our view, data-based services are all kinds of services based on a minimum level of data or having a distinct digital component. It is not limited to data coming from the hardware product of the service provider. Therefore, data-based services range from remote monitoring options to pure digital platforms, somehow connected to the manufacturer's business (Allmendinger & Lombreglia, 2005; Bullinger, Meiren, & Nägele, 2015; Grubic, 2014).

Yet, in the realm of data-based services, a plethora of terminologies exist (see Table 1), and it is worthwhile to briefly elaborate on the demarcation between data-based, smart, and digital services.

Table 1: Collection of existing terminologies by Klein (2017), based on a literature review by Grubic (2014).

<b>Expression</b>	<b>Source(s)</b>
Teleservices	Küssel, Liestmann, Spiess, & Stich, 2000; Lee, 1998
Diagnostics and prognostics	Greenough & Grubic, 2011; Grubic et al., 2011
New digital technologies	Wise & Baumgartner, 1999
Remote diagnostics	S. A. Brax & Jonsson, 2009; Jonsson, 2006; Jonsson & Holmström, 2005; Jonsson, Westergren, & Holmström, 2008; Kuschel, 2009; Kuschel & Ljungberg, 2005
Remote repair, diagnostics, and maintenance	Biehl, Prater, & McIntyre, 2004
Remote monitoring technology	Bandinelli & Gamberi, 2011; Davies, 2004; Gremyr, Löfberg, & Witell, 2010; Grubic, 2014; Grubic & Peppard, 2016; Jonsson & Westergren, 2004; Laine, Paranko, & Suomala, 2010; Westergren, 2011
Remote monitoring system	Jonsson & Westergren, 2004
Remote service	Wunderlich, 2010
Intelligent products	G. G. Meyer, Främling, & Holmström, 2009
Smart technology	Ostrom et al., 2010
Smart, connected products	Porter & Heppelmann, 2014
Smart remote machinery maintenance	Lee, Kao, & Yang, 2014
Smart service	Allmendinger & Lombreglia, 2005; Wunderlich et al., 2015

Following the aggregation of multiple definitions concerning smart services, components, or examples of them, Klein (2017, p. 8) concluded that “smart services are technologically-mediated services actively delivered by the provider through accessing a remote asset and exchanging data through built-in control and or feedback devices.”

This definition is, however, partly neglecting new services of manufacturing companies not necessarily based on data originating from a remote asset. Digital services are, in our perspective, such services. For instance, merQbiz is an online platform of Voith, a manufacturing company over a hundred years old, where

customers can buy and sell the recovered paper<sup>2</sup>. In this case, the application is not building upon original data from Voith paper machines.

To differentiate between physical, smart, digital, and data-based services, we can furthermore draw upon four characteristics, according to Cusumano et al. (2015): intangibility, variability, separability, and perishability.

In contrast to services, products are tangible, easy to standardize, the production and consumption occur separately, and they are storable. Physical services, such as training or repair operations, are still somewhat tangible and easy to standardize. However, the *production*, in this case, the *delivery*, and its consumption coincide, and it is impossible to *store* repair operations.

Digital services are different and more similar to software. The necessary program for a fleet management application, for instance, is stored on a server and can be accessed anytime, while running in the background. Therefore, it is partly durable, and its usage is principally at another time than its production (i.e., its development). Standardization among different customers is, however, questionable, as well as the tangibility.

Smart services are commonly referred to as intangible and difficult to standardize, while the separability and perishability are ambiguous. One example is a predictive maintenance option. Sharing attributes of insurance, the customer cannot grasp what the algorithm is doing. Nevertheless, the program is stored at a cloud or server, while the actual event of replacing a part before the breakdown of a machine occurs at the same time as its *delivery*. As a result, we have to note that characterizing services according to their intangibility, variability, separability, and perishability (Cusumano et al., 2015) leads to blurring boundaries.

Going further, we learned before that the category of smart services is not necessarily including digital services, which is reflected by their ambiguous characterization. Thus, we apply the expression of data-based services within this thesis to overcome the differentiation between, as well as to unite, asset-related smart services, and asset-unrelated digital services. In this sense, we classify classical smart services (e.g., condition monitoring, predictive maintenance), as well as pure digital services (e.g., asset-unrelated applications by manufacturing companies, see merQbiz<sup>2</sup>) as data-based services.

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<sup>2</sup> <https://www.merqbiz.com/>

## 2.3 Structuring the Service Organization

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020a, 2020b).*

As indicated in the introduction, generally, two opposing perspectives exist within the *optimal* organizational structure concerning the service business. Nevertheless, Kowalkowski, Kindström, and Witell (2011) considered the possibility of externalizing the service business completely. Yet, the majority of scholars focus on the internal provision of services in an either integrated or separated fashion.

Commonly, the separation of the service business into a distinct organizational unit is associated with superior performance, since they have to account for their profit and loss responsibility (Oliva & Kallenberg, 2003). Encapsulating the service business into a new department advocates nurturing a service culture and philosophy, in turn, increasing customer and service orientation (Bowen, Siehl, & Schneider, 1989; Turunen & Toivonen, 2011). Another argument for separation builds upon the notion that service development favors decentralized information flows, while product development points out the requirement for centralized information flows (Kim, Park, & Prescott, 2003). Thus, a separate service organization may innovate, develop, sell, and deliver services more efficiently and effectively when being highly autonomous.

Contrary, scholars found evidence why companies should pursue the integration of the service business. Neu and Brown (2005) are among the most prominent researchers defending the point of view that a manufacturing company is commonly serving the same customer base with their new services. Expressed as the market rationale (Drucker, 1974), companies should unite all product-oriented and service-oriented activities directed towards the same market into a single department (Neu & Brown, 2008). Companies operating in highly diversified markets, or markets with high volatility, are especially advised to concentrate their market sensing and seizing endeavors. As a result, combining product and service development has the potential to create synergies when focusing on customer needs and may enable the organization to deliver high-value offerings (Biege, Lay, & Buschak, 2012). Interdisciplinary work is required to serve a broader customer need, supported by an integrated structure, bringing strongly cooperating units closely together (Neu & Brown, 2005, 2008).

While arguments for both extremes—integration and separation—exist, scholars acknowledge that the boundaries increasingly blur. Instead, it is the case that separation per se does not guarantee superior performance (Turunen & Toivonen,

2011) and that a specific organizational configuration should match the service strategy a company pursues (Auguste et al., 2006; Gebauer, Fischer, & Fleisch, 2010). Recently, Raddats et al. (2019) stated that a separate service organization might not be the best solution, but it supports the quick dispersion of a service mindset within the organization. According to these authors, separation could be seen as a necessary pre-condition for formerly product and engineering-dominated manufacturing companies to ramp up the service business (Raddats et al., 2019). In the same article, however, Raddats et al. (2019) acknowledge that the academic discourse is wafting around the separation against integration debate, while they feel that companies will find a way as their service business matures, even though academia has not yet found feasible solutions for that problem.

It becomes apparent that a variety of scholars already coped with the difficulty of shedding light on questions concerning the optimal organizational structure of manufacturing companies offering or intending to provide services. Table 2 consequently gives a brief overview of relevant articles treating effects on the organization due to servitization.

The table shows that traditional after-sales services predominantly drive these assessments. Since the emergence of data-based services questions previous findings, it is worthwhile to elaborate shortly on the role of digitalization in this context.

*Table 2: Overview of statements from literature in the realm of the separation vs. integration discourse.*

<b>Source</b>	<b>Statement</b>
(Auguste et al., 2006)	An independent (or separated) service organization seems to be most appropriate if firms want to increase service profitability and revenues, whereas an integrated service organization improves product sales and customer satisfaction.
(Biege et al., 2012)	Products and services should not be independently developed. Instead, they should be developed in an integrated way to assure that the tangible and intangible components of the product-service bundles fit.
(Bilgeri et al., 2018)	Recent digitalization developments often lead to structural separation in practice (i.e., the allocation of IT responsibilities to new organizational units). The interviewees highlighted that separation increases customer focus, IoT awareness, and the agility to deliver IoT services by introducing a dedicated centralized IoT unit.

- (Böhm et al., 2017) Resources enable the necessary alignment of capabilities and organizational structures within the firm.
- (Bowen et al., 1989) There is an internal rationale that argues for a separate service organization to protect the nascent service culture from the biases and pressures of the product-centric culture.
- (Burton, Story, Raddats, & Zolkiewski, 2017) The data emphasize the importance of having good connectivity between NPD and NSD, discussing key touchpoints between the processes.
- (Bustinza et al., 2015) In general, our findings demonstrate the importance of organizational structure in generating a competitive advantage and improved performance; in some cases, the "right" approach may mean being flexible enough to use different approaches in different contexts.
- (Bustinza et al., 2017) Advanced services may require holistic organizational transformation. During servitization transformation, the firm realigns processes, resources and capabilities, value propositions, and financial expectations.
- (Drucker, 1974) Organizational theory suggests that firms should split their business into different units if each unit serves a different market or customer need.
- (Galbraith, 2002) Companies should design customer segment centers, customer relationship managers, and sales teams for the customer segment. These customer-centric units assess products and service units.
- (Gebauer & Kowalkowski, 2012) To gain a better understanding of whether it should integrate or separate its service organization, a company should consider specific organizational functions (R&D, manufacturing, sales, marketing, human resources, etc.).
- (Gebauer et al., 2009) Companies should integrate or separate service and product functions to achieve service orientation. Moving towards services requires companies to increase the service orientation of their organizational structures. A high level of organizational distinctiveness seems to be counterproductive for increasing the service orientation in organizational structures.
- (Gebauer et al., 2010) Our findings suggest that depending on the service strategy pattern, either separation or integration is supported.
- (Hax & Majluf, 1983) The organizational structure should be designed to facilitate the strategic pursuit of a firm. Usually, a company does not have a single dominant dimension but instead becomes a hybrid structure.
- (Kim et al., 2003) The framework predicts that firms developing services must centralize information flows and decision-making so they can

	engage with customers consistently. The framework says that firms developing services must have a different structure than firms developing products.
(Kindström, 2010)	Successful change is based on the consistency between a company's strategy and all of its structural elements.
(Kowalkowski et al., 2011)	A key factor in favor of internalization is a high degree of service orientation.
(Kowalkowski, 2011)	The effects of service infusion extend to organizational departments and functions beyond those concerned directly with the provision of the service itself, and that will include the sales function.
(Mintzberg, 1980)	An organization searches for harmony in its internal processes and consonance with its environment.
(Neely, 2008; Parida, Sjödin, Wincent, & Kohtamäki, 2014)	Changing organizational structure increases financial requirements in the initial stages of the servitization journey, such as the development of new functional groups and the recruiting of new human resources.
(Neu & Brown, 2005)	The autonomous discrete structural form did not support the formation of a strategy intended to satisfy the needs of a highly complex market.
(Neu & Brown, 2008)	Orientation toward the market is perhaps one of the most important design elements. Forming a strategy to serve the needs of a complex market, product manufacturers that form high-performing business services will exhibit integrated business unit responsibilities.
(Oliva & Kallenberg, 2003)	A critical success factor for the transition is the creation of a separate organization to handle the service offering.
(Oliva et al., 2012)	The creation of a separate service organization as a profit center has a significant positive mediating effect on the managerial commitment towards delivering advanced services; as an autonomous unit, the service business would experience a high organizational clarity to internal and external customers.
(Raddats & Burton, 2011)	Combined product and services SBUs for when services are used to differentiate products; independent services SBU when the intention is to grow services revenue; customer-focused SBUS addressing distinct market sectors or customer group. When services dominate corporate revenue, it is often appropriate to organize around market or customer groups.
(Raddats, Burton, Zolkiewski, & Story, 2018)	Services will generally be closely linked to products in terms of organizational structure (i.e., products and services in the same SBUs). An organizational separation between services and products

- may be required to enable a sufficiently strong service culture or mindset to develop service-specific targets to be set and measured.
- (Raja, Chakkol, Johnson, & Beltagui, 2018) The transition to servitization necessitates organizational design changes to support the provision of servitized offerings.
- (Reinartz & Ulaga, 2008) A separate service-selling sales force may be a necessity.
- (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019) Standardized service processes and increased centralization and control are essential for digital servitization, with further support from extensive IT resources. Centralization of decision-making authority enhanced both global efficiency and responsiveness to customer needs. Closer coupling between front- and back-end and between product and service units facilitates the stronger integration required for global efficiency and standardization of service operations.
- (Turunen & Toivonen, 2011) Although earlier literature has emphasized the positive effects of a separate service unit, the comparative case study indicates that a separate unit, as such, does not guarantee success in the service business.

To provide data-based services, companies have to access data originating from their products at the customer site and/or third sources. The need to incorporate sensors into the product aside from software engineers into service development and delivery reflects a practical consequence. Therefore, the shift towards data-based services requires new competencies, processes, cooperating mechanisms, and structures compared to a traditional product business extended with a separate after-sales service unit.

Adaptions are necessary because traditional after-sales services share the characteristic of being widely independent of the actual goods sold; independent in the sense that the development of repair schemes or training plans commonly succeeds the product development or even product sales. Thus, the influence of traditional after-sales services on product development is limited (Brown & Eisenhardt, 1995; Zirger & Maidique, 1990) in contrast to data-based services. Furthermore, the software is mainly absent concerning traditional after-sales services, adding a layer of complexity to the development of data-based services. For the latter category, companies often require considerably sophisticated knowledge of software engineering and data analytics (e.g., for predictive maintenance algorithms), demanding to enhance cooperation with the corporate IT department, for instance.

The growing digitalization of the company and especially of the services leads to various uncertainties. Here, we focus on the organizational configuration.

Essentially, laying the point of view on data-based services rather than traditional after-sales services, pure separation needs to be questioned. We found evidence that theory treated the organizational configuration of manufacturing companies, while accurate recommendations are still scarce. Especially in the intersection of servitization and digitalization, manufacturing companies seek support. It is thus part of the thesis at hand to unveil feasible structuring solutions.

## **2.4 Theoretical Lens and Research Framework**

Rabetino, Harmsen, Kohtamäki, and Sihvonen (2018) discovered that servitization-related research often misses a distinct theoretical layer. Choosing a particular theory is vital to define the lens guiding future work. Thus, we assess different possibilities that may be associated with servitization research in the following paragraphs.

For a manufacturing company with the focus on increasing its efficiency and excellence in manufacturing goods from low to high complexity over decades, it may seem odd to invest in services. In practice, this company now has to deal with at least two different types of business models and completely different approaches on how to deliver value to the customer (Porter & Heppelmann, 2015). Thus, it would be promising to examine this problem from the view of organizational ambidexterity (Winterhalter, Zeschky, & Gassmann, 2016; Zimmermann, Raisch, & Birkinshaw, 2015). There might be new cues to include investigating the organizational design of a manufacturing company engaging simultaneously in the product business, the traditional service business, and the data-based services business with an ambidexterity lens (cf. Fuchs et al., 2019).

A dynamic capability perspective may underline the focus on the ability of an organization to adapt to a changing environment (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997) and thus provide a capability-driven lens for structuring mechanisms. In the same line, the thesis could profit from the resource-based view (Wernerfelt, 1984) to elaborate on the specific capabilities and resources an organization has to manage data-based service activities.

Changing the business model due to the implementation of services due to strategic reasons is, in the end, caused by differing internal and external factors in action against the organization. By concentrating on a contingency approach, we may investigate the cause and effect relationship in this context (Fiedler, 1964; Lawrence

& Lorsch, 1967). Endorsing the suitability of the contingency view, Neu and Brown (2005) already indicated that product-oriented companies striving to excel in service operations have to align their service organization with the new strategy and peculiarities of the service business (cf. Galbraith, 1973; Mintzberg, 1979).

Contingency factors also appear in the organizational configuration theory proposed by Mintzberg (1980), discussing approaches on how to design organizations and suggesting five types of configurations. Mintzberg (1980) describes within his article two hypotheses an organization should reflect. The congruence hypothesis explains that a purposeful configuration is tightly interlinked with contingency factors and so-called “design parameters” (Mintzberg, 1980, p. 327), while the configuration hypothesis states that these parameters need to be consistent among each other. Based on his publication, Figure 2 below sketches the interrelation between several essential aspects of the organizational configuration theory. It demonstrates the interdependence of multiple factors influencing the realization of an effective organization with the structure at its heart.

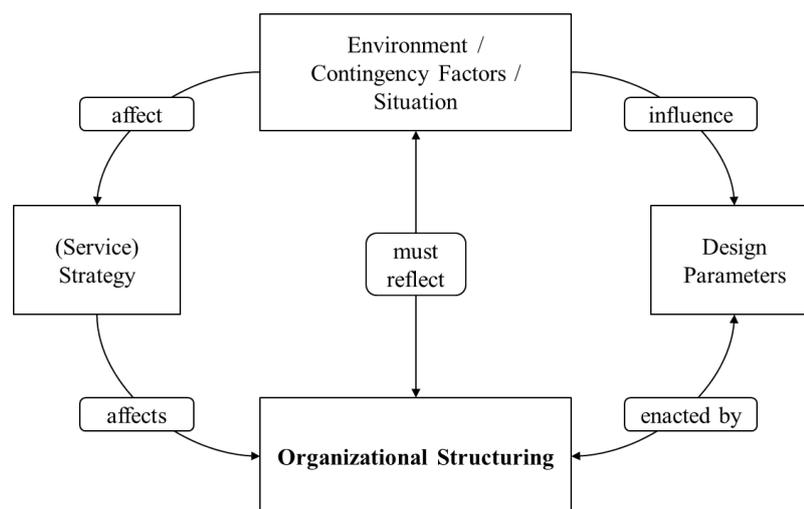


Figure 2: Organizational configuration theory. Own illustration based on Mintzberg (1980).

Therefore, the research project primarily builds upon the view of Mintzberg’s configuration theory, supported by the contingency theory, leading to an eclectic approach. Since Mintzberg (1980) himself is already proposing a few contingency factors, it seemed obvious to include a contingency perspective into the research project.

Building upon the chosen theories previously described, the research framework Figure 3 represents the examination of how a manufacturing company in a B2B environment may alter their organizational structure, due to the incorporation of data-based service activities. We suggest that a variety of factors (influence/ situational factors) influence this organizational change and is not leading to only one single optimal solution but to  $n$  possible configurations feasible for manufacturing companies, aggregated into the term *New Organizational Structure*. Furthermore, it indicates that a new organizational structure is, in most cases, not ideated on a green-field. Instead, one has to be aware of the existing structure and acknowledge certain internal contingencies.

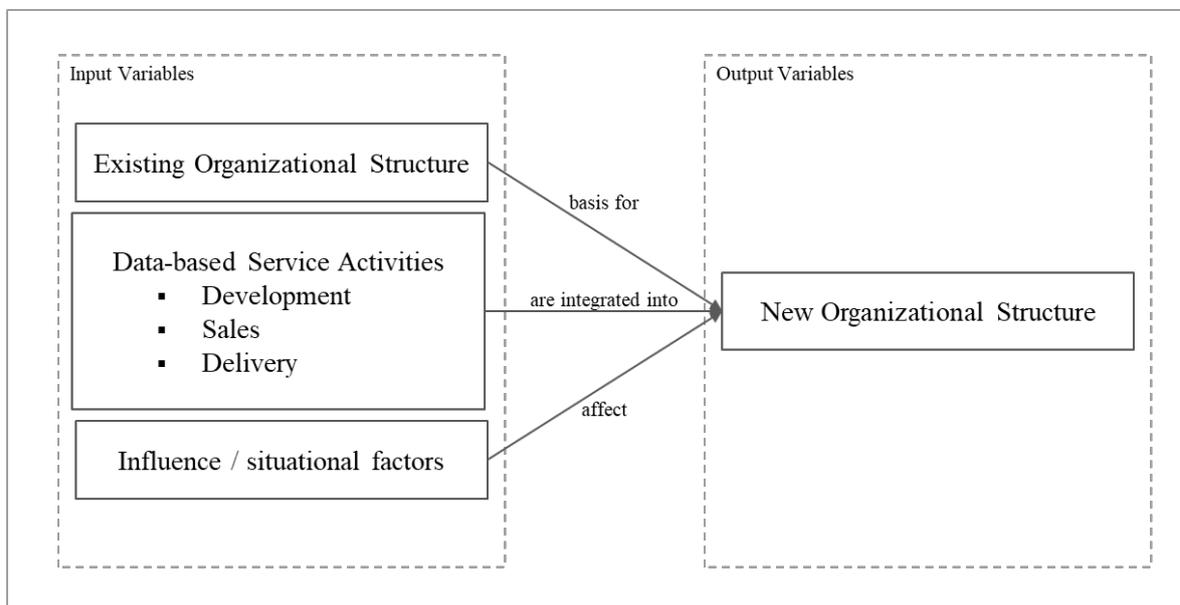


Figure 3: Research framework. Own illustration.

This research framework firmly adheres to the underlying theories. According to Mintzberg (1980), an organizational structure has to reflect the current situation a company is coping with, while its strategy increases the complexity of building the *right* configuration. Embedded into a variety of factors acting against the organization from the inside and the outside is furthermore described by the contingency theory (Fiedler, 1964; Lawrence & Lorsch, 1967).

The data-based service activities are part of the strategic direction of a manufacturing company (see Figure 3), while the existing structure commonly already incorporates an after-sales service business. The question is, therefore, how to integrate the new activities with respect to what the company has already established before. Several

situational factors (internal and external) may affect this decision and lead to the choice of one or the other new organizational structure.

In essence, we suggest that different *right* configurations exist, aligned with pre-existing structures, strategic objectives, and situational factors.

## 2.5 Summary

Chapter 2 covered the theoretical foundations of the dissertation project in the context of the formulated research questions.

We first defined basic terms, which will repeatedly arise throughout the thesis. Afterward, we offered insights into the current state-of-the-art of servitization research in the realm of the organizational structure of manufacturing companies with an excursus to notable findings from the digitalization stream.

We discovered that existing literature only provides a fragmented picture of the present research problem. The debate about a potential separation or integration of the service business mainly concerns the traditional after-sales services. Especially useful recommendations for manufacturing companies on how to structure their service organization are scarce.

Finally, we introduced the selected research theories that focus on contingency factors affecting an appropriate organizational structure.

When we combine the existing knowledge with the underlying theories, we can conclude that the formulated research questions tightly interlink with the revealed deficiencies.

Finding factors influencing the organizational structure of manufacturing companies appears highly relevant concerning the contingency theory and the corresponding aspects of Mintzberg's (1980) configuration theory.

Additionally, the impetus to derive a set of useful organizational configurations logically connects to the unclarity within the separation-integration-continuum.

The following chapter describes the chosen approach to reach the answers to the formulated research goals.

### **3 Methodology**

A sound theoretical contribution relies on a rigorous methodological approach (Corbin & Strauss, 2009). Demonstrating rigor in the pursued methodology should enable the author to build a better theory that is scientifically and practically useful while being transparent to the reader (Corley & Gioia, 2011). A key approach in theory building is cycling back and forth between data collection, data analysis, and emerging results (Eisenhardt & Graebner, 2007; Gioia, Corley, & Hamilton, 2013), wherefore we applied three different methods according to the three different problems we identified before. The general approach is thus strongly aligned with the iterative learning cycle introduced in Chapter 1.3 (see Figure 1), which is naturally run through at least three times throughout the entire dissertation project.

First, we execute a systematic literature review to account for the first research question (i.e., to reveal factors potentially influencing the decision about how to integrate data-based service activities at manufacturing companies). Building upon this set of influence factors, their examination follows through a convergent parallel mixed-method approach. As a consequence of the preliminary results after the second phase, we accomplish the conceptual development of a typology for organizing data-based service activities at manufacturing companies.

#### **3.1 Literature Review**

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2018).*

Systematic literature reviews represent a recognized method to condense and structure the existing knowledge (Baker, 2000) with the impetus to advance the focal academic field (Denyer & Tranfield, 2009; Rowley & Slack, 2004; Tranfield, Denyer, & Smart, 2003). However, they can also be used in different ways. One is to unfold research gaps and point to future research avenues in a structured manner by making use of charts or tables (Fischl, Scherrer-Rathje, & Friedli, 2014). The other is to

leverage existing research by focusing on a distinct objective the literature review is pursuing (Denyer, Tranfield, & van Aken, 2008; Tranfield et al., 2003).

Yet, to achieve reliable, rigorous, valid, and relevant results from a literature review, the systematic nature of the process needs to be documented meticulously and made transparent to the reader (Denyer & Tranfield, 2009; Tranfield et al., 2003; Vom Brocke et al., 2009).

As the first research question imposed the aggregation of influence factors that academia has already discussed, we followed the systematic literature review method proposed by Webster and Watson (2002).

We proceeded by delineating important keywords and search algorithms (e.g., “data-based service” AND organization), based on insights from an initial set of relevant literature. The keywords have then been inquired within the four major databases *EBSCOhost*, *Emerald*, *ProQuest*, and *ScienceDirect* while listing the results thoroughly (cf. Webster & Watson, 2002).

Table 3 provides an overview of the searching scheme together with the relevant results. The lines and columns can be read as follows. The first inquiry has been at *EBSCOhost* with the keywords “smart service” AND “organization,” yielding two results of which one was of higher relevance and has therefore been recorded. The second inquiry was “smart service” AND “organization” AND “factor,” resulting in one hit with no relevance. The residual searches followed the rule of going first through all keyword combinations within one database and then continuing at the succeeding database.

Table 3: Systematic literature review searching scheme & results.

	Keywords search algorithm		Databases			
	AND	AND	EBSCO host	Emerald	ProQuest	Science Direct
		-	2(1)	25(1)	75(3)	11(2)
	organization	factor	1(0)	15(1)	x	x
smart		determinant	2(0)	18(1)	x	x
service		-	1(0)	20(1)	61(2)	5(1)
	structure	factor	1(0)	13(1)	x	x
		determinant	1(0)	15(1)	x	x

		-	17(0)	18(0)	28(1)	22(1)
	organization	factor	1(0)	13(0)	x	x
digital		determinant	0	13(0)	x	x
service		-	2(0)	16(0)	25(1)	9(1)
	structure	factor	0	11(0)	x	x
		determinant	0	13(0)	x	x
		-	1(0)	3(0)	9(0)	71(0)
	organization	factor	1(0)	3(0)	x	x
data-based		determinant	0	3(0)	x	x
service		-	0	2(0)	7(0)	87(0)
	structure	factor	0	2(0)	x	x
		determinant	0	2(0)	x	x
<b>Net subtotal</b>			<b>1</b>	<b>0</b>	<b>3</b>	<b>3</b>

Notably, focusing on the different variations of data-based services (i.e., smart and digital services), combined with the pronounced keywords, led to very few results. Supporting the view that servitization research related to new data-based services is still in its infancy, the findings entailed a higher focus on the subsequent research step.

According to Webster and Watson (2002), we continued with screening the cited references and those articles citing the found artifact, often referred to as forward and backward analysis (Vom Brocke et al., 2009).

The forward and backward analysis incorporated the initial set of relevant literature, besides the seven results from the systematic literature search. We continuously reported the found influence factors. After deriving fourteen factors, we encountered theoretical saturation (Corbin & Strauss, 2009). No more context-specific influence factors could be added, wherefore the aggregated list in Chapter 4 below describes the starting point for the second research cycle.

### 3.2 Convergent Parallel Mixed-Method

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020a).*

Applying a mixed-method approach in the realm of the thesis at hand had two motivations. First, Rabetino et al. (2018) revealed that mixed-method research is

notably underrepresented in servitization research. Furthermore, the applied convergent parallel mixed-method design perfectly relates to a pragmatic worldview, an abductive approach, and the research question (Creswell, 2014). Second, the practical motivation was due to the unique possibility of profiting from a consortium benchmarking project titled *Smart Services – Transformation of the Service Organization*<sup>3</sup>. The respective questionnaire integrates all influence factors, enabling a quantitative analysis of the results, while interviews could be conducted with the successful practice company candidates.

The mixed-method approach consists of a quantitative and qualitative assessment. Accordingly, we continue by introducing the applied statistical methods before giving insights into the performed case studies in the upcoming paragraphs.

### **3.2.1 Correlation and Linear Regression Analysis**

#### ***Quantitative Data Sample***

The impetus was to validate the given set of influence factors, as well as to test their relation to the organizational structure. Hence, we incorporated these into the mentioned benchmarking study and conducted it between May and December 2018. Study participants are from Central Europe and are homogeneous in terms of industry structure. Thirty-four percent of the participants are mechanical engineering companies, 19% produce construction and agriculture equipment, and nine percent are part of the electrical equipment industry. The residual companies are manufacturers within the automotive sector (five percent) and producers of a variety of other goods (33%). Appropriate for our research scope, the vast majority of respondents are manufacturing companies offering industrial products to business customers. Most of the survey participants stem from large companies. Almost 65% of the 95 respondents work in companies with over 1,000 full-time equivalents (FTEs), and over one-third works in a company with over 5,000 FTEs. Strongly correlated with these numbers, participants from larger companies (>1,000 FTEs) answered for their division or strategic business unit. In comparison, those working at smaller companies represent, in most cases, the whole company. In both cases, responsible managers for the service organization of the company, located either at a particular division or at the top management of a company, were the primary recipients of the survey.

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<sup>3</sup> The benchmarking questionnaire and the interview guideline are enclosed in the Appendix A1.

Because of the potential bias of the benchmarking results towards larger companies, and those companies being rather advanced in the field of data-based services (assuming that these companies were more intrigued to participate), we selected the mixed-method approach with a stronger focus on the qualitative part.

### ***Quantitative Data Collection***

We developed a question for each of the fourteen independent variables (i.e., the influence factors) shown in the first column of Table 4, by relying upon existing scales as often as possible. Yet, most of the elements are unique and queried through a self-developed single-item question, wherefore no Cronbach's alpha could be calculated (Bergkvist, 2015; Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012). Since the quantitative and qualitative studies are part of the same project, it was unfeasible to address each influence factor with a multi-item construct and conduct a pretest. Being aware of limitations bound to single item inquiries, we set a stronger focus on the qualitative study below. Nevertheless, whenever possible, an interval-scaled 7-point-Likert scale was used. Several researchers independently reviewed the final questionnaire before we sent it to the recipients.

The results demonstrate a normally distributed population with only a few outliers in most cases. The dependent variable (i.e., the degree of separation [DOS]), was operationalized using an interval-scaled 7-point-Likert scale, where 1 reflects full integration (equals a decentralized configuration) and 7 means complete separation (separate data-based service business unit or division, but not externalized). In total, 498 employees working in a management position at the service organization of a manufacturing company received the questionnaire. Eighty-five of the 95 answers can be used for the quantitative assessment, depicting a response rate of 17%.

### ***Quantitative Data Analysis***

To test the significance of the relationship between each of the given influence factors (independent variables) and the DOS (dependent variable), we performed a correlation analysis using SPSS. Beforehand, a scatterplot examines the linearity. The normal distribution of the variables was verified by creating a graphical interpretation using a histogram, besides a Q-Q plot and executing a Kolmogorov-Smirnov test for  $n > 50$ , as well as a Shapiro-Wilk test for  $n < 50$  (Brosius, 2013; Kuckartz, Rädiker, Ebert, & Schehl, 2013). We performed both tests due to one factor having less than fifty responses. All variables passed the normality test, with only one being at the lower bound of the true significance. To be able to examine specific relations, we

created a table of hypotheses stating how each of the independent variables is expected to interact with the dependent variable. Table 4 displays the given set of variables, their code used for analysis purposes, and the corresponding hypotheses, predominantly supported by literature. The hypotheses originate from the literature-based discussion of the results of research phase one. We continued with an assessment for outliers using SPSS and eliminated all outliers from the sample exceeding a double standard deviation, in line with common approaches (Kuckartz et al., 2013). Based on the cleansed data, we conducted a bivariate one-tailed correlation analysis, since the preparation indicated a directed correlation.

According to Brosius (2013), little or no autocorrelation, homoscedasticity, and a linear relation between the independent variables and the dependent variable are prerequisites for linear regression analysis. We followed with a Durbin-Watson test for autocorrelation. The variables showed little to no autocorrelation with values between 1.7 and 2.1 being in the acceptable tolerance of  $2 \pm 0.5$  (Brosius, 2013). We approved linearity earlier and confirmed homoscedasticity by creating residual plots. Thus, we conducted a set of linear regression analyses to test the 1-to-1 relation between the given set of influence factors with a significant Pearson correlation of  $p < 0.05$  and the DOS.

Table 4: Overview of the given set of influence factors with the corresponding hypotheses.

<b>Given set of influence factors</b>	<b>Code for Analysis Purposes</b>	<b>Hypothesis</b>	<b>Source</b>
Maturity of data-based service business	MAT	H1 High maturity of service business leads to a high degree of separation.	(e.g., Biege et al., 2012; Oliva & Kallenberg, 2003)
Diversification of the organization's markets	MDI	H2 High market diversification leads to a high degree of integration.	(e.g., Drucker, 1974; Mintzberg, 1980)
Market volatility	MVO	H3 High market volatility leads to a high degree of integration.	(e.g., Drucker, 1974; Neu & Brown, 2005)
Separability of the value proposition	SVP	H4 High separability of the value proposition leads to a high degree of separation.	(cf. Kindström, Kowalkowski, & Alejandro, 2015; Kotler & Keller, 2016)

Service strategy	STR	H5	Strong strategic focus on data-based services leads to a high degree of integration.	Self-developed
Product characteristics	PCH	H6	High complexity of products leads to a high degree of integration.	(cf. Oliva et al., 2012)
Degree of centralization of decision-making authority	CDM	H7	A high degree of centralization leads to a high degree of integration.	(Homburg, Workman, & Jensen, 2000; Neu & Brown, 2005, 2008)
Age and size	AAS	H8	A high degree of bureaucracy leads to a high degree of separation.	(Mintzberg, 1991)
Degree of customer-centricity	CCE	H9	A high degree of customer-centricity leads to a high degree of separation.	(cf. Gebauer et al., 2009)
Human resources	HRE	H10	A high degree of employee specialization leads to a high degree of separation.	(cf. Galbraith, 2002; Neu & Brown, 2005, 2008)
Integrated business unit responsibilities	BUR	H11	A high degree of autonomy leads to a high degree of separation.	(Neu & Brown, 2005, 2008)
Service development process	SDP	H12	Existence of a separate service development process leads to a high degree of separation.	(Burton et al., 2017)
Technical System	TSY	H13	A high degree of formalization leads to a high degree of separation.	(cf. Mintzberg, 1980)
Sales process – strategy and channel	SSS	H14	A self-standing service sales process leads to a high degree of separation.	Self-developed

### 3.2.2 Case Study Interviews

To compensate for shortcomings of the described quantitative assessment, as well as to get actionable information from practitioners (M. B. Miles & Huberman, 2007), we decided to conduct further interviews in a convergent parallel manner (Creswell,

2014). It means that with the end of the benchmarking study (i.e., after the data collection for the statistical analysis), we selected seven case study companies from the benchmarking study that demonstrated superior performance (i.e., successful practice company candidates). Subsequently, the quantitative and qualitative analysis of the inherent data sample is executed in a *parallel* manner (instead of sequentially) to converge into combined findings (Creswell, 2014). The idea is to bring both worlds together instead of building succeeding research upon one or the other method.

Case study interviews are a well-known and recurring qualitative research method to examine under-researched topics and derive insights from practice (Edmonson & McManus, 2007; Eisenhardt, 1989; Yin, 2009). Deriving insights from multiple case study research is associated with high interest, replicability, and generalizability (Eisenhardt & Graebner, 2007). Thus, we continue with a brief overview of the data sample, collection, and analyzing procedure.

### ***Qualitative Data Sample***

Complementary to our quantitative analysis and highly suitable for a growing research field, we performed two case study interviews with every company. Seven companies were selected considering their performance in the benchmarking study, the proposed number for multiple case studies, and theoretical sampling (Corbin & Strauss, 2009; Eisenhardt, 1989; Eisenhardt & Graebner, 2007; M. B. Miles & Huberman, 2007).

All case study companies are large manufacturing companies (>5,000 FTEs) from different industry sectors in Central Europe operating in a B2B environment and offer rudimentary to advanced data-based services. They differ concerning the current organization of the service business in terms of their DOS. Moreover, some transitioned from one configuration to another in the progress of leveraging their data-based service business. These companies provide a unique opportunity to benefit from insights about the rationale behind the decision-making. Table 5 offers a summary of the examined manufacturing companies.

Table 5: Overview of the case study companies.

Company Code	Country	Industry	Size [FTEs]	Level of experience with data-based services
Company A	Germany	Machinery industry	13,500	Intermediate
Company B	Germany	Machinery industry	19,000	Advanced
Company C	Germany	Machinery and equipment industry	20,000	Advanced
Company D	Germany	Construction and agricultural machinery	5,000	Novice
Company E	Germany	Construction and agricultural machinery	60,000	Expert
Company F	Liechtenstein	Construction and building equipment	27,000	Expert
Company G	Switzerland	Machines for process industry	11,000	Intermediate

### ***Qualitative Data Collection***

The interviews followed a two-step approach. First, semi-structured interviews helped obtain a more general view on the topic of data-based services and organizational transformation at the focal companies. We recorded these and formulated a case study report after each interview. Based on the first insights, we developed another semi-structured interview questionnaire<sup>4</sup> (cf. Maurer & Ebers, 2006; Sutton & Callahan, 1987; Yin, 2009), explicitly incorporating the fourteen influencing factors, resulting in more in-depth interviews with the same companies again. An additional researcher reviewed the questionnaire to accommodate for validity and consistency.

The second round of interviews consisted of two parts. The first part included questions about the general organizational setting, such as how it evolved and what the advantages and drawbacks are. The second part focused on the set of influence

<sup>4</sup> See Appendix A1 and A2 for details on the interview guidelines.

factors. Here, we inquired whether these factors are consciously, unconsciously, or not at all incorporated into the organizational structuring process. If the companies integrated these knowingly, the interview partners provided a number between 1 and 5 (5-point-Likert scale) from not important to very important at the moment of decision-making. We further asked the participants to give another evaluation in the same style, whether they believe that the focal value increases or decreases (or remains at the same level) in its significance in the next three to five years. The interviews finished with an explanation of the local service delivery.

We ensured anonymity (Gioia et al., 2013; Huber & Power, 1985) and conducted all interviews via telephone between December 2018 and April 2019. Every interview of the second round lasted between 35 and 70 minutes, has been recorded, and consequently transcribed, resulting in a total of 74 pages of interview material.

### ***Qualitative Data Analysis***

In coherence with the abductive research approach, we developed a list of twenty-one codes before the beginning of the analysis, following the hypothesis coding scheme described by M. B. Miles and Huberman (2007). Thus, the coding list closely reflects topics inquired about during the interviews, to be able to relate the emerging findings with the data analyzed in the quantitative part. We screened the interview material and assigned the predefined codes wherever applicable using ATLAS.ti 8.3. This procedure offers the possibility to analyze each case individually and then across all seven cases, focusing on the relevant citations collected within each code (Eisenhardt, 1989).

Instead of following an open coding scheme to derive new aggregated constructs from the interview data (cf. Edmonson & McManus, 2007; Gioia et al., 2013), we intentionally strove to preserve the narrative content of the citations to enrich the statistical analysis with storytelling elements.

In summary, the quantitative and qualitative analysis builds upon the same dataset (i.e., the interviewed companies all participated in the benchmarking study and achieved superior performance compared to the study average). Different analysis techniques combine strengths and compensate for the limitations of the applied research methods. Each analysis provides insights into the researched phenomenon from a distinct point of view, enabling the possibility to acquire a more round and profound understanding of the organizational configuration of data-based service activities at manufacturing companies.

### 3.3 Conceptual Typology Development

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020b).*

The ultimate objective of the dissertation project is to derive feasible solutions for structuring data-based service activities at manufacturing companies. The first two research phases enabled an understanding of potential influences on structuring mechanisms and showed current tendencies in organizational configurations. Consecutively, we dedicate the third phase to developing types of organizational configurations based on the acquired knowledge so far.

In general, typologies emerge purely conceptual (Bailey, 1994; Fiss, 2011). We chose to follow the three steps explained below with the impetus to develop a typology with high rigor. Therefore, we leveraged the findings of the conceptual development with expert discussions and empirical cases.

#### 3.3.1 Conceptual Development

Rooted in action-based research covering the subject of organizational integration of data-based service activities at manufacturing companies, certain potentially promising types of organizational configurations emerged. Discussions with industry experts and theory especially helped to shape the conceptual development of eight basic types by relying upon real-world evidence. Consequently, the initial set of types has neither been derived purely deductive, nor strictly inductive. Referring to Bailey (1994, p. 32), however, combining the conceptual development of types with empirical studies to find evidence is called the “classical strategy” and seen as a deductive approach.

With a distinct effort to balance the level of abstraction between good practical transferability and general applicability, we created visual representations of each type comparable to known organization charts. We added a description of the main characteristics, as well as a deduction of advantages and disadvantages connoted to each type. Out of these descriptions, we delineated a list of attributes characterizing the types.

We focused on critical and dominant attributes that help to differentiate these types among each other. Yet, we were aware that this list might not be conclusive concerning a detailed analysis. Nevertheless, we found the aspects to be a manageable number of vital attributes characterizing these types sufficiently, being in line with

known approaches to concentrate on differences among types in creating a typology (Doty & Glick, 1994; R. Meyer, 2007).

Additionally, guidelines for deriving a functional typology supported the conceptual development of the eight types. The types should be mutually exclusive and collectively exhaustive (MECE), have clear and concise labeling, and highlight the differences (Bailey, 1994; R. Meyer, 2007, p. 28).

### **3.3.2 Expert Discussions**

Following up the conceptual development, we conducted unstructured interviews with four experts from academia and industry. The objective was to get feedback on the typology, with a distinct focus on the MECE criteria, their practical applicability, and on the attributes characterizing the types.

The interviews lasted between 60 and 90 minutes, were both executed personally and through calls, and we directly noted the comments on the visual representations of the types.

We managed adaptations to the graphics and the list of attributes in two ways. Incremental adaptations, such as wording issues, were incorporated directly after the interviews. At the same time, we unfolded changes (eliminations, additions) to the types or the list of attributes only after the first discussion round with the expert during the meeting.

The experts declared that the types respect the MECE criteria, while the attributes were slightly adapted. Thus, the findings created the basis for the subsequent industry feedback.

### **3.3.3 Characterization Feedback**

With the impetus to achieve higher clarity about the actual characteristics of the types according to the improved list of attributes, we sent the types together with all the necessary information to industry managers. These are mainly responsible for or highly knowledgeable about organizational decisions of the service organization at their company. The companies are all large international manufacturing companies with more than 1,000 FTEs, operate in a B2B environment, and actively offer or intend to provide data-based services. The fourteen answers supported shaping the degree to which each attribute describes a particular configuration.

The practitioners should evaluate to what extent the attributes adhere to the types with a value between 1 (= not at all) and 5 (= to a very great extent). Moreover, the

objective was to test the easiness (i.e., practical applicability) and usefulness of the derived configurations by letting the respondents select which configuration (or hybrid) suits their organization best. Here, “other” was an allowed answer to validate the collective exhaustiveness of the typology. However, no respondent selected this option.

As we were primarily interested in the binary assessment of whether an attribute is characterizing a configuration or not, the answers allowed us two approaches.

First, we set the thresholds for “in” and “out” as follows: if an average lies between 1 and 2.5, we consider it as “out” equaling 0; if an average is between 3.5 and 5, we consider it as “in” equaling 1. The interval  $2.5 < x < 3.5$  is considered as indifferent and marked as 0.5. Thus, depending on the specific execution form, it may be an attribute or not.

Second, taking the median value of the 5-point Likert-scale (i.e., the 3) as the anchor, the data permits to mark a minus or double-minus, as well as a plus or double-plus, to describe the degree a specific attribute adheres to the focal configuration or not. Thus, we chose to display the second option in Chapter 4.2, as it demonstrates a higher resolution onto the findings.

### 3.4 Summary

Chapter 3 unveiled how we strive to answer the formulated research questions. We stated that each methodology has its rationale since we aim at achieving sound results for each research objective.

To find influencing factors that interlink with the underlying contingency and configuration theory (RQ1), it appears highly appropriate to conduct a systematic literature review.

Where we believe an aggregation of influencing factors provides first insights, their validation will improve the significance of the findings. A mixed-method approach consisting of statistical analyses and case study research consequently accounts for the quest for validation and examining tendencies of the factors (RQ2).

As we are finally intrigued to offer useful recommendations for manufacturing companies about organizational configurations, we continue with a conceptual typology development. Deriving types of organizational configurations enables us to showcase promising designs (RQ3) and their characteristics (RQ4).

In essence, Chapter 3 demonstrated how we tackle the research questions one by one, while the following chapter introduces the corresponding outcomes.

## **4 Findings**

Each iterative learning cycle grounds on a deliberately selected methodology, in turn, leading each to specific results. The findings of the systematic literature review demonstrate the basis for the succeeding mixed-method approach, while the types would not have emerged without the second research phase.

Each research phase is, to some extent, self-contained. Yet, every step contributes to the endeavor of examining structuring possibilities of data-based service activities at manufacturing companies within the sphere of the separation against integration discourse.

Consequently, this chapter covers first the results of each research phase stepwise and ends with a profound discussion about salient aspects that may have been neglected so far, due to a reasonable simplification (cf. Ulrich, 1984).

### **4.1 Influence Factors**

RQ1 mainly expresses the quest to find relevant influence factors in the context of the thesis at hand. The aggregation of these factors enabled and naturally entailed their more profound analysis. Specifically, RQ2 questioned whether these factors have a genuine impact on the organizational structuring mechanism (validation) and, if so, which tendency these influences support within the separation to integration continuum (direction).

#### **4.1.1 Aggregation and Enumeration**

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2018).*

The systematic literature review yielded fourteen influence factors, following the approach described in Chapter 3.1 above. But before providing details about the factors illustrated in Table 6, we have to state that we explicitly strove to collect the elements in an unbiased manner. Meaning, we are not judging and assessing the significance of each factor related to its impact on the organizational structure in the

first place. The upcoming enumeration is, therefore, not sorted with a particular underlying logic, but grouped according to similar characteristics.

Table 6: Aggregated list of influencing factors.

<b>Factor</b>	<b>Category</b>	<b>Reference</b>
Maturity of data-based service business		Gebauer, Saul, Haldimann, & Gustafsson, 2017
Diversification of the organization's markets	Market-related characteristics	Mintzberg, 1980
Market volatility		cf. Kowalkowski et al., 2011; Neu & Brown, 2005
Separability of the value proposition		cf. Kindström et al., 2015; Kotler & Keller, 2016; Kowalkowski et al., 2011
Service strategy	Offer-related characteristics	Chandler, 1962; Galbraith, 2002; Kowalkowski et al., 2011; Mintzberg, 1980
Product characteristics		cf. Oliva et al., 2012
Degree of centralization of decision-making authority (power structure)		Homburg et al., 2000; Mintzberg, 1980; Neu & Brown, 2005, 2008
Age and size	<i>Intangible</i> organizational characteristics	Mintzberg, 1980
Degree of customer-centricity		Gebauer et al., 2009; Kindström et al., 2015; Matthyssens & Vandenbempt, 1998; Turunen & Toivonen, 2011
Human resources		Galbraith, 2002; Kowalkowski et al., 2011; Neu & Brown, 2005, 2008
Integrated business unit responsibilities		Neu & Brown, 2005, 2008
Service development process	<i>Tangible</i> structural characteristics	Burton et al., 2017
Technical system		Mintzberg, 1980
Sales process – strategy and channel		Gebauer et al., 2009; Kindström et al., 2015; Kowalkowski et al., 2011

***Market-related characteristics***

The first group of factors encompasses elements linked to the presence in, properties, and diversity of markets a company is handling. As such, highly fluctuating markets require vast flexibility and dynamic capabilities within organizations in being able to tackle the altering environmental conditions (Teece et al., 1997).

Accordingly, market volatility influences the organizational structure (Kowalkowski et al., 2011; Neu & Brown, 2005). Neu and Brown (2005) argue that integrating the service unit favors a concentration on specific markets with appropriate bundles of services and products. Thus, it may be superior to organize by devotion to market segments to consolidate market knowledge and build upon experiences on how to handle the volatility. Mintzberg (1980) is taking the same line by articulating that an organization's design should reflect the diversified markets in which they are operating.

Assuming a company is already serving one or more of its market segments with a portfolio of physical products and data-based services, the maturity of the data-based service business will most probably influence the organizational structure as well (Gebauer et al., 2017). Starting to provide data-based services might be realized by occasionally devoted (e.g., sales staff) and a handful of focused employees (e.g., service development), who are likely to work within their current departments. Yet, when the company increases its investment into this field, rising sales and profit amount to a significant quantity. Oliva and Kallenberg (2003), as well as Biege et al. (2012), conclude that companies should pursue the transition to a separate business unit. While the maturity factor addresses the presence on and coverage of the conquered market segments, it is also closely linked to the offer itself.

***Offer-related characteristics***

The second cluster of determinants demonstrates the dependence of the organizational structure on the products and services a company is offering. For instance, Oliva et al. (2012) promote the discrepancy between a product and service culture, translating into the differences in how these units think and work. Furthermore, depending on the product itself, there might be a considerable shift between the resources needed to develop and produce a specific good. It depends on whether the product is rather simple, cheap, and manufactured as bulk material, or highly complex for which the company requires extensive knowledge. In turn, the service design reflects the altering complexity of the corresponding products. Hence,

characteristics of the product are eligible to affect possible data-based services and, consequently, the organizational structure as well (Oliva et al., 2012).

The interdependence of physical products and services is dichotomous. As mentioned in Chapter 2.3, most articles treat product-service bundles with no or very few interfaces during the development. Hence, the interdependence is rather low. However, with the rising importance of data-based services, new value propositions (complex, comprehensive offers) are much more intertwined leading to development cycles, where product and service development teams need to work with each other (Kindström et al., 2015; Kotler & Keller, 2016; Kowalkowski et al., 2011).

The separability of the value proposition, therefore, represents the interdependence of products and data-based services. The term we introduce describes to what extent a product or (data-based) service can be sold on its own or is only able to deliver the desired value when offered together with its complementary products or services. Consequently, it is possible for stand-alone products and services to be developed separately from each other, while closely intertwined and complex value propositions create stronger coherence through an integrated structure.

Whether a company is selling services as an add-on to products (Oliva et al., 2012) or strives to leverage a higher profit share (Turunen & Toivonen, 2011) will be mainly directed by the strategy (Galbraith, 2002; Gebauer et al., 2010). Already discovered by Chandler (1962) and Mintzberg (1980), the strategy is likely to have a significant impact on the structure of an organization.

Imagine a company pursuing its service business mainly as a marketing tool to promote its competitive products, compared to companies striving to diminish the effect of their product becoming a commodity and thus seeking services as a significant income stream. Either way, a clear tendency on what effects the strategy has on the organization does not exist.

Gebauer et al. (2010) propose patterns when a company should opt for integration or separation, relying upon the enacted strategy. However, their article is not taking data-based services into account. While separation defenders, such as Oliva and Kallenberg (2003), advocate separation with increasing service focus, we believe it is precisely the other way around. With an intense devotion to data-based services, the product is likely to be modified and adapted according to the service a company wants to offer. Accordingly, adjusting the attention to data-based service requires strong intra-firm collaboration leading to integrated team structures (Neu & Brown, 2005, 2008).

Strategy is a multifaceted factor not unequivocally assignable to one or the other group of determinants. While it has a strong impact on the portfolio the company is offering, it characterizes an organization as well by its vision and mission.

### ***Intangible organizational characteristics***

Factors of the third group share elements that developed naturally over time or the company practices in a specific manner due to the imposition of individual behavior in the history of the company.

Age and size of a company are two examples that evolved over time and still influence the design of an organization (Mintzberg, 1980). Older companies often reflect rigid and bureaucratic organizations unfolding higher barriers in contrast to young and flexible start-ups (Mintzberg, 1991). Thus, introducing services as major cooperation most probably favors a separate service unit, since the changes needed to realize a completely integrated solution bear high cost and friction within the organization.

Another aspect often treated and already mentioned above is the culture of such organizations. While we do not want to spread the gates for a philosophical conversation about culture in general, we have to admit that employees in product development and those selling a service think and value differently. For instance, the degree to which these employees set the needs and problems of their customers in the center of their work varies a lot (Gebauer et al., 2009; Kindström et al., 2015; Matthyssens & Vandenbempt, 1998; Turunen & Toivonen, 2011).

Condensed in the expression of customer-centricity (Gebauer et al., 2009), the organization is likely to differ in terms of processes and structures, depending on whether a technology push or a market pull philosophy mainly characterizes its DNA. It may be evident that innovating services require extensive customer knowledge, especially when these unfold their highest value once being co-created with the customer (Vargo, Maglio, & Akaka, 2008).

Thus, what would be the right organizational form? It is possible to argue both ways: separation would ease the incorporation of customers, their knowledge, and the transfer within a smaller part of the company, while integration has the potential to change the mindset of all employees when realizing the benefits of providing services.

With an increased focus on distributed service personnel establishing bonds with customers and transmitting the field knowledge back to the company, another effect goes hand in hand: the power structure (Mintzberg, 1980). While traditional product

and technology-driven organizations usually centralize the decision-making authority, service organizations favor decentralization (Homburg et al., 2000; Neu & Brown, 2005, 2008), similar to information flows.

### *Tangible structural characteristics*

Neu and Brown (2005, 2008) coined an additional factor that is part of the last group considering tangible structural characteristics of an organization and captures the decentralization of decision-making authority as well. According to these authors, an organization should build up integrated business unit responsibilities for products and the appropriate services, incorporating several arguments mentioned above.

These responsibilities further encompass the service development process, as well as the sales process, strategy, and channel, described as determinants for the organizational structure by Burton et al. (2017) and by Gebauer et al. (2009), Kindström et al. (2015), and Kowalkowski et al. (2011) respectively.

A distinct service sales department, including the respective processes, strategies, and channels, clearly prefers separation (Gebauer et al., 2009; Kindström et al., 2015; Kowalkowski et al., 2011). On the contrary, it is challenging to state whether the service development process should be pursued in a separate or integrated fashion (Burton et al., 2017), again referring to the separability of the value proposition.

The way of working, exemplarily the idea of selling or developing products and services, is summarized by the technical system (Mintzberg, 1980). Here, Mintzberg (1980) links the way of working to the degree of formalization. Thus, highly controlled processes will be found in bureaucratic organizations tending to be old in age and large in size. Instead, younger companies often demonstrate higher flexibility (Mintzberg, 1980). Therefore, the technical system influences the choice of the organizational design, whereas we cannot express a significant causality between the degree of formalization and the DOS.

Slightly apart from other factors within this group, the last element concerns the people working within the focal organization. Since most companies face limited financial and human resources (Kowalkowski et al., 2011), thinking about a feasible organizational structure depends on the personnel (Galbraith, 2002; Neu & Brown, 2005, 2008). Meaning, if, for instance, employees within an organization possess talents in more than one field, it may be possible and viable to integrate the service and product organization. Yet, if the human resources reflect a strong focus on technology and the continuous development of new products, a separated organization with new inputs may yield better performance.

Designing an organization needs to include and reflect a wide variety of influencing factors, always depending upon the individual contingencies of the focal firm. Therefore, the enumerated list of determinants may partly or as a whole affect one organization more than another. The brief discussion of each factor shows no clear tendency, whether a typical manufacturing company offering or intending to provide data-based services should integrate or separate the service organization. Thus, the upcoming chapter is shedding light on the real impact and the tendency of the influence factors on the integration mode of data-based service activities.

#### **4.1.2 Validation and Contextualization**

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020a).*

Following the same sequence as before in Chapter 3.2, we first delineate the results of the statistical analysis before heading over to the findings of the case study interviews. The last sub-chapter covers the intertwining of both outcomes. We opted for this approach since both analyses resulted in considerable insights individually and ultimately converged into combined conclusions.

The results of each study reflect a static nature, showing the companies' situations today. However, the combined insights create recommendations for managers about which transformational path they may follow in the future.

##### ***Results of Quantitative Assessment***

In general, the results of the correlation and linear regression analysis are very positive. The correlation analysis without outliers showed that nine out of the given set of fourteen independent variables do have a significant relation with the DOS. Hereof, seven at the highest significance level ( $p < 0.01$ ) and two at  $p < 0.05$  level. With a Pearson correlation between  $|0.204|$  and  $|0.537|$ , the strength of the relationship lies between low, medium, and high, according to Cohen (1988). Table 7 provides an overview of the specific values.

Table 7: Results of the correlation analysis.

<b>Relation - bivariate</b>	<b>Pearson Correlation</b>	<b>Significance</b>	<b>Direction</b>
DOS – MAT	-.508	.000	One-tailed
DOS – MDI	.172	.065	One-tailed
DOS – MVO	.062	.290	One-tailed
DOS – SVP	.413	.001	One-tailed
DOS – STR	.408	.000	One-tailed
DOS – PCH	-.103	.189	One-tailed
DOS – CDM	.329	.002	One-tailed
DOS – AAS	.537	.000	One-tailed
DOS – CCE	-.046	.347	One-tailed
DOS – HRE	-.204	.036	One-tailed
DOS – BUR	.245	.015	One-tailed
DOS – SDP	.348	.001	One-tailed
DOS – TSY	.377	.000	One-tailed
DOS – SSS	-.196	.077	One-tailed

Table 8: Recap codes and their definition.

<b>Code</b>	<b>Definition</b>
MAT	Maturity of data-based service business
MDI	Diversification of the organization's markets
MVO	Market volatility
SVP	Separability of the value proposition
STR	Service strategy
PCH	Product characteristics
CDM	Degree of centralization of decision-making authority
AAS	Age and size
CCE	Degree of customer-centricity
HRE	Human resources
BUR	Integrated business unit responsibilities
SDP	Service development process
TSY	Technical System
SSS	Sales process – strategy and channel

Continuing with a linear regression analysis of those independent variables having a p-value of  $<0.05$  in a 1-to-1 relationship with the dependent variable creates Table 9. As expected, the adjusted R-square delivers about the same values as R-square, describing again low, medium, and high effects referring to the classification of Cohen (1988). For R-squares being in the region of 0.02, he defined a low effect, while R-squares around 0.13 equal a medium effect and around 0.26 a high effect

(Cohen, 1988). Thus, only HRE, BUR, and CDM have a low to medium effect on DOS, whereas the residual factors do have at least a medium effect on the organizational structuring mechanism within our sample.

The significance of these effects is again high, with the exception of HRE. Notably, only HRE (with the least significance) and MAT (with a high impact, but with a low  $n$ ) have a negative standard coefficient beta. Consequently, the higher the respective values of the independent variables are, the higher the DOS. A universally valid statement is still impossible.

Each of the relations, and the corresponding hypotheses, require individual evaluation. We have to note that we will not treat H2, H3, H6, H9, and H14 further since the respective factors were found not to have a significant correlation.

Table 9: Results of the 1-to-1 linear regression analysis.

Variable	Model Summary				Coefficients			
	n	R-square	adjusted R-square	Sig.	F-value	Stand. Coeff. Beta	t-value	Sig.
MAT	39	.258	.238	.001	12.838	-.508	-3.583	.001
SVP	55	.171	.155	.002	10.909	.413	3.303	.002
STR	81	.166	.156	.000	15.559	.408	3.944	.000
CDM	80	.108	.096	.003	9.321	.329	3.053	.003
AAS	80	.289	.280	.000	31.283	.537	5.593	.000
HRE	80	.042	.029	.071	3.344	-.204	-1.829	.071
BUR	80	.060	.048	.030	4.915	.245	2.217	.030
SDP	79	.121	.110	.002	10.492	.348	3.239	.002
TSY	77	.142	.131	.001	12.286	.377	3.505	.001

*H1: High maturity of service business leads to a high degree of separation.*

As we interpreted maturity in terms of financial revenue for data-based services (cf. Homburg et al., 2000), the results of the linear regression analysis demonstrate a surprisingly negative relation. According to our sample, the higher the turnover share of data-based services, the higher the probability is for integration, necessitating the rejection of H1. This finding contradicts existing beliefs that a focus on the service business in a separated business unit with an individual profit and loss responsibility is a requirement for financial success (cf. Oliva & Kallenberg, 2003). It also opposes statements of some of the case study companies that strive to consolidate service endeavors in a single business unit to increase synergies, clout, and sales. However,

even though the calculated values show good results, the number of relevant responses usable for the quantitative assessment is rather low (n=39).

*H4: High separability of the value proposition leads to a high degree of separation.*

If a data-based service can be sold on its own, not explicitly requiring the proprietary product of the same company, the separability of the value proposition increases. The statistical analysis supports this view that the more a company sells its services on its own, the higher the probability of separation. We thus fail to reject H4.

*H5: Strong strategic focus on data-based services leads to a high degree of integration.*

We support the view that for the provision of a compelling data-based service solution, multiple departments have to collaborate closely. An integrated structure may thus be beneficial. However, the results demonstrate that the stronger the strategic focus on data-based services, the higher the probability of separation. As a result, we can reject H5. The case study interviews significantly highlight this result.

*H7: A high degree of centralization leads to a high degree of integration.*

Again, we need to reject H7. We unveiled in our sample that the more decisions are delegated to the top management, the higher the probability of separation.

*H8: A high degree of bureaucracy leads to a high degree of separation.*

Age and size, operationalized as the degree of bureaucracy within a company referring to Mintzberg (1991), has the highest effect on the DOS and significance of all examined relations. The older and more rigid the focal company is, the higher the probability of separation. Therefore, we fail to reject H8.

*H10: A high degree of employee specialization leads to a high degree of separation.*

The second value with a negative standard coefficient beta states that the more a company distributes new tasks to existing employees, the higher the probability of integration. In other words, a low degree of employee specialization favors integration, wherefore we fail to reject H10. Yet, as mentioned before, the relation HRE-DOS has the most moderate effect and significance. The result induces a level of uncertainty about the relevance of the finding.

*H11: A high degree of autonomy leads to a high degree of separation.*

*H12: Existence of a separate service development process leads to a high degree of separation.*

*H13: A high degree of formalization leads to a high degree of separation.*

The findings of the statistical analysis support all three hypotheses, wherefore we combined their evaluation. Accordingly, we fail to reject H11, H12, and H13. The more autonomous a business unit may operate, linked to the fact that the more a company applies a dedicated service development process, and the higher the formalization at the focal company, the higher the probability of separation.

To sum it up, seven of the nine significant dependent variables tend to support an increasing separation with an increased focus on the specific variables. Only two factors favor integration, while these underlie severe limitations. We observe in practice that many manufacturing companies tend to separate their (data-based) service business from the product business, which is reflected by the statistical analysis of the given sample. Nevertheless, the interviewed managers are not always as sure about separation as the quantitative evaluation indicates.

### ***Results of Qualitative Assessment***

With the impetus to obtain more insights directly from the field into the organizational structuring process at manufacturing companies, we conducted a total of fourteen interviews with seven different case companies that offered notable findings. Table 10 shows the subjective evaluation of the questioned managers about the importance of each factor concerning the decision about where to position the data-based service activities. Additionally, Table 11 includes information about the organizational structure of each case company.

Two main facts become apparent. First, we observe that none incorporated all factors into the decision-making process. Each company deemed at least one variable as not relevant at all. Four companies even excluded three to four variables. The determinant with the most exciting distribution is MDI. Four companies eliminated it, while the other three rate it as “important.” MDI was found as “not significant” in the correlation analysis, while the surveyed companies offer one explanation. In cases where the organizational design strongly mirrors market diversification, it was valued very high. Otherwise, the impact is negligible. Second, patterns are not distinguishable. Supporting the perspective that an organization is a sensitive

scaffolding embedded in an individual environment, general rules are almost impossible to deduct, or too generic.

Table 10: Results of the evaluated variables by the case study companies. 0 = not relevant at all; 1 = incorporated; but not important; 2 = slightly important; 3 = moderately important; 4 = important; 5 = very important.

Variable	Comp. A	Comp. B	Comp. C	Comp. D	Comp. E	Comp. F	Comp. G
MAT	4	2	3	3	1	4	4
MDI	0	0	4	4	0	0	4
MVO	2	3	0	5	5	0	2
SVP	4	2	3	3	2	4	4
STR	5	4	4	4	4	4-5	2
PCH	4	0	3	5	2	5	4
CDM	4	3	3	0	2	4	4
AAS	5	4	2	0	3	1	1
CCE	5	5	4	5	5	1	2
HRE	5	2	4	5	3	4-5	0
BUR	4	4	2	2	4	0	5
SDP	4	0	4	0	4	1	0
TSY	4	3	3	1-2	3	4	0
SSS	2	0	2	3	2	5	0

Table 11: Selected information gathered from case study interviews.

	Comp. A	Comp. B	Comp. C	Comp. D	Comp. E	Comp. F	Comp. G
Organiza- tion was adapted significantly over time	Yes	No	Yes	No	No	Yes	No
Current structure	Staff position	Integra- ted	Project/ Lead Team	Integrated	Separated	Separated	Integrated
<i>If applicable:</i> Former structure	Separated	X	X	X	X	Project/ Lead Team	X
Main reason for current structure	Dis- simila- rity; Speed	Tradi- tion	Dis- simila- rity	Every- thing from a single source	Tradition	Dis- simila- rity; Clout; Speed	Tradition

Considering Table 11, we perceive two more facts as worthwhile to discuss. First, tradition appeared as one determining factor. Organizations tend to be path-dependent (Sydow, Schreyögg, & Koch, 2009), and seldom can a manager design a new organization on a green-field from scratch. The daily routine at many companies is instead to give existing personnel new and additional tasks.

Thus, many interviewed companies mention that it was a logical (and often the only) choice to designate employees already working on similar topics (either service or software) in a preexisting environment, as the company always did it before. Consequently, responsible managers thought about the *how* and *where* to position the data-based service activities, but “tradition” played a significant role for Companies B, E, and G.

When Company E was initializing the data-based service business some years ago, tradition triggered the separation of a dedicated unit.

*“So, when we want to start something new that is globally business relevant, and will have a long-term business impact and profit, then that is quite common that within [Company E] for its tradition and size that a new business unit is created.”*

Company G established a central position to coordinate the data-based service activities at the company, but the business areas execute most of the work. Our interview partner would see advantages in bundling and separating this effort, but in particular, due to tradition and political reasons, the integrated structure is not scrutinized in the foreseeable future.

The second aspect is the closeness of the current business. Data-based services per se were new to all of the companies in the beginning. However, some stated that the new business evolved to be so significantly different from the current product and service business that it had to be separated. Company F, for instance, found from the beginning that it does not make sense to work with existing processes and approaches in any of the existing units. They decided to form a project team within a short distance to top management, similar to a staff position. It mirrors the impetus to ideate and develop data-based services easier, more flexibly, and faster. After the first years of success with these services, Company F realized that to increase efficiency, effectiveness, and clout, they have to form a new business unit next to the others. Within the new business unit, the company introduced new processes and scaled up the data-based service business.

*“This software-as-a-service is fundamentally new to us. We’ve never developed cloud-based software, we’ve never sold software, so it didn’t fit what we were doing before. And so, there wasn’t a natural home for this initiative, and we said we really need people from different units and bring them together in a project organization.”*

*“When we started, we had no experience at all. Now, of course, we have learned a lot over the last few years and believe that a certain degree of maturity has led to the fact that we have now created a regular organizational unit.”*

For Company D, it is the other way around. Customers expect them to deliver everything the company offers out of one hand. Thus, to be able to provide a compelling solution instead of pieces of a value proposition that can be acquired selectively, Company D sees an integrated structure as the prime option.

*“Where is an optimization of a service organization on its own target-oriented in the overall interest, if I want to convince the customer of my complete solution, consisting of a product and a service together?”*

While the correlation analysis led to the elimination of “customer-centricity” in the quantitative assessment, we observed that the way a company connects to its customers might play a vital role. At least for Company D, they incorporated customer expectations on how the interplay between product and (data-based) service should be.

Interestingly, the local service distribution, through either the proprietary sales department or a dealer network, did not affect the decision about where to position the data-based service activities. Companies E and F are similar in terms of current structure and level of expertise, but Company E cooperates exclusively with external distributors, while Company F has its dealer network. Yet, the type of data-based service they (can) offer and the activities they have to accomplish differs a lot. Generally, having an individual sales force is connoted with easier access to customer information and other advantages in providing data-based services (Kindström et al., 2015). Nevertheless, Company E impressively demonstrates that it can work as well without direct sales.

### Combined Insights

Integration or separation? In the realm of servitization literature, this question is almost twenty years old, and scholars still cannot answer it conclusively. The quantitative assessment of the sample showed that an increasing focus on the given set of influencing factors in most of the cases (seven out of nine) supports a separation. That is what the data says. That is what business reality looks like today. However, coming from a time where separation may seem dominant concerning traditional after-sales services (cf. Gebauer et al., 2005), the companies should question themselves: Is separation still the prime option? Just because we always did it that way does not mean that we should continue doing so. It may often be the easiest way to choose to separate a unit, consolidating people and other resources, and letting them conquer the new data-based service business. But is it also the most purposeful configuration? The case study companies do not reflect the apparent tendency of separation within their organization. All of them showed superior performance against the residual sample of the underlying benchmarking study. Each figured out their own best way. Repeating the unanswered question of Fliess and Lexutt (2017), when separation is required, we see strong coherence to the following issues a company should treat: How does my company usually approach new topics? How similar is the aspired data-based service business to currently existing businesses? How do we commonly interact with customers?

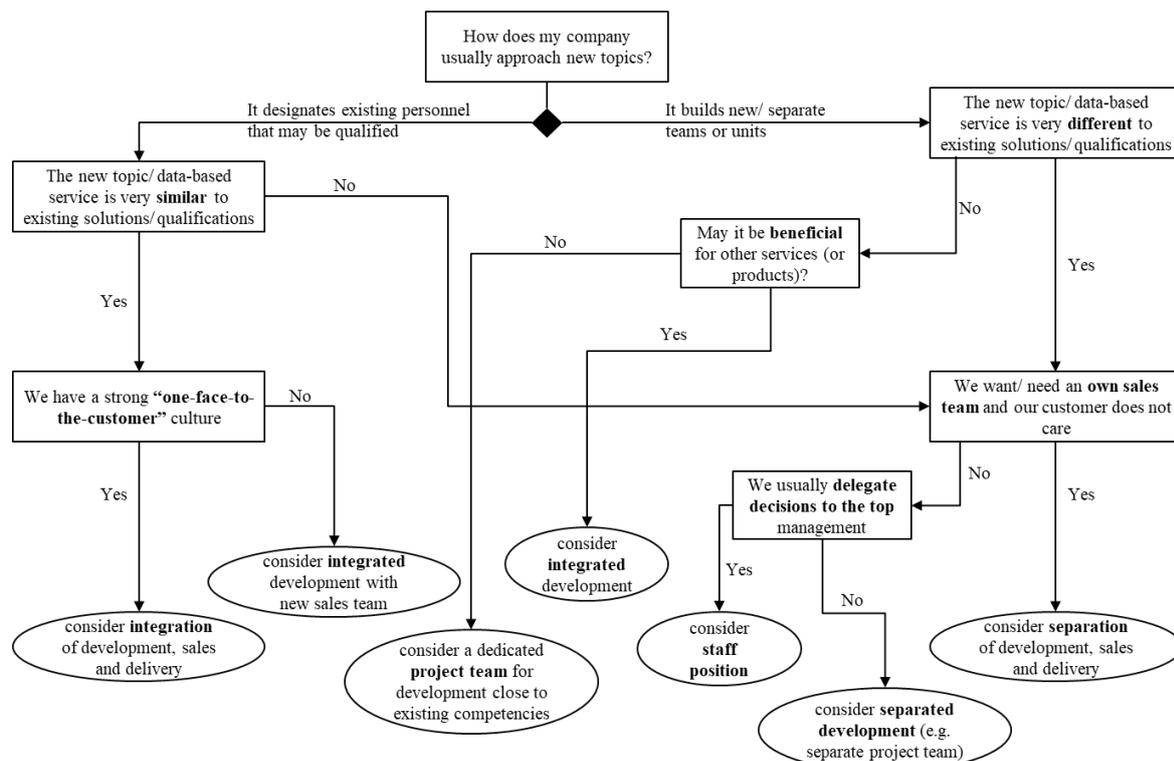


Figure 4: Organizational configuration navigator. Own illustration.

Combining the gathered insights from the statistical and qualitative analysis finally led to the development of the flow chart (Figure 4).

It should offer companies the possibility to gain a first impression of potential organizational designs. Thus, the flow chart serves a) as a summary of the main findings from the pursued mixed-method research and b) as a navigator for manufacturing companies offering or intending to provide data-based services.

We have to note that it is not conclusive concerning the number of configurations and potentially decisive influences originating from specific company contingencies. However, we designed the flow chart to trigger discussions and to provide a fast and easy way of narrowing down organizational structuring options.

Eventually, Figure 4 includes most of the underlying determinants to a greater or smaller extent. The first question treats “tradition,” as it was found in the qualitative analysis, incorporating factors such as AAS, CDM, HR, BUR, TSY, and SDP. STR, MAT, and SVP are part of the subsequent statements, dealing with the similarity or dissimilarity to the existing business. Further, CCE finds itself in the third step, comprised in the inquiry about customer interaction.

In summary, it was a vital decision to follow a mixed-method approach, since the pure statistical analysis provided a biased picture of a tendency towards separation. The combination of the findings of both methods led to a more thorough understanding of the phenomenon. Additionally, it resulted in a flow chart aiding manufacturing companies in getting a tool to assess potential organizational configurations for their data-based service business. In combination with the developed types we are presenting hereafter, the results are a strong lever for the practical application of the research findings enfolded in the methodology described below.

## **4.2 Structuring data-based Service Activities**

So far, we discovered that multiple contingency factors exist that a responsible manager should keep in mind when deciding on future reorganization measures in the process of introducing data-based services. We examined each of these factors to find cues, whether it supports the tendency towards the separation or the integration of data-based service activities, neglecting the actual manifestation of a separated or integrated structure at first. Focusing on the sole characteristic of each factor led to ambiguous interpretations. It depends more on the chain of arguments and the

selection of the right peculiarity to create the meaning of these factors favoring either separation or integration.

Consequently, the factors were embedded into a benchmarking study to find out with real-world evidence, whether the principle direction tends towards separation or integration. Notably, we validated the effect of nine out of fourteen factors on the organizational configuration, while seven relations suggest the dominance of a separate service organization. We contrasted the statistical findings with qualitative insights yielding contradicting but explanatory cues.

All in all, even though each step provided relevant and conclusive outcomes on the micro-level, the macro-level still reflects a considerable uncertainty about the organizational structure of manufacturing companies. These results may seem demotivating at this point but strongly align with the underlying research theory.

Mintzberg (1991) discovered before that generally valid structuring guidelines, and the one successful organizational design do not exist. He, therefore, constructed building blocks of organizations, described relationships, and dominant rule sets within a handful of global organization types that mirror the congruence and configuration hypotheses (Mintzberg, 1980). Condensed in his words, “do your own thing is [the] motto, LEGO [the] metaphor” (Mintzberg, 1991, p. 55), it implies a modular approach with the possibility to construct an individual organization with a finite amount of sub-elements.

Where Mintzberg followed this approach to create meaningful insights on the organizational level incorporating insurances, banks, pharmaceutical, and electro-optical companies besides any other kind of organization, we transferred his idea of a typology with a concentration on data-based service activities at manufacturing companies.

#### **4.2.1 The Typology**

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020b).*

Typologies are “conceptually derived interrelated sets of ideal types” and “identify multiple ideal types, each of which represents a unique combination of the organizational attributes that are believed to determine the relevant outcome(s)” (Doty & Glick, 1994, p. 232).

In the process of creating typologies, scholars strive to categorize by similarity within-group and maximize between-group variance (Bailey, 1994; Fiss, 2011).

Typology development stands further for a unique approach to theory building (Corley & Gioia, 2011; Fiss, 2011), supported by the delineation of a typological theory.

As the purpose of a functional typology is to reduce the real-world complexity, deriving ideal types mostly includes the pragmatic concentration on a relevant set of dimensions, supporting the overall objective of the typology (Bailey, 1994). Besides their task of reducing complexity, the pragmatic focus also demonstrates one of its advantages, according to Bailey (1994). Typologies help to find similarities and differences with the ultimate goal of allowing comparison.

Allowing comparison has been a significant objective in the process of deriving the typology below. With the impetus to provide a useful tool for academia and practice in the transformation of the service organization, we want to enable companies to evaluate different organizational configurations on how to integrate data-based service activities.

### ***Earlier Approaches***

Scholars have previously dealt with the issue of raising the abstraction level of organizational designs to derive a working typology. Amongst the most prominent are the grand approaches of R. E. Miles, Snow, Meyer, and Coleman (1978) and Mintzberg (1980).

R. E. Miles et al. (1978) describe in their strategic typology four different types of organizations: the defender, the analyzer, the prospector, and the reactor. Each of the first three types has its distinct strategy and organizational structure, whereas the latter one is a residual type where inconsistencies exist among the strategy-structure configuration (R. E. Miles et al., 1978). It is notable that even though the typology is on a high abstraction level, the authors state that it is likely not every existing form of a real organization may be categorized among these four types as organizations tend to be too unique (R. E. Miles et al., 1978). Consequently, a useful typology has to reduce the individual level of complexity pragmatically to derive a manageable number of types applicable to a higher number of situations (Bailey, 1994; Fiss, 2011).

Accordingly, Mintzberg (1980) presents five organizational configurations—the simple structure, machine bureaucracy, professional bureaucracy, divisionalized form, and adhocracy—each consisting of a specific combination of the basic building blocks, coordination mechanisms, design parameters, and contingency factors of an organization. Here, Mintzberg (1980, p. 330) achieves to, on the one hand, deliver a

general approach to structuring an organization by focusing on five basic configurations and, on the other hand, detail each configuration with sixteen different characteristics.

Even though both typologies are prominent advocates of approaches to classify organizational structures and share the characteristic of being theoretically and empirically proven, they still have questionable practical usability. Referring to Corley and Gioia (2011, p. 15), we describe their utility more as scientifically than practically useful.

Thus, the exercise is to find types of organizational configurations by achieving two objectives. First, the types are required to eliminate the profound individuality of real-world organizations by grouping artifacts to account for a wider variety of manufacturing companies. Second, the types still need to be at a reasonable abstraction level to ensure practical applicability for industry managers.

### ***Types for the Organizational Integration of Data-based Service Activities***

Adhering to the process of creating a sound typology explained before, Table 12 provides details about each attribute, characterizing the eight types. Afterward, we introduce the types.

*Table 12: Explanation of attributes.*

<b>Attribute</b>	<b>Description</b>
Central coordination of technology	The extent to which a particular configuration supports the coordination of the technological development of data-based services. It includes setting standards for interfaces, databases, platforms, etc.
Central coordination of service (development)	The extent to which a particular configuration supports the coordination of service development (e.g., to avoid redundancies).
Close to product(s)	The distance from data-based service development and sales to product development and sales.
Strong market and customer orientation	The extent to which a particular configuration supports the close market and customer relation for data-based service development.
Short distance to top management	The distance to the most critical decision-makers within a company.
Ease of implementation	The extent to which a particular configuration supports the smooth implementation/ramp-up of data-based service activities. It is strongly connected with the initial resource investment.

Active technology management	The extent to which a particular configuration supports R&D and R&D management of digital technologies relevant for data-based services, potentially outside the individual company.
Service culture diffusion	The extent to which a particular configuration supports the dissemination of a service culture/mindset throughout the whole company.
High agility and speed	The extent to which a particular configuration supports fast decision-making, pivotal behavior, short time-to-market, quick results, etc.
Good measurability	The extent to which a particular configuration supports the measurability/controllability of all activities related to data-based services.
Innovation capability	The extent to which a particular configuration supports an innovative environment, considerable output concerning innovative data-based services, etc.
Robust service delivery	The extent to which a particular configuration can demonstrate a robust service delivery (all operations related to it, including installation, troubleshooting, remote repair, etc.), once the data-based services have left the pilot stage.
Long-term sustainability	The extent to which a particular configuration supports a long-lasting structure. In contrast to structures that only work as intermediate configurations or demonstrate a good start.

### *Hub & Spoke (divisional, market-based structure)*

Companies adopting this scheme (Figure 5) commonly have many diverse divisions or business areas in which they operate. So, they strive to develop data-based Services (dbS) close to their market requirements, but profit from technical expertise pooled together at a central position.

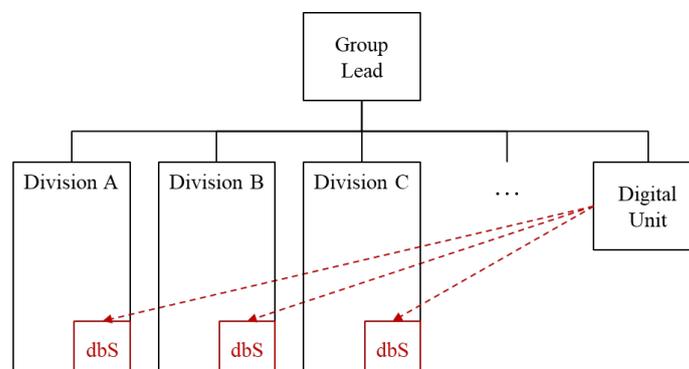


Figure 5: Hub & Spoke visual representation. Own illustration.

Considering the attributes in Table 12, feedback from practitioners triggered the perception that the *Hub & Spoke* configuration unites most of them, while none to a very great extent. Notably, we received the most returns onto this specific configuration among the companies we contacted, reflecting a distinct curiosity of manufacturing companies adopting this scheme.

Manufacturing companies that like to introduce this kind of structure need to think about the specific responsibilities and tasks split between the data-based service units at the division and the herein called digital unit. The degree to which central service coordination may take place depends upon the strategic positioning of the digital unit. For instance, if each division is very autonomous and taking advantage of the digital unit as a pure advisor for technical expertise, the digital unit may merely ensure standardization among platforms, interfaces, and other software-related topics. The sovereignty about the final data-based service characteristics might still lie within the division, not considering the portfolio and established data-based services of the adjacent business units.

Thus, companies that like to adopt this configuration need to thoroughly construct their particular version of it, specifically considering the interfaces, tasks, and responsibilities, as it is the case for all other types equally.

#### *Front-End Convergence (divisional, product-based structure)*

Companies within this category (Figure 6) tend to sell everything they have out of one hand. Meaning, there may be different units or divisions for various products and services, but ultimately products, services, and data-based services are sold by one customer-facing department.

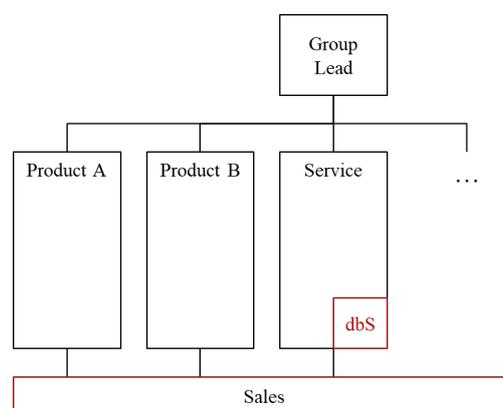


Figure 6: *Front-End Convergence* visual representation. Own illustration.

Even though this form may imply a distinct market and customer orientation, industry feedback is indifferent about it. Yet, this type favors coordination mechanisms besides high innovation capability, long-term sustainability, and above all, robust service delivery.

Conversely, this type lacks a sound service culture diffusion within the company and is challenging to implement. Manufacturing companies that feel a particular affinity to this type should be aware of the associated drawbacks and encounter these deliberately.

#### *Top Loading (functional or divisional structure)*

Dissimilarity to the current business and high concentration of decision-making at the top are common reasons why companies tend to unite their data-based service team within a staff position (Figure 7).

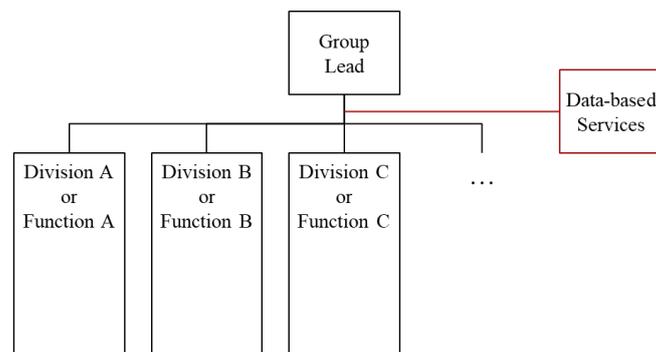


Figure 7: Top Loading visual representation. Own illustration.

Yet, the technical expertise necessary for service development and execution sits mostly in another department. These are, for example, corporate IT, research and development (R&D), or a particular unit for digital technologies.

The attributes of this configuration show good coordination and a short distance to the top management, while the measurability is particularly questionable. Notably, the feedback from the industry declares this type as a version with no long-term sustainability, whereas it is also not easy to implement. Connected with the absence of other attributes, such as innovation capability and robust service delivery, the power and clout of this type seems limited. Nevertheless, for organizations with high power concentration in the “strategic apex” (Mintzberg, 1980, p. 324), it may be a feasible solution to start with data-based services and create first offers grounded on customer needs and market requirements.

*Breaking Up (functional or divisional structure)*

Separating the data-based service activities for increased distinction, to nurture a specific culture, increased clout and measurability can happen on different levels. Displayed is the divisional level in Figure 8. Yet, it may also be possible on the unit or team level. Mostly, establishing new divisions, units, or teams comes along with hiring new personnel.

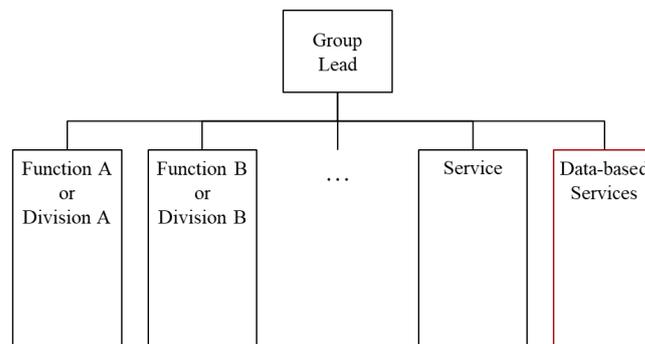


Figure 8: *Breaking Up* visual representation. Own illustration.

This type can be seen as the closest representative of a separate service organization, as promoted by Oliva and Kallenberg (2003), Gebauer et al. (2005), and other authors. We characterize the type with excellent coordination possibilities (within the division), good service culture diffusion (within the division), good measurability, a robust service delivery, long-term sustainability, and a strong market and customer orientation linked to superior innovation capabilities.

However, industry feedback is undecided about the ease of implementation. The tremendous resources required to establish a division from scratch might explain this perception. Consequently, we saw this type often emerging after a company started to cope with data-based services in another, less resource-intensive configuration.

Due to its recurring appearance in real-world environments, we assign this configuration, besides *Hub & Spoke* and *Leveraging the Existing*, the status of a grand type. Grand types describe those three of the eight possible types with the highest probability of appearing and having long-term sustainability in the context of manufacturing companies providing data-based services. These three combine a broader set of relevant attributes compared to the residual types, suggesting them to be natural choices for many companies. Nevertheless, as we found before, organizations tend to be highly unique. For many existing companies, one of the other five types may be more relevant as their situation changes the severity of the drawbacks or even switches their effective direction.

### *Zipper Organization (functional structure)*

Companies that follow this scheme temporarily assign employees to project teams that have the mission of developing data-based services (Figure 9). Commonly, the team members are from different departments and may still have further tasks at their home base, leading to the short-time phenomenon of potentially having two supervisors and two objectives simultaneously.

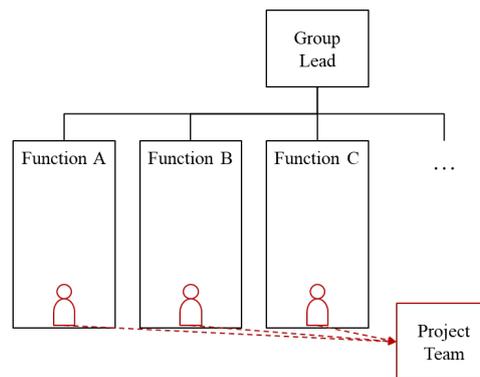


Figure 9: Zipper Organization visual representation.  
Own illustration.

Naturally, these project teams are fast and flexible, favoring coordination and active market and customer orientation. It is interesting to note that industry feedback reveals for the *Zipper Organization* of having a short distance to top management, while an easy implementation is not assigned.

Four attributes are marked as indifferent, leading to the assumption that there are multiple ways of implementing such a type. Therefore, depending on their execution form, these attributes could characterize this structure or not. Ultimately, it is up to the organization deciding for this type to encounter potential drawbacks and manage these meticulously from the beginning.

One of these indifferent attributes is its long-term sustainability. In general, we suggest not to use this configuration over a long period for the same goal of developing data-based services. But it is quite a valid and legitimate solution for starting with such new offerings, without expending enormous amounts of resources.

### *Leveraging the Existing (functional and divisional structure)*

Where *Breaking Up* is the closest form to a separate service organization, this type reflects the opposite, meaning a completely integrated structure (cf. Neu & Brown, 2005, 2008). Companies following this approach (Figure 10) tend to assign new tasks to existing personnel instead of hiring new employees.

Thus, organizations frequently add tasks to units, teams, or employees within the existing structure to provide data-based services. Often, their former position was somehow related to now additionally developing, selling, or delivering data-based services.

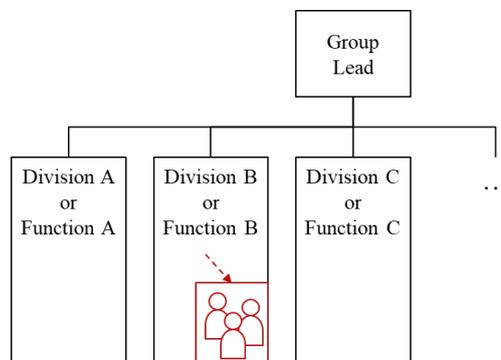


Figure 10: Leveraging the Existing visual representation.  
Own illustration.

Being the third grand type, it embraces many positive attributes, including good coordination schemes, the opportunity for active technology management, high innovation capabilities, and long-term sustainability. Coming quasi-natural and underlined by industry feedback, this type achieves the highest value concerning the closeness to the companies' products among all types.

Contrarily, companies likely to adopt this structure need to be aware of limited service culture diffusion, agility and speed, as well as questionable measurability.

#### *Market Rationale (divisional, market-based structure)*

Relative of the *Hub & Spoke* type, companies within this group (Figure 11) structure their organization in close accordance with the markets they are serving. Thus, members tend to bring service and product business closely together to deliver compelling solutions for each specific market, customer segment, industry, etc. (cf. Biege et al., 2012; Drucker, 1974).

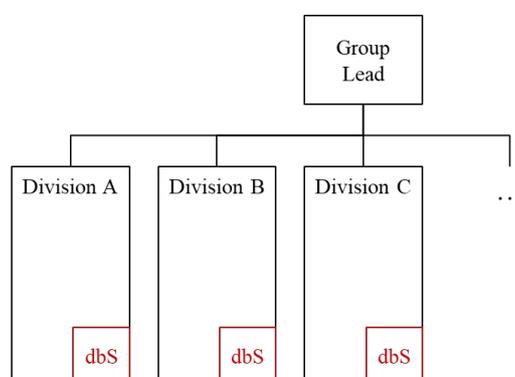


Figure 11: Market Rationale visual representation.  
Own illustration.

Due to the missing digital unit overseeing the technical development, the attributes lack central coordination of the technology, resulting furthermore in no active technology management. Equally, this type misses the central coordination of service development.

While this configuration permits high service culture diffusion within each division or functional unit, it is similar to the *Zipper Organization* four attributes stated as indifferent. Again, it strongly depends upon the particular execution form, whether or not these attributes tend to be part of and support the chosen organizational design.

### *Service Nexus (matrix structure)*

Being the sole representative of a type based on a matrix structure (Figure 12), companies adopting this configuration combine economy of scale in a centrally coordinated but decentral executed data-based service development with a strong market focus. Service, product, and technology development are thus likely to be better aligned throughout the company.

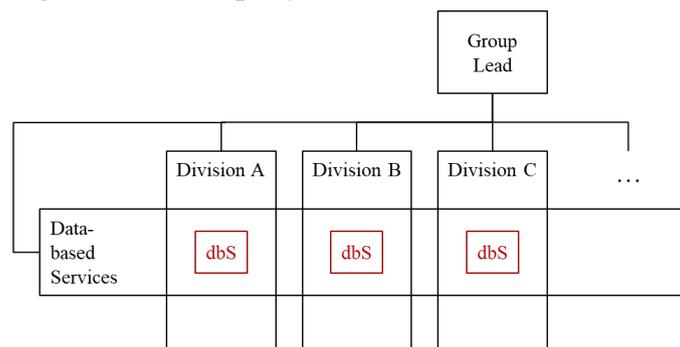


Figure 12: Service Nexus visual representation. Own illustration.

Yet, the feedback received from practitioners is dichotomous. They actively support the view of this type enabling the central coordination of the technology but feel that the active technology management and central coordination of the data-based service development are not characterizing it. Depending on the power structure within the company, powerful division heads might corrupt the coordination responsibility of the data-based service function, as well as superordinate technology management.

Furthermore, many attributes are not assigned according to this characterization, leading to several drawbacks of the *Service Nexus* type. This configuration is seen as rather slow and rigid, difficult to implement and measure, and lacking a robust service delivery.

Nevertheless, when a manufacturing company can achieve a reasonably working version of this matrix-based type, long-term sustainability is not considered an issue.

### Summary

The conceptual consideration and re-consideration of possibilities to structure data-based service activities at manufacturing companies led to the derivation of eight particular types describing a context-specific typology. Table 13 and Table 14 consequently summarize the eight types (x-axis) and provide insights regarding the manifestation of each attribute (y-axis) explained above.

Table 13: Characterization of the eight types. Part one.

Attribute	Hub & Spoke	Front-End Convergence	Top Loading	Breaking Up
Central coordination of technology	+	+	+	++
Central coordination of service (development)	+	++	+	++
Close to product(s)	+	o	o	+
Strong market and customer orientation	+	o	-	+
Short distance to top management	+	-	+	o
Ease of implementation	o	-	-	o
Active technology management	+	-	o	+
Service culture diffusion	+	-	-	+
High agility and speed	o	o	o	+
Good measurability	o	o	--	+
Innovation capability	o	+	-	++
Robust service delivery	+	+	-	+
Long-term sustainability	+	+	-	+

Table 14: Characterization of the eight types. Part two.

Attribute	Zipper Organization	Leveraging the Existing	Market Rationale	Service Nexus
Central coordination of technology	+	+	--	++
Central coordination of service (development)	+	+	-	-
Close to product(s)	+	++	+	+
Strong market and customer orientation	o	++	+	+
Short distance to top management	++	o	+	+
Ease of implementation	-	o	-	o
Active technology management	+	+	o	-
Service culture diffusion	o	o	++	-
High agility and speed	+	-	-	o
Good measurability	-	-	o	o
Innovation capability	o	+	o	o
Robust service delivery	-	++	-	o
Long-term sustainability	o	+	o	+

#### 4.2.2 Towards a Typological Theory

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020b).*

To advance the theory in the specific setting of creating a typology, we leveraged the findings introduced above and developed a propositional model. Figure 13 visualizes the path of a manufacturing company and concentrates on the requirement to re-

structure the service organization due to the emergence of servitization and digitalization. Where the selection of an appropriate organizational design is dependent on the service strategy and other contingency factors, we centered the propositions on potential cues for or against certain types.

Consequently, the following propositions describe a potential relationship between the “old” organizational structure and the “new,” aspired design<sup>5</sup>. Each proposition focuses on specific attributes that may trigger a particular type.

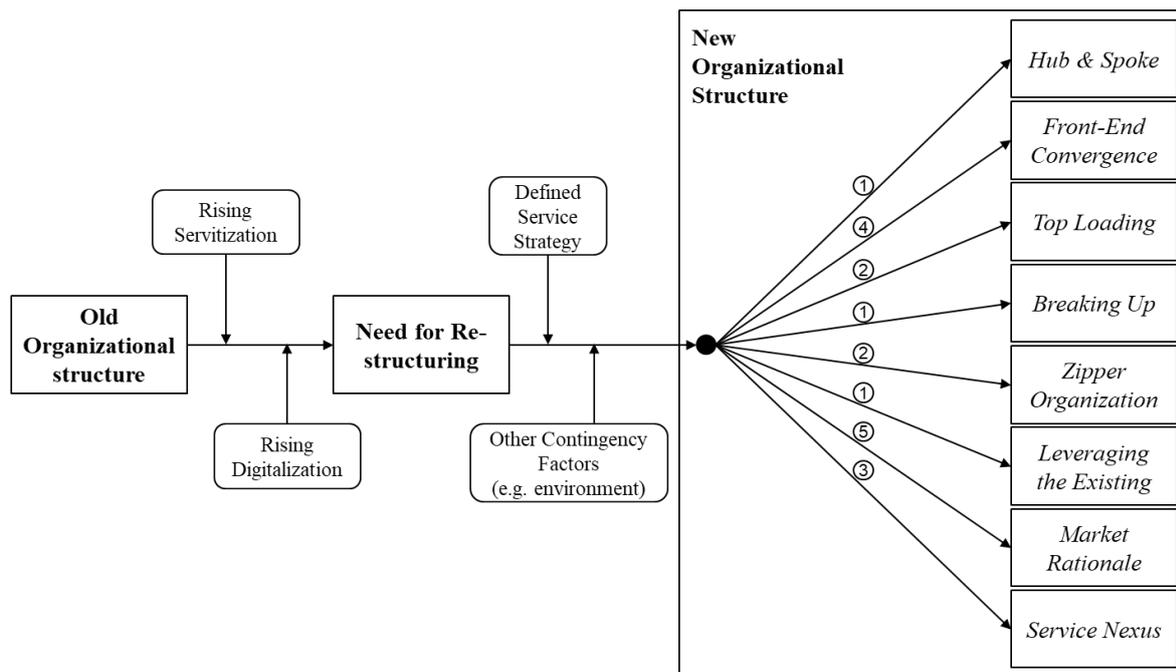


Figure 13: Propositional model of the typological theory. Own illustration.

**Proposition 1:**

*Hub & Spoke, Breaking Up, and Leveraging the Existing* are types that are more suitable for long-term sustainability.

**Proposition 2:**

*Top Loading* and the *Zipper Organization* are prime types when a company wants to focus on speed and agility.

**Proposition 3:**

*Service Nexus* is a candidate with high potential but prone to extraordinary coordination effort and intra-organizational politics.

<sup>5</sup> The numbers on the arrows in Figure 13 state the corresponding propositions.

**Proposition 4:**

*Front-End Convergence* is not as widely applicable as many other types due to the focus on a dominant sales department.

**Proposition 5:**

*Market Rationale* is likely to be a structure organically grown, but once managed actively, the type transitions to one of the grand types.

The developed types show manufacturing companies ideal-typical versions of organizational configurations emphasizing the integration opportunities of data-based service activities. Due to the claim of being a widely useful typology with a limitation to most of all Western manufacturing companies, practitioners that like to profit hereof need to transfer the underlying logic to their specific contingencies. Consequently, practitioners cannot just *copy and paste* the organizational structures but need to systematically analyze the provided types and refer them to their needs. The following chapter presents a potential methodological approach building upon the research insights gathered throughout the entire dissertation project.

### 4.2.3 The Methodology

Reconsidering the current organizational design in the process of developing, introducing, or selling data-based services is most likely not the first thing to do. But a manufacturing company has to retighten it sooner or later to ensure growing performance (cf. Hax & Majluf, 1983).

Often, we encountered a similar situation throughout the consulting projects with manufacturing companies. These companies are still making most of their revenue with the traditional product business, and sometimes, the physical services contributed with a substantial share. Each of them already had a certain number of products in the field that can capture data, while in most cases, the main challenge was to gain access to the data from their customers. In the process of trying to convince their customers to share the data, they realized that they have to offer more value in return. Preferably something of value, for which the customers would even pay.

Since companies have been aware of the promises connected to data-based services, they started to invest in developing such services. Yet, organizations spent most capital in the development of the technological readiness of the whole IT

infrastructure, the development of software, and the equipment of the products with more sensors and actors. Often, the business side of a potential new service received little attention.

Here we entered the stage and should help our customers in defining which service(s) they should offer based on the needs of and the value for their customers. The idea is, in principle, to derive a strategy for data-based services suiting the overall corporate strategy, resources, and capabilities. In the process of advising a manufacturing company, sooner or later, the question of the organizational structure arises. All contacted companies underlined the need for clarification, as roles change, new functions emerge, formerly independent processes have to interact with each other, and the alignment of product and service development, sales, and delivery increases in its complexity.

In this context, we propose to apply the following methodology to discuss feasible solutions for the challenges of a focal manufacturing company. The following five steps compose the general approach:

1. Reduction of feasible solutions
2. Screening
3. Pre-selection of preferred types
4. Prioritization of preferred types
5. Customization and implementation

### ***Reduction of feasible solutions***

Seldom do companies create new organizational structures from scratch on a green-field. In most cases, a particular structure already exists. As an organization tends to be path-dependent (Sydow et al., 2009), the first step is to reduce the number of feasible solutions according to the general design principle of a focal company. Depending on whether the general design principle is a divisional, functional, or matrix form, between one and six types remain. However, reducing the solution space in this step is a proposition. A company may still deliberately consider all types for a more in-depth analysis in the following process.

### ***Screening***

The purpose of the second step is to make oneself familiar with the available solutions and to get a sense of the differences among the types. When examining potentially logical structures, learning from confronting designs may enable the user to think out-

of-the-box (i.e., considering approaches that do not initially seem feasible). A deeper understanding of the types and the individual organizational configuration is essential to select preferred solutions in the following.

To structure the screening of the types, we propose two approaches in line with Gassmann et al. (2014). Adhering to the principle of similarity, we need to ask ourselves which of these types are similar to the current structure or which of these types would be “easy” to convert to, and what the differences are in comparison to today’s design. On the contrary, the principle of reciprocity focuses on learning from entirely different approaches to today’s configuration. Here, we look at configurations that are highly divergent to the current design of the focal company with the impetus to derive inspiration from counterintuitive solutions.

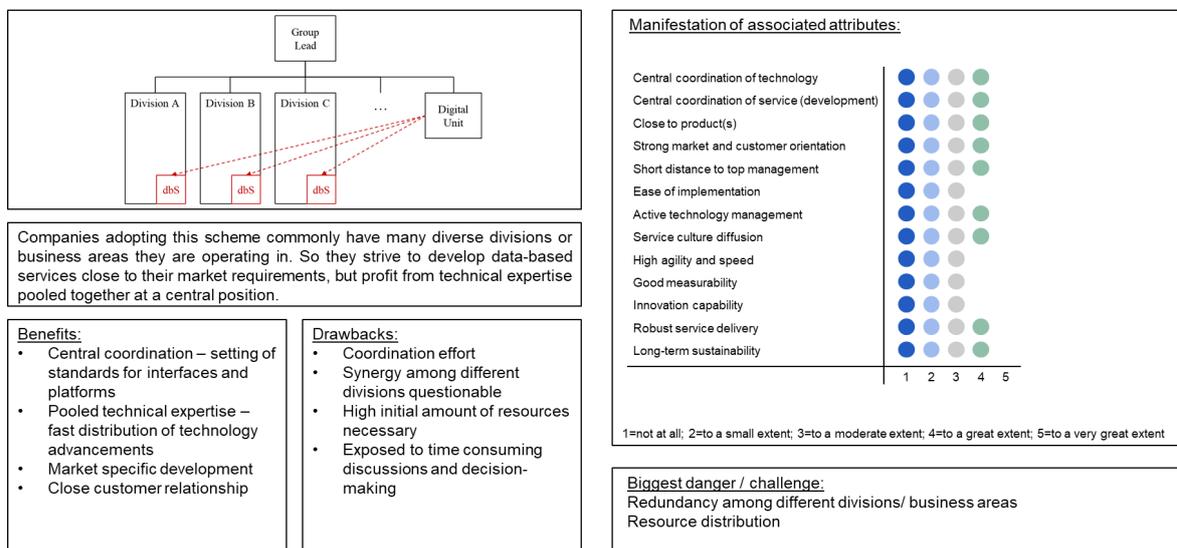


Figure 14: Hub & Spoke set card. Own illustration.

To structure their examination, we created set cards of each type containing a graphical representation, a short description, and information about the benefits, drawbacks, the manifestation of associated attributes, and the biggest challenge. Figure 14 visualizes one of the set cards with the example of the *Hub & Spoke* type<sup>6</sup>.

### ***Pre-selection of preferred types***

The pre-selection of preferred solutions may come naturally or has to be discussed in-depth—with both ways, a choice needs to take place at that point. When looking at the available types, we should ask: Which types would fit our current situation, the corporate strategy, and especially the data-based service strategy the best?

<sup>6</sup> The set cards of all other types can be found in Appendix A3.

Here, we have to note that this exercise may be done in a short time to get initial feedback and trigger discussions. However, to build an organizational structure with long-term sustainability, we advise first to define a clear data-based service strategy, if the company has not done it before. We strongly encourage adhering to the structure following a strategy approach (Chandler, 1962), which interlinks tightly with the section of the MRQ, stating “strategically structure.”

Explained in Chapter 1.2, depending on the general strategic objective of a company leveraging the service business as a lever for differentiation, financial, or marketing purposes, we expect users to alter their preferred types (cf. Raddats & Burton, 2011). Furthermore, especially considering the associated benefits and the level of manifestation of the attributes of each type characterizes the third step. It is, therefore, crucial to think about which characteristics the new organization should entail and which hereof are valued the most.

The goal is to derive two to three types describing the basis for the subsequent step. Yet, if done meticulously, the selection procedure can imply major background work, discussions, and decisions.

### ***Prioritization of preferred types***

The fourth step aims at finding a single solution that the company should implement afterward. Instead of examining the potential advantages of a specific type, we now have to discuss the impact of the associated drawbacks. In striving to transform the organization, we usually want to choose an optimal configuration eliminating all shortcomings. However, all types have certain weaknesses that may or may not have a dramatic effect on the focal company. It is therefore essential to delineate, whether these drawbacks depict lower barriers a company can overcome or that may not have an impact on their business at all, and those that could turn into real roadblocks.

The mean of elimination consequently makes the selection. We eliminate those types whose corresponding drawbacks require significant resources to overcome, leaving a more suitable type, considering the current capabilities and culture.

Nevertheless, once the company discovers during the customization and implementation stage that the favored type evokes major roadblocks, it is possible to cycle through steps three and four iteratively.

Additionally, it is worthwhile to note that the methodology focused so far on the selection of one suitable type. But it is not only allowed to think about a hybrid configuration of two (or more) types. It may even provide completely new insights, along with increasing complexity.

### ***Customization and implementation***

Up and until the final selection of one suitable type, this methodology consists of a manageable number of clear and concise steps. However, the most difficult and most crucial part is the last phase.

A series of questions have to be asked and answered, including: How do we organize the service business today? Which consequences would it have to transform it into the selected version? Which processes need to be changed? Do we require new roles and functions? Are we able to improve our structure that way? What needs to be adapted?

The individual nature of each organization, due to their current structure, culture, financial situation, and other contingency factors make it hard to derive general guidelines on how to proceed. Thus, the customization and implementation of the preferred type should be executed stepwise in a systematic, understandable, and transparent manner. Depending on the organization, it has to be analyzed from the macro- to the micro-level or vice versa, which aspects require adaption and additional attention. Following a countercurrent method may enable the comprehensive cooperation of the basis and the top management in the process of reorganization.

Again, coming back to the findings of Mintzberg (1980), the challenge is to find a harmonized temporary optimum within the structure accounting for the complex mesh of strategic requirements, pre-existing boundary conditions, related attributes, and further contingency factors.

The real-world application is thus more complex than the deliberate simplification of the reality to achieve relevant results implied (cf. Ulrich, 1984). We are aware of the limitation that the types and associated methodology are a reasonably good start to cope with the challenge of re-organizing the currently unsuitable structure due to the integration of data-based service activities. But they are neglecting several causal relationships outside the system boundary of the dissertation focus. Therefore, we discuss the results and closely related interdependencies in the following chapter.

## **4.3 Discussion**

The MRQ of the dissertation at hand is guided by the endeavor to find cues for manufacturing companies on how to strategically structure data-based service activities. We tailored the scope to the integration of these activities, with the side effect that the dissertation project neglects interdependencies to related fields.

Otherwise, the complexity to derive suggestions for widely applicable types would have been unmanageable.

Yet, we acknowledge the fact that we cannot apply these types in a vacuum. Figure 15 shows four kinds of implications that the findings of this research project entail. While these do not claim to be conclusive and universally valid for all manufacturing companies, the four categories provide insights about the far-reaching consequences and considerations of a restructuring project.

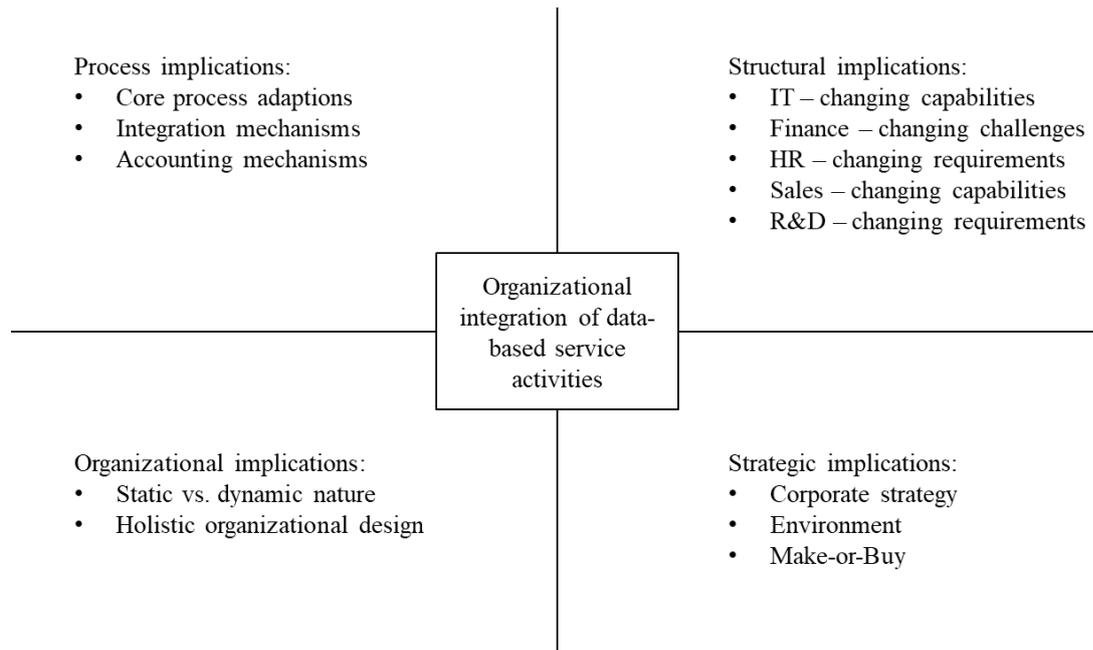


Figure 15: Discussion of implications. Own illustration.

Process implications account for the changes on the micro-level the introduction of a new organizational structure would cause. These interlink with the structural implications, which explain the influence on other departments besides the one directly suffering from the reorganization. Strategic implications encompass macro-level aspects that are affected by or act upon a certain strategy-organization relation. Finally, a reorganization project for the integration of data-based service activities demands the consideration of implications on a general organizational level.

Each category of implications is detailed in the following.

### ***Process implications***

According to Kindström and Kowalkowski (2014), and Posselt (2018), data-based service activities are mainly described by the three core activities: data-based service development, sales, and delivery. Underlying processes, approaches, idiosyncrasies, and more can describe each core activity, which relates to the individual

characteristics of an organization and its transformation towards a servitized and digitalized future.

We mainly discussed the organizational integration on the general level of data-based service activities, while notably, the combined findings in Chapter 4.1.2 and the typology offer insights into a more detailed differentiation between development, sales, and delivery. Yet, to understand the real implications for these core processes when a manufacturing company decides to move into the direction of providing data-based services strategically, scholars need to execute a more profound assessment. Therefore, we analyze each core process a little closer.

### *Data-based Service Development*

Service development has a hard stand against product innovation in most manufacturing companies (Dörner, Gassmann, & Gebauer, 2011). Dörner et al. (2011) state that in terms of resource distribution, product-related innovations usually receive the largest share. Further, developing services is mostly done after the product development, as an add-on, on an ad-hoc basis, as we revealed in the course of the benchmarking study *Smart Services – Transformation of the Service Organization*.

Where companies make a massive internal effort to increase the standing of the service department and consequently of the value of a dedicated service development process, developing data-based services does not make it easier. Here, companies highlighted the challenge of combining the iterative way of developing software and services with the often rigid stage-gate product development process. The question is, therefore, should a company define a dedicated (data-based) service development process, should they include it into the known product development process, or should they stick to the un-formalized ad-hoc development in case smart employees have good ideas or customers express a particular need?

Bühler, a successful Swiss machinery manufacturing company, followed the approach of defining an overarching generically applicable development process for products, services, and automation solutions. The process allows a certain dynamic, meaning that depending on the innovation project an employee is pursuing, the process slightly adapts.

John Deere takes a similar approach. Their product delivery process has historically grown over recent decades, and there is a distinct team only working on improving this process. With the rising importance of data-based services, mainly driven by the customer service department, the responsible managers now strive to include specificities of data-based services into the overall product delivery process.

Yet, these are two companies that are already relatively advanced when it comes to the maturity of their data-based service business. Most other companies stated that they either had not defined any specific process or, even worse, some agreed upon a particular sequence of steps, but nobody adheres to them in practice.

Coming back to the initial motivation of diving into the service development process, we see many issues from an organizational perspective that have to be solved when re-tightening the organizational structure. Data-based service development necessitates competencies from the IT department and product development. Vice versa, new product development projects should not be launched without a service representative.

It may undoubtedly be the case that for some organizations, product and service development need to be close to each other when compared to other companies. But interfaces between these teams have to be designed purposefully every time.

### *Data-based Service Sales*

Once the data-based service, or its combination with a particular product, has been fully developed, the company has to sell it at some point. With a focus on service sales, we can distinguish various challenges for manufacturing companies. To name a few, the general pricing strategy, the composition of the revenue model, the underlying logic of the pricing approach, and many people-related issues, such as capabilities for selling services and incentive schemes, are demanding topics.

From an organizational point of view, this is relevant insofar as we have to decide who is actually in charge of defining the revenue model and pricing level, for instance. Moreover, it is questionable who is selling data-based services.

We encountered many manufacturing companies struggling to sell their services. Most sales staff, the companies emphasized, are trained to sell products. They often know these products from their heart to the last screw and can easily compare them to competitor products or explain to the customer why it is the right product for them. But services—especially data-based services—are intangible, somehow fuzzy, and not easy to describe. Selling data-based services requires other competencies and another way of approaching the customer. Often, the counterparts at the customer site hold different roles, and a service level agreement is usually not closed within one meeting. It requires a long breath with an ambiguous provision for the sales employee in the end. If the sales staff is, for example, still incentivized by an individual provision on the turnover they created, it is a natural behavior of most employees to sell expensive capital goods instead of a service contract.

Organizations need to find solutions to this problem. Depending on the type a manufacturing company has selected, it may be feasible to install a distinct service sales staff with the required competencies. At many other companies, the highest probability of selling a service level agreement is at the point of sales of the machine. Here, it needs to be balanced, whether it is more reasonable to send a product and a service sales employee to the customer or train significant parts of the existing personnel to be able to sell both. Either way, a restructuring project should cover the necessary adaptations to the sales organization.

### *Data-based Service Delivery*

The last core process is related to the manner the company delivers the data-based service to the customer. When, for example, a condition monitoring or a predictive maintenance service is sold and installed at the customer site, the program is primarily running in the background. Compared to traditional after-sales services, which are delivered physically (imagine a repair operation), the idea of a data-based service is to work without any continuous human interaction.

While a service technician, who is often part of the support department, primarily conducts physical service operations, new service admins or similar functions may be necessary for the data-based service business. Here, the place of action is moving from the customer site to an operations center of the manufacturing company, where the company handles all information centrally. In case of a failure, the exceeding of a specific threshold, or in case of any other pre-defined event, the service admin comes into play and executes an appropriate reaction. A possible consequence may be the timely dispatch of a service technician with the right spare parts.

That said, the service delivery process is changing from a purely physical appearance at the customer site to back-end and front-end activities due to the introduction of data-based services. Front-end activities maintain the installation of a machine and the respective software, as well as training or repair operations. Back-end activities encompass data gathering, data analysis, data monitoring, and further actions that result from reactions to or insights from the former three.

Considering the organizational structure, a responsible manager needs to be aware of changing mechanisms within the service delivery that may impact the organizational configuration. Where to locate the back-end activities of service delivery executed by which personnel suggests one of the aspects that are worthwhile to explore.

We can conclude that once a manufacturing company has decided which type to adopt, the specification of the underlying core and enabling processes need to follow. The last step of the presented methodology, namely customization and implementation, covers the step of examining the necessary changes within these processes. Therefore, we elaborated on the three core processes and discussed possible implications of the introduction of data-based services from an organizational perspective.

### *Integration Mechanisms*

Assuming again that a manufacturing company selected a suitable type, they now received insights about essential consequences for the core processes and decided to integrate new functions, teams, or units in existing structures because of the newly required capabilities. Hence, another practical question concerns the integration mechanism.

Coming from a high-level discussion about general types, we now arrived at the operational level. When we consider different forms of integration approaches, Kim et al. (2003) describe four kinds. The authors propose people-based, information-based, formalization-based, and centralization-based integration (Kim et al., 2003). With a focus on people, the idea is to reach cooperation, coordination, and control by transferring employees, meetings, teams, training, and other means involving a person (Kim et al., 2003).

Conversely, an information-based integration mode mirrors the attention on the exchange of information, the purposeful design of the information flow, the use of information systems, and other software tools (Kim et al., 2003).

The third possibility uses formalization in terms of standardization of processes, rules, and governance as the primary control for integration (Kim et al., 2003).

Depending on the size and culture of the focal manufacturing company, the fourth integration mode can be suitable. The centralization-based integration builds upon active top management, where the managers make all the relevant decisions and cascade them down the chain of command (Kim et al., 2003).

Similar to the described four integration approaches, Ståhle, Ahola, and Martinsuo (2019) recently developed a classification of four different types of means for the integration of business functions: personal meetings, software systems, transfer of people, and formalized procedures and rules.

The learning about the existence of different integration approaches is that restructuring the organization with a focus on the integration of data-based service

activities has to cover multiple dimensions. Going deeper and deeper from an abstract level to the operational level is likely required to achieve the commitment of all the personnel.

### *Accounting Mechanisms*

Slightly apart from the process-related implications discussed above is the subsequent excursion into accounting mechanisms. While the formerly presented consequences that are primarily caused by the selection of a particular type, the relation between possible organizational configurations and the accounting mechanisms is not unidirectional. In principle, it can go both ways.

A manufacturing company may have a dominant approach on how to implement new activities, meaning whether the data-based service activities should have an individual profit and loss responsibility or be deployed as a cost or as an investment center.

Separating the service business has, for instance, the advantage of having better controllability in terms of profit and loss expectations. On the other hand, being highly integrated into a product- or market-based division leads to great difficulty in deriving the monetary impact of the additional data-based services. Imagining the *Hub & Spoke* type leads inevitably to the discussion, which department is paying for what. The company might manage the digital unit as an investment center providing technical support during the development phase of new data-based services for the divisions, or they could also charge internal transfer prices for their consulting service (cf. findings from Fuchs et al. (2019)).

Consequently, the general approach of an organization dealing with these issues might limit the solution space for feasible types or vice versa.

### *Structural implications*

Besides the evident impact on underlying and related processes, integrating data-based service activities from an organizational perspective result in significant changes at adjacent departments as well. Therefore, we decided to discuss changes at the IT, Finance, Sales, R&D, and Human Resources (HR) department in a nutshell.

#### *IT*

Data-based services are strongly dependent on specific software and digital technologies. Looking at the developments in the field of digital technologies within the last years, terms such as Industry 4.0, IoT, Industrial Internet-of-Things (IIoT),

Smart Factory, and more are ubiquitous. Even without thinking about data-based services, companies steer towards data-driven organizations (Kiron, 2017; Porter & Heppelmann, 2015).

Managing the sheer amount of data is a demanding endeavor, wherefore scholars questioned the role of the traditional corporate IT department at manufacturing companies (e.g., Bilgeri et al., 2018). Discussions waft around centralizing all data-related issues within one IT department or separate the traditional corporate IT from a new digital unit catering for all trending data topics (Bilgeri et al., 2018; Fuchs et al., 2019).

Adding data-based services to the discussion, it becomes apparent that these research topics are tightly interlinked. Therefore, choosing a suitable type for the integration of data-based service activities has to be aligned with the structure of the software aspect of the service offer. However, we can argue that referring to the software aspect of the data-based service as a supplier of digital capabilities enables us to discuss the service business individually, as we did it throughout the entire thesis at hand.

The transformation of the corporate IT department is therefore not only triggered by the introduction of data-based services and the required capabilities in terms of data gathering, data analysis, and data interpretation, but by the entire digitalization journey.

### *Finance*

The organizational integration of data-based services activities leads to changing challenges, even in the Finance department. Consider the following example. Many years ago, Hilti introduced its fleet management system as a new service for its customers. Compared to the traditional sales of Hilti equipment, the changes for the Finance department were quite significant.

In the past, a tool was produced and sold for an amount  $X$  at one point in time. Now, Hilti manufactures the same device but only leases it for a smaller amount  $Y$ , whereas the company incurs the amount on, perhaps, a monthly basis. Consequently, instead of billing a higher amount once, the Finance department suddenly needs to manage recurring micro-billing.

Multiple manufacturing companies encounter the same issue, as the introduction of data-based services most often entails a change in the business model, including the revenue model and the pricing strategy. The rising attractiveness of subscription-based business models in the field of data-based services requires a structural change

in finance departments. The company needs to lower the administrative effort for each invoice as much as possible to be cost-effective.

But it does not stop there. To be able to offer a fleet management service on a large scale, Hilti had to tie up a large amount of capital in the form of the produced tools, which made them reach their break-even later than before. Formerly unknown or irrelevant risks accompany this evolution that requires appropriate attention.

### *Sales*

Tightly interlinked with the processual implications addressed before, the Sales department is likely to suffer from the introduction of data-based service activities. We already discussed that a potential solution might be to separate service and product sales operations.

One problem could, however, be the expectation of a customer to always speak and negotiate with the same person. We indicated in Chapter 4.1.2 that the one-face-to-the-customer mindset could reflect a barrier of erecting a dedicated service sales unit. The implications for the Sales department are thus various, encompassing processual and structural impacts due to changing activities, conditions, and capabilities.

### *R&D*

Similar to the Sales department, the R&D department, herein standing for product- and service-related R&D operations, pertains to the core process of service development described before.

The processual implications in the dichotomy between product and data-based service development lead accordingly to structural changes in the entire R&D department.

Particularly, requirements for product development alter. Product development should foresee the use of data for service purposes by including the right sensors and actors. The rising importance of (data-based) services for the whole company entails a cultural change up to the engineering-dominated product R&D, resulting in smaller to larger adaptations during the holistic organizational transformation.

### *HR*

Put in the last place, structural implications for the HR department originate mainly from the changing capabilities required at many locations throughout the organization. Manufacturing companies need to increase their digital skills (cf.

Ardolino et al., 2017), especially in the R&D department, but also need other competencies; for example, within the sales and support staff.

The need for new talents ultimately leads to further development of the HR department. Where the company excelled in the acquisition of engineering talents, other soft skills and data-related competencies now have to be sourced from the outside. Notably, the standardized recruitment process at larger companies sometimes hinders the signing of IT talents, as not all high-performing software engineers left university with the necessary degree for a specific pay grade.

The more significant challenge is to attract IT talents at all, as the competition for them is immense.

We have seen that the structural implications do not end at the departments directly linked to data-based service activities. We even have to scrutinize the Finance and HR departments in case a manufacturing company decided strategically to offer data-based services. Logically, the subsequent paragraphs present additional strategy-centered implications.

### ***Strategic implications***

The term strategic implications subsume the third group of consequences. Where there remain more facets we could discuss within this sphere, we want to focus on the corporate strategy, the environment, and make-or-buy considerations. Notably different from most implications shown previously, the corporate strategy and the environment do mainly act upon the organizational structure, not the other way around. Yet, both topics are prominent participants in seminal papers treating the organizational structure (e.g., Ambroise, Prim-Allaz, Teyssier, & Peillon, 2018; Forte, Hoffman, Lamont, & Brockmann, 2000; Lawrence & Lorsch, 1967; Mintzberg, 1980), which is why we want to examine their relations briefly.

### ***Corporate Strategy***

We discovered before that the service strategy influences the organizational integration of the data-based service activities. To some extent, we neglected the extension of the overall corporate strategy.

In general, the service strategy should be part of the corporate strategy or at least the then-defined service strategy has to comply with it. Meaning, the mission of the service business is inherited from the corporate direction. Here, the corporate mission could define whether the whole company strives to stay a primarily product-oriented

business, whether it tries to minimize the effect of the product business on the overall earnings or whether it has any other ultimate target.

The corporate mission would lead to the purpose of the service business to either support differentiation, to increase the income, or to serve as a marketing tool for the companies' products. In turn, the presence as a strategic differentiation factor, as a financial driver or as a product promoter, causes the organizational structure to underline the mission (cf. Chandler, 1962).

Data-based services serving as a marketing tool are likely not to be very sophisticated. Approving huge investments into service development is not expected, as the focus is still on the product business. Services should instead support the products and attract customers to buy these. Therefore, companies tend to give services away free of charge. Consequently, a type will be selected that reduces the financial burden as much as possible. The *Zipper Organization* could be one possible solution in this case.

On the contrary, when data-based services are supposed to function as a lever for strategic differentiation or increased earnings, the service business is much more valuable.

Concerning the latter function, *Breaking Up* may be a tempting configuration. Here, the organization could control the separated (data-based) service business through an individual profit and loss responsibility. Moreover, it opens up the possibility to establish a distinct service sales team, which academia connotes commonly with superior sales performance (cf. Kindström et al., 2015).

To obtain strategic differentiation, we recommend bringing the product and the respective market knowledge close to the data-based service activities. For instance, the *Hub & Spoke* type provides exciting features to increase differentiation through data-based services. Excellent technological support from the digital unit and their learning across divisions enables superior data handling performance. In contrast, the positioning within the divisions ensures closeness to the products, markets, and customers.

Concluding, the corporate strategy has a crucial channeling function for the service strategy, in turn, having a substantial impact on the organizational structure.

### *Environment*

The same holds for the environment. We hinted at the influence of the environment on the organizational integration of data-based service activities in Chapter 4.1.1. We

first found market volatility to have an impact on the decision-making about a feasible structure, but we could not validate it in the statistical analysis.

However, research on the environment-strategy relation comes in high numbers (e.g., Venkatraman & Prescott, 1990). We can consequently extend it to the triadic environment-strategy-structure.

According to Mintzberg (1980), the environment is another major contingency factor, while R. E. Miles et al. (1978) state “proponents of the strategic-choice perspective argue that organizational behavior is only partially preordained by environmental conditions and the choices which top managers make are the critical determinants of organizational structure and process.”

Without elaborating on all the potential influences the environment may have on the specific integration of data-based services, we can conclude that a manufacturing company should not neglect its surroundings when selecting a suitable type.

However, to visualize potential impacts, we showcase two cause and effect relations. For example, we explained in Chapter 4.1.1 that high market volatility suggests bringing products and markets closer together, wherefore *Hub & Spoke* or *Leveraging the Existing* could be promising solutions. Whereas in environments, where new entrants threaten incumbents, companies could leverage speed and agility in the *Zipper Organization* or *Top Loading* configuration.

### *Make-or-Buy*

Compared to the former two strategic aspects described as acting on the organizational structure and the consequent reduction of the solution space when it comes to the selection of a preferred type, the third aspect is partly independent of the definitive choice of an organizational configuration. Executing a make-or-buy assessment is predominantly dependent upon the corporate and service strategy, while an interrelation with the organizational structure certainly exists.

A company that wants to offer data-based services has to align the make-or-buy assessment with the general strategic purpose. Again, referring to the three different directions mentioned before (strategic differentiation, financial lever, marketing tool), we expect significant changes for the make-or-buy decision.

With the impetus to reduce the financial burden of the (data-based) service business to promote the products, it may be feasible to outsource significant parts of its development. Similar thoughts could wave around the goal to reach superior financial performance. Costs, above all high initial investment costs, may be inhibited by evaluating outsourcing possibilities. On the other hand, following a differentiator

strategy likely entails a “make” approach. In particular, a company should execute all data-related activities (data gathering, analysis, and interpretation) in-house to profit and learn from the captured insights.

Bustinza, Lafuente, Rabetino, Vaillant, and Vendrell-Herrero (2019), for instance, found that manufacturing companies showed superior performance when partnering with the appropriate service provider for the development of “simple” services. However, the development of sophisticated data-based services should be executed internally (Bustinza et al., 2019). The authors are neglecting the strategic purpose of the service business, wherefore, the decision about an in- or outsourcing approach is more complicated.

Referring to the interrelation of strategy, structure, and make-or-buy assessment, we see an altering severity of mutual implications depending on a variety of influences. Going down the line of defining a strategy, then an appropriate organizational type, followed by an evaluation of which activities should be executed in-house or sourced externally, the effect between the structure and make-or-buy is likely to be marginal. On the contrary, if a company decides to have a distinct strategy described as a system integrator approach (Davies, Brady, & Hobday, 2007), the make-or-buy assessment has a much higher weight. The consequences for the organizational structure may then be significant, as the company decides to coordinate many different sub-elements of the business model, delivered from various external partners. Yet, the developed typology and methodology primarily focus on manufacturing companies in a B2B environment, where this kind of system integrator approach is likely to not be a widespread model.

### ***Organizational implications***

The last two consequences are part of a top-level organizational perspective, meaning that they refer to a change or at least to considerations within the entire organization.

#### *Static vs. dynamic nature*

The developed types demonstrate a rather static picture in this thesis. Even though the typology and methodology show a prescriptive research result (i.e., they induce transformative changes within manufacturing companies), the organizational configurations describe a snapshot of a potentially rigid structure. However, academia and practice call for the necessity of permitting certain flexibility and dynamic nature of the organization.

The dynamic organization, as introduced by Araujo (2014), mentions the four attributes: fast and reactive, flexible, and adaptive. These adjectives are said to prescribe how an organization should be to reach a certain dynamism. If we strive to make an organization more dynamic and implement this perspective into the typology, the question arises, what does this mean for the developed types and ultimately for the companies?

To some extent, a written and harmonized organizational structure will always find its way to company documentation and representations, simply because of stating who is situated where and who is in charge of what. The operative scheme can still be different.

It is possible to think of agile project teams with a distinct mission to be creative and deliver something new. Once the team filters such ideas by their feasibility and potential interest of customers, they can find its way back into the line, where the regular development and release process is going to take place. Thus, the agile project teams connect to the line organization at some point. Eric Ries already discussed this kind of coupling as the “sandbox-principle” in his book *The Lean Startup* (2011). The *Zipper Organization* may be one option to create such agile de-coupled teams that can feed innovative data-based services back to the line (i.e., to the divisions) where they belong next to the complementary products and physical services.

How to incorporate the dynamism of data-based services into a formerly rigid manufacturing company is of significant interest on the one hand, but questionable on the other. Once a company passes a considerable number of employees, clearly defined processes become more relevant. Interview partners mentioned the fact of some types supporting the fast and agile development of data-based services (e.g., *Zipper Organization* and *Top Loading*), while they might be intermediary phases. Long-term sustainability is, according to them, only ensured in defined departments or divisions.

A measure can, therefore, be to allow certain degrees of freedom within established processes and structures. Consequently, the teams have to adhere to quality gates for steering meetings, but the employees are engaged to be creative, be non-linear, or out-of-the-box in between.

Ultimately, scholars and practitioners have to place a higher focus on the data-based service development process, which has to combine the rigid boundary conditions of hardware manufacturers, and the agile mentality of software companies. But this is part of the processual implications related to data-based service development described above.

*Holistic organizational design*

The last aspect we want to highlight is not a real implication in itself. It is, in fact, the outcome of all the small pieces of necessary changes discussed before. The final puzzle needs to be put together by all treated aspects into a whole coherent organizational design.

Starting to adapt the organizational structure by focusing on the data-based service activities at first requires examining all the complementary implications on the macro- and micro-level. But in the end, the ultimate target should be to define a harmonious holistic organizational design that suits the company, its corporate strategy, and its environment at that moment, until a new phenomenon leads to another organizational restructuring process.

## **5 Conclusion**

The final chapter of the dissertation at hand covers a brief summary and reflection of the overall research design, together with its results. Additionally, the conclusion points out the practical and theoretical contributions, the limitations bound to the research, and provides suggestions for future research avenues.

### **5.1 Reflection**

We embedded the entire dissertation project at the intersection of the servitization and digitalization research stream, meaning that the academic field we refer to focuses on manufacturing companies in a B2B environment actively offering or intending to provide physical to data-based services. Bringing in the organizational lens, we sharpened the core of this research project to the organizational integration of data-based service activities.

The uncertainty of practitioners about how to structure their data-based service development, sales, and delivery endeavors triggered the dissertation project, but it was logically mirrored in the absence of literature treating this exact problem.

Even though the academic debate in this specific research context is wafting around the general direction of either integrating or separating the service business, clarity about suitable organizational configurations is lacking.

Based on the assumption that not a single optimal organizational configuration exists (no one-size-fits-all solution), we directed the dissertation project towards finding feasible solutions ( $n > 1$ ) for integrating data-based service activities at manufacturing companies.

Principally, the MRQ is concerned with the integration of data-based service activities at manufacturing companies. Deducted hereof, the four sub research questions RQ1-4 tackled the identified research gaps.

RQ1 treated the question of what factors exist, potentially influencing the decision-making about the organizational configuration of data-based service activities. We

consequently applied a systematic literature review that led to fourteen influencing factors after an extensive forward and backward search of the initially found articles. The fourteen influencing factors distributed among four different groups that do not claim to be MECE but instead offer a thematic frame to be easily discussable. We examined each of these factors according to existing perspectives found in the literature. Finally, we deduced their potential to either support the integration or the separation of the data-based service business.

All in all, no general tendency could be declared, as the inherent characteristics of the influencing factors may be developed to a lesser or greater extent, depending on the specific situation of a focal manufacturing company.

The aggregated and discussed influencing factors are, thus, informative but created cues that required further clarification.

To account for this clarification, namely, whether the initially found influencing factors have a real effect and if so, which general direction they support, we formulated RQ2 accordingly.

The validation and the examination of the effective direction of the influencing factors were executed by following a mixed-method approach. Nestled in a benchmarking study, we used the survey responses to test the validity of the influencing factors. Nine factors showed a significant correlation, of which seven suggested to separate the service business.

While one could have expected this finding, as most manufacturing companies operate with separate service units today and the presumed change of the organizational structure is likely to be very slow, the definitive nature of the results was surprising.

Notably, we experienced a different picture in the qualitative part of this research phase. All examined companies demonstrated superior performance in the benchmarking study and showed an equal distribution between an integrated or separated structure.

Combining these insights led to the development of a simple flowchart to navigate manufacturing companies through different structuring possibilities by focusing on a few vital questions. This scheme is especially helpful together with and complementary to the typology developed as the response to RQ3 and RQ4.

Reading the thesis at hand might have been frustrating at some point as the findings of the second research phase had to state again that no clear tendency towards integration or separation exists. We were still living in this continuum between the two extremes of pure integration and pure separation of the data-based service

business, without a clear indication of where to head. Even though we were not able to find the one clear answer to what is better, integration or separation, we can highlight one essential insight: it depends.

What several scholars found before on a general organizational level, we could prove that not a single structure exists to excel in developing, selling, and delivering data-based services. It is instead the case that alternative organizational configurations are possible, a fact we assumed already in the introduction.

Consequently, RQ3 and RQ4 treat exactly this subject to find organizational configurations focusing on the integration of data-based service activities at manufacturing companies.

As we opted for action research throughout the entire dissertation project, promising organizational configurations already emerged from existing solutions, discussions, and insights from the literature. Therefore, we pursued a conceptional development of a typology for alternative organizational configurations. We profited from feedback loops with experts in the field, to first concretize the final types and finally validate them by the input of fourteen companies.

Respecting the MECE criteria and more characteristics of a sound and rigorous typology, the types reflect particular organizational configurations with high practical usability.

To highlight the practical applicability, we created not only a propositional model but, most of all, a methodology. This methodology enables manufacturing companies to use the derived types systematically and find the appropriate solution for their specific situation.

To sum it up, the dissertation at hand shows influences on the organizational structure of manufacturing companies with a focus on data-based services activities comprehensibly. It offers practitioners, as well as scholars, a typology for alternative forms of organizational configurations in this context.

## **5.2 Practical and Theoretical Contributions**

We already hinted at several previous contributions to practice and theory. In this paragraph, we describe these in a structured manner by grouping the practical and scientific contributions into two sub-categories. We split the practical contributions into aspects implying “Awareness” and those offering “Guidance,” as well as divide

the theoretical contributions into the two categories, “Enriching the Debate” and “Creating Theory.”

### ***Theoretical Contributions***

Concerning the scientific implications, we can show two general directions. First, we address the ongoing debate between those scholars promoting the integration of the service business and those arguing for its separation. Second, the findings of the dissertation project can advance the underlying theory and propose a new theory. Hence, we detail both parts in the following.

#### *Enriching the Debate*

Throughout the entire thesis at hand, we showed the adherence of this research to the servitization and digitalization literature stream. To be more exact, we concentrate on organizational considerations where servitization and digitalization meet. In this nexus, we pointed out that previous literature predominantly addresses the problem of manufacturing companies finding the right organizational structure from either a separation or integration perspective. Meaning, most research was concerned with providing arguments for or against the integration or separation of the service business.

While this debate is already fifteen years old, scholars recently acknowledged that there is still room for clarification (cf. Raddats et al., 2019). The transition to data-based services specifically created new uncertainties.

Here is where our findings contribute to the ongoing debate. We enrich the academic community by an unbiased consideration of multiple structuring variants. Unbiased in a sense that we did not strive to focus on the one or the other side of the integration-separation continuum. We instead wanted to broaden the view to multiple feasible solutions.

Consequently, we contribute with a set of influencing factors affecting the moving direction of a focal manufacturing company within this continuum. Scholars may investigate these factors further and use them as a basis for future research.

By reaching the conclusion that multiple variants exist and continuing with presenting possible organizational configurations, we shed light on how one might imagine the continuum between the two poles. Additionally, we moderate the discrepancy between proponents of the separation and integration party with these findings.

Mainly, we enrich and advance this debate with the novel findings introduced above.

#### *Creating Theory*

While the primary scientific contribution lies in enriching the debate as previously shown, the findings of the dissertation project advance and create theory as well.

A typology stands for a unique form of theory building (Fiss, 2011), wherefore the results demonstrate the creation of specific theory applicable in the underlying research context. Leveraging the found types into a propositional model was crucial to suggest testable hypotheses in the future.

Where creating theory is difficult to achieve, the propositional model mirrors an incremental step forward in understanding the transformation of manufacturing company structures within the process of introducing data-based services. The findings are thus able to show potential in advancing theoretical considerations.

We also advance the applied theory, as the examination of influencing factors with their progressive reduction to applicable determinants may be connected with the underlying organizational configuration theory (cf. Mintzberg, 1980).

Going back to Figure 2 in Chapter 2.4, Mintzberg (1980) introduces contingency factors that must reflect the organizational structure and vice versa. Within his publication, he proposed several such contingency factors we added to the initial list. Combining this perspective with the validated list of influencing factors, we can state that these influencing factors advance the model of Mintzberg (1980) by specifying the organizational configuration theory for our particular context.

Consequently, the overall results of the thesis at hand provide cues for the academic community in terms of enriching the debate about integrating or separating the service business and in terms of advancing and creating theory.

### ***Practical Contributions***

As we want to do research with an impact that should come from practice and be applicable to practice, the action-based research setting of the dissertation project provides actionable insights for industry in two ways.

#### *Awareness*

The main findings split into two fields: the influencing factors and the typology. Concerning the influencing factors, we experienced that most practitioners were aware of some of the validated factors, while others have only been unconsciously (or not at all) considered during the process of deciding on a new organizational structure.

Circulating back and forth with this list of factors provides managers input about what they might or might not contemplate during times of restructuring. Only when being aware of potential influences, such a manager can decide if it pertains to their organization as well.

Moreover, the typology creates awareness of the existence of several possible solutions for new organizational configurations. Potentially, the team occupied with structuring and re-structuring the organization has a precise design in mind, where they might use the typology to open up their thinking and widen the solution space to alternative variants.

The stronger contribution is, however, the typology itself as a tool to guide future restructuring operations and is therefore discussed in the next section.

### *Guidance*

As the term suggests, the key practical contribution is the fact that the findings of the thesis at hand can guide manufacturing companies. In the beginning, we mentioned that companies asking us how they should structure their data-based service activities triggered the impetus to research the present problem.

They sought guidance in the quest for structuring possibilities. At that point, we mentioned that offering a detailed plan covering recommendations, such as: if you do A, you get B, is tempting but not achievable. Therefore, we decided to aim at suggesting alternative organizational configurations to let the asking manufacturing companies decide themselves.

The results in the shape of the typology, and especially the thereof developed methodology, is now the sought-after tool to guide restructuring operations.

The types help companies in obtaining inspiration about potential organizational configurations. Additionally, the methodology offers a systematic recipe to apply the typology and discuss the current, as well as a new organizational structure.

Both findings, in particular concerning their practical significance and applicability, have already been introduced before in-depth. Therefore, we forgo a further description at this point.

In summary, the 2x2 groups presented above subsume many contributions. But we want to emphasize that both the examined influencing factors and the developed typology have actionable implications for industry and the scientific world.

### 5.3 Limitations

*Note: Parts of the following paragraphs are extracted from Osterrieder and Friedli (2020a, 2020b).*

All research has certain limitations. Some have already been discussed in Chapter 4.3, predominantly inherited from the necessary thematic concentration and simplification executed at the beginning. While we do not want to repeat the limitations bound directly to the results as we did it before, the upcoming paragraphs concentrate on constraints concerning the applied research methodologies.

As each methodology is introduced individually in Chapter 3, we are similarly discussing one research method after the other.

#### *Literature Review*

Where the advantage of a systematic literature review is to be generally replicable, the main uncertainty lies in the course of developing the right keywords and keyword combinations, as well as during the review process.

To find the right keywords, we relied on multiple literature reviews and further peer-reviewed articles treating the core topic. We set narrow boundaries to find the most relevant publications. Unfortunately, the initial search process did not lead to a sufficient number of results. A rigorous application of the forward-backward search accounted for this insufficiency and created a satisfying list of determinants.

Nevertheless, we may not have found all relevant articles due to the selection of the described keywords and databases.

Furthermore, during the review process of the generated list after each search procedure, it could have been the case that we dismissed a promising article unintentionally at that stage. While the likelihood of this problem occurring is on a neglectable level, it still reflects an indication of the overall limitation that the literature review does not include all relevant articles.

#### *Convergent Parallel Mixed-Method*

Quantitative studies are often only as good as the dataset underneath. Hence, we see that first, the sample of companies who participated in the benchmarking survey tends to be above the industry average in terms of data-based service adoption. Moreover, the sample is skewed towards large companies, while small- to medium-sized enterprises are under-represented. We suspect that perhaps those companies, who

already cope with data-based services, were more intrigued to participate, being most of all larger companies with the required slack of resources.

Second, while we strove to control for acknowledged approaches in developing questions for statistical analysis, a residual uncertainty exists about their reliability.

Additionally, academia often associates a qualitative case study approach with a lack of generalizability and risk of subjectivity during the analysis. To compensate for the pitfalls of both methods, we chose mixed-method research and meticulously documented the steps undertaken during the examination.

### *Conceptual Typology Development*

Bailey (1994) describes the limitations of typologies in addition to the reification of being mostly static, biased by the researcher conducting the conceptual development, and the pragmatic reduction of complexity usually comes along with a loss of information for the sake of generalization.

Furthermore, the developed types could be polythetic groups, as we assume that not all organizations adopting one of the presented configurations are congruent across all attributes. Such a typology contradicts common perspectives of typologies encompassing generally monothetic groups (Bailey, 1994).

Extrapolating these limitations may lead to necessary adaptations of the typology, the propositional model, and/or the methodology once these are tested in the field or researched further.

## **5.4 Outlook**

Limitations often provide cues for future research since dedicated research endeavors and new insights from theory or practice could resolve the acknowledged uncertainties or insufficiencies.

Focusing on the typology, for instance, scholars might examine its general applicability to a broader range of manufacturing companies in a quantitative study. It may result in slight adaptations of the existing types, as stated before, or even new ones could be found.

Another research avenue that is worthwhile to elaborate on is its detailed comparison with the typology of Mintzberg (1980). While we accounted for the typology not contradicting it, it may be interesting to examine the fit between the specific characterization of Mintzberg's ideal types and the ones suggested in this thesis.

Moreover, adopting the approach of Fiss (2011) to research the core-periphery distinction within the derived typology might reveal considerable insights, whether all attributes are equally crucial for the characterization.

Concerning the findings of the first and second research phases, two avenues present promising directions for future research.

On the one hand, scholars may investigate the set of influence factors in other settings, or add new, initially undiscovered variables. On the other hand, researchers could test the developed flow chart in real-world environments for validation and adaptation purposes. Additionally, the inherent data gathered from the quantitative data collection may be examined further by applying multi-linear regression analysis and/or factor analyses. These could offer new findings and insights about potential groups of significant factors.

While the pronounced research avenues demonstrate valid opportunities to resolve insufficiencies of the applied research methodologies, Chapter 4.3 exposes more exciting aspects, on which we could focus.

Future research endeavors should dig deeper into the core processes of manufacturing companies offering or intending to provide data-based services.

It may be interesting to obtain an understanding of the relationship between performance outcomes (such as turnover or revenue from data-based services) and the choice between operating with investment, cost, or profit centers.

Fruitful would it be to investigate the transformation of the corporate IT of manufacturing companies together with the increased importance of data-based services.

Moreover, the tangible tension between a product and a service culture at manufacturing companies should be examined based on the organizational ambidexterity theory (cf. Zimmermann et al., 2015) to bring in another theoretical lens.

To conclude, possible research directions are manifold and can stem from methodological issues, theoretical perspectives, and practical insights. Therefore, we summarize an excerpt of intriguing research questions in the agenda aggregated in Table 15: Research Agenda. Table 15.

Table 15: Research Agenda.

<b>Source</b>	<b>Research Question</b>
Topic	How can data-based service development be organized?
Topic	What is the relationship between alternative forms of data-based service sales organization and performance outcomes?
Topic	How should we organize back-end activities in the process of data-based service delivery – internal and centrally, internal and decentral, or external?
Topic	What are the dominant accounting mechanisms for data-based service activities? Which yields the best performance outcomes on the service level and the organizational level?
Topic	How does the servitization and digitalization of manufacturing companies influence their merger and acquisition behavior?
Topic	How can we organize manufacturing companies with the impetus to allow high dynamism in the era of data-based services?
Topic	How would a general typology look like for the organization of manufacturing companies in the era of digitalization and servitization?
Methodology	What might be a taxonomy of organizational configurations of manufacturing companies deducted from cluster analysis?
Theory	What are necessary dynamic capabilities to excel in developing, selling, and delivering data-based service activities?
Theory	How can we manage organizational ambidexterity at manufacturing companies in the era of digitalization and servitization?

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## **Appendix**

### **A1. Benchmarking Study – Transformation of the Service Organization**

This section encompasses the benchmarking questionnaire sent to the participants (part one) and the interview guideline used for the case study interviews (part two).

## Part One – Benchmarking Questionnaire

### Questionnaire

#### 1 Language Selection

Herzlich Willkommen zum Benchmarking "Data-based Services - Transformation of the Service Organization"  
Welcome to our Benchmarking "Data-based Services - Transformation of the Service Organization"

Bitte wählen Sie eine Umfragesprache. Please select your language.

German  
English

#### 2 Introduction

Introduction >> Strategy&Organization >> Stakeholder >> Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >> Corporate Information >> End

### Welcome to our benchmarking "Data-based Services"

A project by the ITEM-H&G division of Production Management

Until a few years ago, industrial services mostly played a minor role in manufacturing companies. Service offerings supported product sales and were considered more a cost than a revenue driver.

Successful examples of companies show that this picture has changed. Today, industrial services enable strategic differentiation and thus increasing profits. However, service departments of manufacturing companies also have to keep up with technical progress.

A current trend are the so-called **data-based services**. They are based on two elements:

- They are made possible by transmitting and processing **data from connected products**
- They allow **digital and remote** provision of **services**.

These services are also called **smart services** or **remote services**. An example for this is predictive maintenance.

Although the technological requirements for data-based services are already largely met, manufacturing companies have **difficulties in commercializing their services successfully**. To successfully establish the business for data-based services, companies need to:

- fully understand their own **product and service portfolio**,
- adapt their **strategy, business model and organizational structures**
- build up the **relevant technological and organizational capabilities**

This survey examines the above mentioned success factors for the **digital transformation** of manufacturing companies' **service business**. The goal is to find "**Successful Practices**" among all participating companies that show successful approaches to marketing data-based services in their industry and to learn from them.

#### Your benefits as a participant

- **Customized final report** for your company (Example: Big Data Study)
- **Compare** your performance to companies within your **industry** and to the "**Successful Practices**"
- Levers and Ideas for **improving** your company with regard to the **digital transformation** of your **service business**
- Depending on your performance you might be chosen as "Successful Practice" candidate
  - In this case you have the possibility to **visit other "Successful Practice" companies**
  - On this occasion you **get into contact** with other executives and experts from industry and science (networking)
  - Furthermore you discuss **challenges and opportunities** as well as new **approaches** for your business

#### Confidentiality

All data is treated confidentially by the University of St.Gallen and is not given to third parties. In addition, we comply with the „International Benchmarking Code of Conduct“, which is based on the widely used APQC/ISPI Code of Conduct.

Let's explore the transformation of the service organization together!

#### Contact Information

For receiving an individualized report, please enter your contact details:

Title

Mr  
Ms

First name



Surname

Company

Position

Email Address

Phone

**Would you like to answer the questionnaire for the entire company, a specific business unit or a single location?**

To ensure the consistency of the results, we kindly ask you to answer the questionnaire either for the whole company or a distinct part of the company.

- Entire company
- Business unit / division / location / etc. - Please specify:

**What is the primary type of goods produced by #c\_0001#?**

Please choose one option.

- Consumer goods (B2C)
- Industrial goods (B2B)

**How would you primarily classify your company or business unit?**

In order to keep the questionnaire as short as possible, certain questions will be adapted to your company profile according to your selection.

- Manufacturing industry (production of goods)
- IT & Internet business
- Financial and insurance services
- Others

### 3. Strategy & Organization

Introduction >> **Strategy & Organization** >> Stakeholder >> Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >> Corporate Information >> End

**How important are the following corporate values at #c\_0001#?**

Please choose one answer per category.

	Not at all important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important	Don't know
Customer service	<input type="radio"/>							
Product quality	<input type="radio"/>							
Problem solving for customers	<input type="radio"/>							

**Does #c\_0001# possess clearly formulated strategic goals for the service business?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
We have clearly formulated strategic goals for the <u>service</u> business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We have clearly formulated strategic goals for the <u>data-based service</u> business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Which goals does #c\_0001# primarily pursue with the introduction of data-based services?**

Please check all that apply.

- Differentiation from competitors
- Raising the entry barriers for new competitors
- Supporting product sales
- Acquiring additional sources of revenue
- Advancement of new innovations

**Which service strategy does #c\_0001# pursue?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
We primarily focus on products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customers choose us because of our products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customers choose us because of our services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We actively offer data-based services to our customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**What market situation is #c\_0001# exposed to?**

Please indicate the degree to which you agree or disagree with each statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
We are serving <b>many different markets</b> with our products and services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We are operating in highly fluctuating markets (changing customer needs, new competitors, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Which of the following services does #c\_0001# offer?**

Please check all that apply.

- Maintenance Services
- R&D Services (Research and development by order of a third party)
- Operational Services (development, construction and optimization of customer projects)
- Data-based Services (services enabled through transmission and/or processing of data from connected products)
- None of those mentioned above

**How large is the estimated potential of data-based services regarding #c\_0001# in the following categories?**

Please choose one answer per category.

	Very low	Low	Neutral	High	Very high	Don't know
Increasing machinery/ plant availability	<input type="radio"/>					
Reducing maintenance/ service costs	<input type="radio"/>					
Customer retention through improved service	<input type="radio"/>					
Informing the management in real-time	<input type="radio"/>					
Reducing the total cost of ownership (TCO)	<input type="radio"/>					
Offering new, enhanced services	<input type="radio"/>					
Improved products	<input type="radio"/>					

**What organizational structure describes your company best?**

Please choose one of the options below. A description of the structures can be found here.

- Decentralized structure
- Functional structure
- Matrix structure
- Project organizational structure
- Other:

**How is #c\_0001# 's organization designed?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
Service business is mainly separated from our product business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our service organization has an own profit and loss accountability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Product and service business are sharing important resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How has #c\_0001# primarily organized its activities/ responsibilities concerning data-based services and how does it plan to adapt**

**It? What do you think is the optimal organizational structure?**

You can find an explanation for the organizational structures here. If no changes are planned, please select the same organizational structure for "current" and "planned".

	Current	Planned	Optimal
Organizational structure	<div style="border: 1px solid black; padding: 2px;">                     &lt;span style="color:#BDBDBD"&gt;                      Decentralized                      Project/ lead Team                      Staff function                      Integrated in functional unit                      Separate functional unit                 </div>	<div style="border: 1px solid black; padding: 2px;">                     &lt;span style="color:#BDBDBD"&gt;                      Decentralized                      Project Team                      Staff function                      Integrated in functional unit                      Detached functional unit                 </div>	<div style="border: 1px solid black; padding: 2px;">                     &lt;span style="color:#BDBDBD"&gt;                      Decentralized                      Project Team                      Staff function                      Integrated in functional unit                      Detached functional unit                 </div>

**How would you describe the organization of #c\_0001#?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
Work at #c_0001# is highly formalized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Most processes at #c_0001# are defined step by step	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our company can be considered as bureaucratic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our company delegates all important decisions to the top-management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
#c_0001# aims to centralize all information flows	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our business units make decisions independently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our business units unify all relevant responsibilities to develop, produce, sell and provide new products and/or data-based services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**To what extent have the following elements of the business model changed at #c\_0001# due to the introduction of data-based services?**

Please choose one answer per category.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent	Don't know
Key partners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Key activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer relations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer segments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distribution channels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost structure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sources of income	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Competences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**To what extent does the IT department at #c\_0001# perform the following tasks in the context of data-based services?**

Please indicate to what extent the following statements apply.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent	Don't know
Provision of IT and telecommunication equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Specification of guidelines for data protection/ IT security	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analysis of customer data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Remote customer assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ensuring the availability and performance of products operated by customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compiling requirements for new product and service development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaboration in cross-functional development teams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Formulation of strategy for connected products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How would you describe the service orientation of all employees at #c\_0001#?**

Please indicate the degree to which you agree or disagree with each statement.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
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They understand the marketing opportunities of services	<input type="radio"/>							
They are aware of the financial potential of services	<input type="radio"/>							
They recognize strategic possibilities of services	<input type="radio"/>							
They consider services as a main part of our value creation	<input type="radio"/>							

**3.1 Service Portfolio Details**

**Maintenance Services**

Please tick all services offered by #c\_0001#.

- Preventive maintenance
- Complete maintenance contracts
- Annual maintenance activities
- Service level agreements for maintenance
- Process optimization through continuous maintenance
- Life cycle maintenance services

**R&D Services**

Please tick all services offered by #c\_0001#.

- Process design
- Process-oriented development services (tests, optimization, simulation)
- Development services
- Construction-/ design services
- Consulting services in process or product development

**Operational Services**

Please tick all services offered by #c\_0001#.

- Managing the whole maintenance function
- Product operation
- Spare parts logistics management
- Operation of repair teams for customers
- Managing training and personnel development
- Disposal/ recycling services

**What is the status of the following data-based services for #c\_0001#?**

Please choose one answer per category.

	Not relevant	In observation	Researching and developing	Pilots in use	Fully implemented	Don't know
Remote monitoring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data analysis/ diagnostics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Functions on demand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Software updates (through internet/ cloud)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Licensing services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Predictive Maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data-based process optimization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benchmarking services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other: <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**4 Stakeholder**

Introduction >> Strategy&Organization >> Stakeholder >> Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >> Corporate Information >> End

**How does #c\_0001# typically assign tasks to its employees?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
Our employees are <b>very specialized</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our employees have a <b>broad range of tasks</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We often assign new tasks to <b>existing personnel</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For managing new tasks, <b>we hire personnel</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How important are the following competencies for employees providing data-based services?**

Please choose one answer per category.

	Not important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important	Don't know
Process and customer know-how	<input type="radio"/>							
Coordination of workflow	<input type="radio"/>							
Problem solving/ optimization competence	<input type="radio"/>							
Interaction with technology	<input type="radio"/>							
Interdisciplinary thinking/ acting	<input type="radio"/>							
Mastering complex work contents	<input type="radio"/>							
Participation in Innovation processes	<input type="radio"/>							
Service orientation	<input type="radio"/>							
Independent decision making	<input type="radio"/>							
Social/ Communication competence	<input type="radio"/>							
Leadership competence	<input type="radio"/>							

**Which measures does #c\_0001# use to acquire the needed competencies for providing data-based services?**

Please tick to which extent you use these measures.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent	I don't know
Employee training/ Further education	<input type="checkbox"/>							
Outsourcing (Activities are handled by a service provider)	<input type="checkbox"/>							
Recruiting of new talents	<input type="checkbox"/>							
Merger and acquisition (M&A) of companies	<input type="checkbox"/>							
Purchase of licences (or something similar)	<input type="checkbox"/>							

**Which technological functions are provided by the CRM (customer relationship management) system of your service organization?**

Please choose one answer per category.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent	Don't know
Integration of the information systems over several functional units	<input type="checkbox"/>							
Acquisition of data from every interaction with customers	<input type="checkbox"/>							
Collection of all customer-related data in a central database	<input type="checkbox"/>							
Use of data between different information systems	<input type="checkbox"/>							

**Which of these measures does #c\_0001# use to develop customer relations?**

Please check all that apply.

- Key account management teams
- Exclusive events for customers
- Periodic notifications, e.g. about new services
- Early access to new products/ services
- Individual special offers
- Training offering
- Others (please specify):

**To what extent is your service organization supported in the execution of data-based services by the following providers?**

Please choose one answer per category.

- Software providers (e.g. SAP, Oracle)
- Software platform providers (e.g. Siemens Mindsphere, Hitachi Lumada)
- Cloud storage and cloud computing providers (z.B. Amazon Web Services, Microsoft Azure)
- Data analysis providers (e.g. Infosys)
- Telecommunication providers (e.g. Swisscom, Deutsche Telekom, Vodafone)
- Others (please specify):
- Don't know

**How important are the following reasons when your service organization is cooperating with an external service provider (ESP)?**

Please choose one answer per category

	Not at all important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important	Don't know
<b>Service quality</b> (z.B. time, operating reliability, geographical coverage)	<input type="radio"/>							
Secure or build <b>market share</b>	<input type="radio"/>							
Expand service <b>offering</b>	<input type="radio"/>							
Increase <b>productivity</b> of core activities	<input type="radio"/>							
Obtain <b>market access</b>	<input type="radio"/>							
Access to additional <b>knowledge</b>	<input type="radio"/>							
<b>Cost reduction</b> of non-core activities	<input type="radio"/>							

**Which of the following activities do external service providers (ESP) perform on behalf of #c\_0001#?**

Please check all that apply.

- Service development
- Consulting and sales of service contracts
- Deploy service personnel for field service
- Customer training
- Operation of workshops
- Spare parts logistics
- Customer support in local language
- None of those mentioned above

## 5 Service Innovation

Introduction >> Strategy&Organization >>Stakeholder >>Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information >> End

**What describes service development at #c\_0001# best?**

Please choose one of the options below.

- There is no standard approach for developing new services
- The process for developing new services corresponds to the process for developing new hardware products
- There is a dedicated process for developing new services

**Which of the following methods does #c\_0001# use to develop new services?**

Please check all that apply.

- V model
- Agile methods (e.g. scrum)
- Quality function development (QFD)
- Minimum viable service development
- Stage-gate model
- Design thinking
- Lean Start-up

Other (please specify):

**Which of the following activities are part of the service development process at #c\_0001#?**

Please check all that apply.

- Strategic planning
- Idea creation
- Idea selection
- Business-case analysis
- Building cross-functional teams
- Service description (core service, service levels)
- Process design (customer process, internal service process)
- Resource planning (personnel, facilities)
- Staff training
- Testing of services and trial runs
- Test marketing
- Marketing conception
- None of those mentioned above

**To what extent are the following functional units involved in the development of new services?**

Please choose one answer per category.

	Not at all	To a very small extent	To a great extent	Leading	Don't know
Marketing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sales	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
After sales	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Business development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Product development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Service development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
IT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Process development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Finance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Legal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data analytics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How often does #c\_0001# use the following methods to bring the customer perspective into the development of new services?**

Please choose one answer per category.

	Not at all	Rarely	Often	Always	Don't know
Examination of the usage behavior of our services based on genuine <b>customer data</b>	<input type="radio"/>				
<b>Meeting</b> between <b>service developers</b> and <b>customers</b>	<input type="radio"/>				
Using <b>customer's feedback</b> to adapt newly introduced services	<input type="radio"/>				
Internal meetings to discuss potential <b>customer needs</b>	<input type="radio"/>				
Information systems for sharing <b>customer knowledge</b>	<input type="radio"/>				
Systematic review of previous <b>customer relations</b>	<input type="radio"/>				
Temporary <b>task-force teams</b> with our customers	<input type="radio"/>				

**To what extent does #c\_0001# use the following criteria to prioritize service innovations?**

Please choose one answer per category.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent
Financial profitability (e.g. return on investment)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Payback period	<input type="radio"/>						
Uniqueness of Innovation	<input type="radio"/>						
Realisation of the corporate strategy	<input type="radio"/>						
Costs of delay (e.g. by competitors entering the market, missing a promising opportunity...)	<input type="radio"/>						
Extensibility/ Possibility of technical development	<input type="radio"/>						
Potential for future business opportunities (e.g. through data generation)	<input type="radio"/>						
Others (please specify): <input type="text"/>	<input type="radio"/>						

**To what extent do the following stakeholders at #c\_0001# influence decisions in the development of new services?**

Please choose one answer per category.

	Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent
Executive board	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Steering committee	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Project lead	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sales	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
R&D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Product management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strategy department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Others (please specify): <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Which of the following aspects does #c\_0001# use to make data-based service pilot projects available to a larger number of customers?**

Please choose one answer per category.

	Not at all	Rarely	Often	Always	Don't know
Development of pilot projects and further development to market maturity in different departments	<input type="radio"/>				
Use of easily scalable technologies (e.g. cloud services with modular options)	<input type="radio"/>				
Marketing measures (discounts, advertising)	<input type="radio"/>				
Fast expansion to new countries	<input type="radio"/>				
Standardization and automation of processes (in the service delivery and in the back-office)	<input type="radio"/>				

## 6 Service Sales

Introduction >> Strategy&Organization >>Stakeholder >>Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information >> End

**Which criteria are the most important for your customers, when they purchase #c\_0001#'s products?**

Please rank the following purchasing criteria in descending order of importance for **your customers**

To do this, drag the items individually into the right-hand block. You can adjust the order of the elements in the right block by dragging.

	1	2	3	4	5	6	7	8
Brand name	<input type="radio"/>							
Quality	<input type="radio"/>							
Price	<input type="radio"/>							
Support services	<input type="radio"/>							
Data-based services	<input type="radio"/>							
Responsiveness	<input type="radio"/>							
Performance	<input type="radio"/>							
Expertise	<input type="radio"/>							

**Which of the following elements does #c\_0001# use to quantify the value proposition of its services?**

Please check all that apply.

- Point out how our services enhance our **customer's performance**
- Show the customer the **financial impact of a collaboration** with us

- Measuring the **advantages of our services** against those of our **competitors**
- Measuring the value of our services **perceived by the customer**
- Measuring the value creation potential along the **process chain** of the customer
- None of those mentioned above

**Which pricing principle does #c\_0001# mainly use for data-based services?**

Please choose one of the options below.

- Value-based pricing
- Competition-based pricing
- Cost-based pricing
- No defined pricing strategy

**How important are the following elements for #c\_0001# regarding the pricing of data-based services?**

Please rank the following elements according to their importance for pricing data-based services.

	1	2	3	4	5	6	7	8
Customer segment	<input type="radio"/>							
Current demand	<input type="radio"/>							
Capacity utilization (staff, equipment)	<input type="radio"/>							
Prices of other services in our portfolio	<input type="radio"/>							
Effort to provide the service	<input type="radio"/>							
Prices of our products	<input type="radio"/>							
Time of day	<input type="radio"/>							
Others	<input type="radio"/>							

**How do you sell your data-based services?**

Please select all approaches that #c\_0001# follows.

- Separately: as a separate product
- Combined: with other services as part of a service contract
- No separate sale: We sell hardware products and provide the service complimentary

**Please rank the following sales channels by their importance for the service business.**

Pull the elements individually into the right block. You can adjust the order of the elements in the right block by dragging.

	1	2	3	4	5	6	7
Internet	<input type="radio"/>						
Phone	<input type="radio"/>						
Fax	<input type="radio"/>						
External service providers (excluding distributors)	<input type="radio"/>						
Distributors	<input type="radio"/>						
Sales staff	<input type="radio"/>						
Key account teams	<input type="radio"/>						

**Please rank the following digital sales channels by their importance for the service business.**

Pull the elements individually into the right block. You can adjust the order of the elements in the right block by dragging.

	1	2	3	4	5	6
Company website	<input type="radio"/>					
Third party websites (e.g. online marketplaces)	<input type="radio"/>					
Electronic data interchange - EDI (e.g. ERP, other e-procurement systems)	<input type="radio"/>					
Online communities (e.g. social media, expert forums)	<input type="radio"/>					
Chat	<input type="radio"/>					

Mobile application

**What type of goal agreement is most commonly arranged with the sales force?**

Please choose one of the options below.

- Goals for product sales, but **not** for service contracts
- Goals for product sales and service contracts, but **not** specifically for data-based services
- Goals for product sales, service contracts, and especially for data-based services
- Goals for service contracts, but **not** for product sales

**For which of the following metrics has #c\_0001# defined specific targets for its sales force?**

Please check all that apply.

- Sales volume
- Service revenue
- Number of new customers
- Customer satisfaction
- Retention of existing customers
- Closure rate
- Others (please specify):

**7 Service Delivery**

*Introduction >> Strategy&Organization >>Stakeholder >>Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information >> End*

**Which of these functions are fully automated?**

Please check all that apply.

- Confirmation of customer requests
- Notification of order status
- Dispatch of service technicians
- Fetching spare parts demand
- Control of process parameters
- Control of product components
- Installation of software updates
- Other:

**What is the cost split of an average service order?**

Please arrange the positions in descending order of their cost share.

	1	2	3	4	5	6	7
Service staff in the field	<input type="radio"/>						
Service staff in the office	<input type="radio"/>						
Staff for data processing & IT	<input type="radio"/>						
Mobile hardware material (service vehicles, tools ...)	<input type="radio"/>						
Mobile computer equipment (phones, scanners, ...)	<input type="radio"/>						
Telecommunication & data transmission	<input type="radio"/>						
Computer equipment (data centers)	<input type="radio"/>						

**8 Technology**

*Introduction >> Strategy&Organization >>Stakeholder >>Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information >> End*

**How frequently are the following items embedded in your currently installed base?**

Please choose one answer per category. Answers are in % of the installed base products.

	Below 10%	11% - 25%	26% - 50%	51% - 75%	More than 75%	Don't know
Sensors	<input type="radio"/>					
Processors	<input type="radio"/>					
Connectivity elements (ports, antennas ...)	<input type="radio"/>					
Operating system	<input type="radio"/>					
Onboard software applications	<input type="radio"/>					
Advanced user interface	<input type="radio"/>					
Components for product control	<input type="radio"/>					

**What share of your currently installed base is (permanently or temporarily) connected to the internet?**

Please enter a rounded percentage:

%

**Which of the following strategies uses #c\_0001# to extend the connectivity of the installed base?**

Please check all that apply.

- Financial incentives (for example discounts on service fees)
- Technical retrofitting
- Exchange with new connected products
- Supply of mobile devices (phones, tablets, ...)
- Cooperation with telecommunication providers (e.g. Swisscom, Vodafone)
- Others (please specify):

**To what extent do you use the following remote software applications in your currently installed base?**

Please choose one answer per category. Answers are in % of the installed base.

	Below 10%	11% - 25%	26% - 50%	51% - 75%	More than 75%	Don't know
<b>Product database</b> (for managing real-time and historical product data)	<input type="radio"/>					
<b>Application platform</b> (for developing and running online applications)	<input type="radio"/>					
<b>Analytic engine</b> (algorithms that provide new insights about products)	<input type="radio"/>					
<b>Smart product applications</b> (remote control, optimization and autonomous execution of product features)	<input type="radio"/>					

**What data does #c\_0001# use for data-based services?**

Please check all that apply.

- Data about product components
- Data about the entire product
- Customer process data
- Data from customer ERP
- Environmental data (e.g. temperature, pressure, humidity)
- Data about products of third parties
- External data (e.g. weather, traffic, markets, GPS, ...)

**What organizational measures has #c\_0001# taken for the data security of its data-based services?**

Please check all that apply.

- Hiring of employee(s) exclusively for data protection
- Use of legal advice before the introduction of data-based services
- To assure the customer that current privacy policies will be followed
- Building a deep understanding of current privacy policies
- Consistent implementation of current data protection guidelines

**To what extent are the following technical data security measures for data-based services of #c\_0001# currently available?**

Please choose one answer per category.

	Not implemented	Sparsely implemented	Partially implemented	Mostly implemented	Fully implemented	Don't know
Encryption (especially cloud services, remote services, external data carriers and hard disks)	<input type="radio"/>					
Application control for protection against installation and execution of unauthorized applications	<input type="radio"/>					
Patch management (regular updates for software and system)	<input type="radio"/>					
Device management (Centralized management of mobile devices such as smartphones, tablets, ...)	<input type="radio"/>					
Protection against ransomware	<input type="radio"/>					

## 9 Performance

Introduction >> Strategy&Organization >> Stakeholder >> Service Innovation >> Service Sales >> Service Delivery >> Technology >> Performance >> Corporate Information >> End

**What effect did the introduction of data-based services have on the following factors?**

Please choose one answer per category.

	Much lower	Lower	Slightly lower	No change	Slightly higher	Higher	Much higher	Don't know
Customer satisfaction	<input type="radio"/>							
Service revenue	<input type="radio"/>							
Service return on sales	<input type="radio"/>							
Share of data-based services in the service revenue	<input type="radio"/>							
Cost of service provision	<input type="radio"/>							
Share of first-time-solved incidents	<input type="radio"/>							
Share of remotely solved incidents	<input type="radio"/>							
Average resolution time of incidents	<input type="radio"/>							

**What share of #c\_0001#'s revenue has been - on average - generated by services over the last three years?**

Please choose one of the options below.

- Less than 5%
- 5% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 50%
- 51% - 75%
- More than 75%
- Don't know

**What share of #c\_0001#'s revenue has been - on average - generated by data-based services over the last three years?**

Please choose one of the options below.

- Less than 1%
- 1% - 3%
- 4% - 5%
- 6% - 10%
- 11% - 15%
- 16% - 25%
- More than 25%
- Don't know

**How do you evaluate #c\_0001#'s performance in following categories compared to its main competitor?**

Please choose one answer per category.

	Much worse	Worse	Slightly worse	No change	Slightly better	Better	Much better	Don't know
Customer satisfaction	<input type="radio"/>							
Share of service revenue in total revenue	<input type="radio"/>							
Share of data-based service in service revenue	<input type="radio"/>							
Cost of service delivery	<input type="radio"/>							

**How much is #c\_0001# investing in expanding its service business?**

Please indicate the degree to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Don't know
In the <u>past</u> 3 years, we have significantly invested in expanding our service business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the <u>next</u> 3 years, we plan to invest significantly in expanding our service business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 10 Corporate Information

*Introduction >> Strategy&Organization >> Stakeholder >>Service Innovation >>Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information > End*

**How many people are employed by #c\_0001# in total as measured in full-time equivalents?**

If you do not have the exact number, please give your best estimate. Please provide a whole number and do not make use of a separator for thousands.

[FTEs]

### 10.1 Branche

**Which industry does #c\_0001# operate in?**

Please tick the industrial sector, in which your company is operating. If more than one category is correct, please choose the one that applies predominantly.

- 10 - Manufacture of food and animal feed
- 11 - Manufacture of beverages
- 12 - Manufacture of tobacco products
- 13 - Manufacture of textiles
- 14 - Manufacture of clothes
- 15 - Manufacture of leather and related products and shoes
- 16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of straw and plaiting materials
- 17 - Manufacture of paper, carton, cardboard, corrugated board and paper products
- 18 - Manufacture of printing products, printing and reproduction of recorded media
- 19 - Manufacture of coking coal, coke oven gas and refined petroleum products
- 20 - Manufacture of chemical products
- 21 - Manufacture of pharmaceuticals
- 22 - Manufacture of rubber and plastic products
- 23 - Manufacture of glass and glassware, ceramics and other non-metallic mineral products
- 24 - Metal production and metal processing
- 25 - Manufacture of metal products
- 26 - Manufacture of data processing equipment, electronic and optical products
- 27 - Manufacture of electrical equipment
- 28 - Mechanical engineering
- 28.5 Construction and agricultural machinery
- 29 - Manufacture of automotive and automotive components

- 30 - Manufacture of other transport equipment
- 31 - Manufacture of furniture
- 33 - Repair and installation of machinery and equipment
- 32 - Production of other goods, namely:

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**11 Ende**

*Introduction >> Strategy&Organization >> Stakeholder >>Service Innovation >>Service Sales >> Service Delivery >> Technology >> Performance >>Corporate Information > End*

**What do you think about data-based services? Do they have the potential to become an important source of income in the future?**

**Have approaches of #c\_0001# to data-based services won an award or have they been published in an article?**

Please choose one of the options below.

- No
- Yes, approaches or solutions have been published
- Yes, we received one or multiple award(s)
- Yes both, approaches or solutions have been published and we received one or multiple award(s)
- Don't know

**When you think of the most successful companies commercializing data-based services, which companies come to your mind?**

Mentioned companies might be within your industry or even in completely different industries.

	Company name	Reason
1st	<input type="text"/>	<input type="text"/>
2nd	<input type="text"/>	<input type="text"/>
3rd	<input type="text"/>	<input type="text"/>

Thank you very much for your valuable contribution and the participation in our benchmarking!

*Click on "Continue" to finish this survey. Afterwards, the results cannot be changed anymore.*

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**12 Endseite**

**Thank you for your participation - You have successfully finished this survey!**

*We look forward to providing you with the results as soon as possible. Please do not hesitate to contact us for further information on this or other projects of the Institute of Technology Management at the University of St.Gallen.*

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## Part Two – Case Study Interview Guideline

### 0. *Introduction to the discussion (5 min)*

- Personal introduction of the participants
- Presentation of the benchmarking-process inclusive arrangement of site visits
- General information:
  - Goals, process, and time schedule of the interview
  - Number and selection of the respondents
  - Emphasize site visits (incl. introduction of the companies which would participate)
  - Evaluation approach (especially: confidentiality and anonymization)
  - Taking minutes
- Opportunity for further inquiries

### 1. *Strategy & Organization (15 min)*

- Which data-based services do you currently offer? With which service did you have the biggest success so far?
- What significance do services and especially data-based services have in your corporate strategy? How many people work on them? How much money was invested in the past three years?
- How did the significance change in the past three years?
- In which functional area are your activities concerning data-based services currently organizationally based? Why there? Please indicate your motivation with the help of an organization chart.
- Which organizational changes were undertaken through the introduction of data-based services?
- Which barriers were overcome by the development and commercialization of data-based services? How did you manage this?

### 2. *Stakeholders & Culture (10 min)*

- How would you describe the “service culture” in your corporation? (e.g., service orientation of the employees)
- Has there a certain “cultural transformation” taken place? (management push vs. employee pull)

- Which KPIs do you use to measure the progress regarding the implementation of data-based services?
- Make or buy:
  - How did you build up essential skills for the development and delivery of data-based services? (internal vs. external)
  - Who analyses the collected data? (internal vs. external, if internal: function?)

### 3. *Service Innovation (10 min)*

- How do you identify opportunities for new data-based services?
  - Who is in your corporation responsible for the identification of data-based service-ideas?
- How structured and specific does your company develop the service component of data-based services?
- How does your company build up knowledge about customer needs and customer processes in the area of data-based services?
- In what form does your company involve customers in the development of data-based services?

### 4. *Service Sales (10 min)*

- How do you sell data-based services?
  - Bundling: Are data-based services bundled with existing ones, or are they marketed as an independent offer? If the latter – how is the offer designed?
  - Pricing: How did you accomplish the free-to-fee transition when selling data-based services?
  - Sales Staff: What professional background do the sales staff of your data-based services have?
- If target agreements or incentives, especially for the sale (of data-based) services exist: How are they designed?
- If there are no such agreements: Why not?

5. *Technology (5 min)*

- How did you manage to increase the share of the networked installed base?
- How do you convince your customers to give you access to the data? (data which you use to deliver data-based services)

6. *Highlights – How do you stand out as a Successful Practice? (5min)*

- Optional: How do you conclude that you outpaced the level of the industrial sector?

7. *Conclusion of the interview (5min)*

- Thanking for the interesting conversation
- Ask if there are still open-ended questions on the part of the interviewee
- Further brief reference, when and by what means information/results of the interview will be circulated
- Details to site visits (note: arranging a date)

## A2. Interview Guideline – Research Phase Two

### 0. Introduction

Thank you very much for considering this questionnaire. You kindly participated in our Benchmarking Study “Transformation of the Service Organization.” As part of my doctoral thesis, I am exploring the organizational configurations of manufacturing companies with a focus on the positioning of data-based service activities. In a first approach, I summarized 14 factors from the literature that should influence the location of these activities, which I want to test in this interview. Ultimately, I try to uncover the relationship between these factors and the organizational change of manufacturing companies offering data-based services.

### 1. Preliminary Information

- The interview will last approximately 30-45 minutes
- Your answers will be anonymized
- In total seven interviews will be executed
- The interview is going to be transcribed and send back to you for a final approval
- Your input is analyzed together with the other interviews and quantitative evaluation of the benchmarking results (no direct link to your company will be possible)
- The final article will be published in a journal (e.g., Industrial Marketing Management) and used for my doctoral thesis
- If you are interested, I may send you the findings after publication

### 2. Questions Part One

The questions of this interview guideline build upon certain answers to the benchmarking study. One question concerned the current, planned, and optimal organizational structure of your company. Your answers were as follows:

Current	Planned	Optimal

- a. How did your organization evolve in the past, reaching the current structure?
- b. Why is after you “xxx” the optimal organizational structure?
- c. If applicable: Why is the optimal structure, not the planned structure?
- d. Why do you strive to adapt your current organizational structure in the stated manner?
- e. What factors made you decide upon the planned structure?
- f. What was the reasoning/argument behind this decision?
- g. What are the advantages, disadvantages of the new (planned), and the current structure in your context?

### 3. *Questions Part Two*

As mentioned above, in the first research, I collected a list of 14 factors potentially influencing the positioning of data-based services activities. Please have a look at the following list and answer the remaining questions. Note, a declaration of the factors can be found overleaf.

- a. Which of these factors did you consciously incorporate into the decision-making process for choosing upon the planned organizational structure?
- b. Which of these factors may have been unconsciously incorporated due to your knowledge or predisposition?
- c. How important has been each factor for deciding upon the planned (optimal) structure?
- d. How would you estimate the development of the importance of each factor in the next three years?
  - 1 = not important
  - 2 = slightly important
  - 3 = moderately important
  - 4 = important
  - 5 = very important
- e. Could you please explain how the (main) factors influenced your decision-making?
- f. How do you incorporate local subsidiaries/service stations for data-based service activities?

<b>Factor</b>	<b>Conscious incorporation</b>	<b>Unconscious incorporation</b>	<b>Importance (from 1 to 5)</b>	<b>Tendency (from 1 to 5)</b>
<i>External Factors</i>				
Market volatility				
Market diversification				
<i>Internal Factors – Organization related</i>				
Human Resources				
Strategy				
Distinct service development process				
Maturity of data-based service business				
Self-standing service sales (sales process, strategy, and channel)				
<i>Internal Factors - Characteristics</i>				
Product characteristics				
Separability of the value proposition				
Age and size of the company				
Customer-centricity				
Centralization of decision-making authority				
Integrated business unit responsibilities				
Degree of formalization (Technical System)				

### A3. Set Cards – Research Phase Three

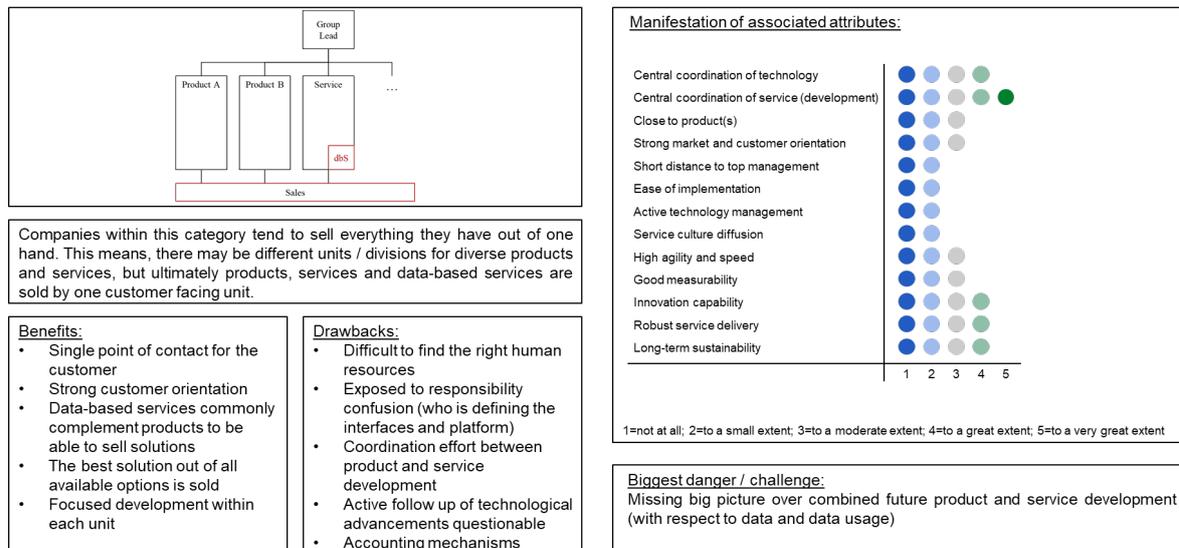


Figure 16: Front-End Convergence set card. Own illustration.

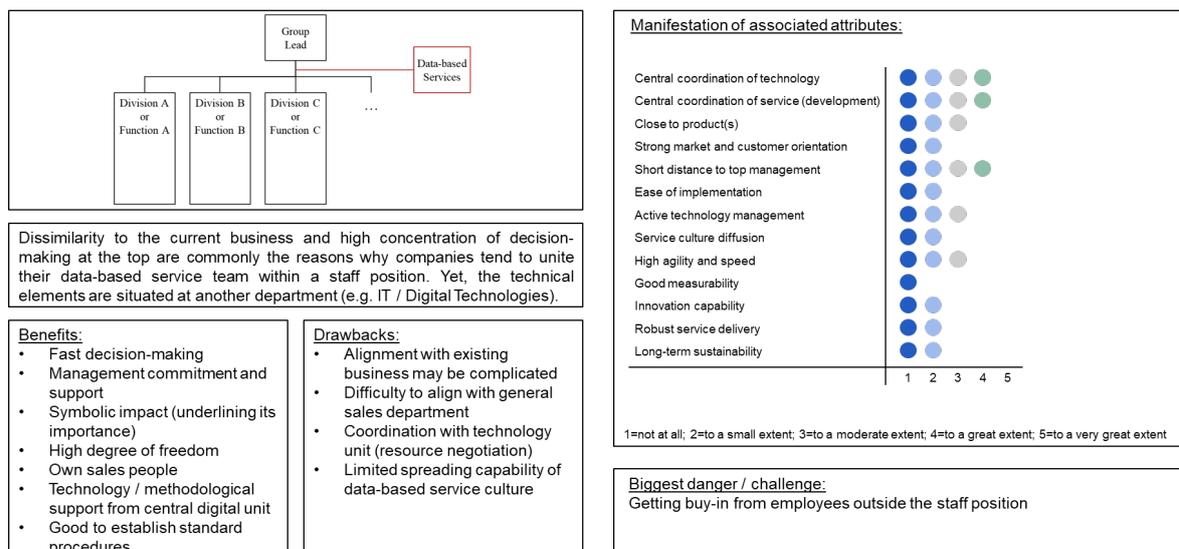


Figure 17: Top Loading set card. Own illustration.

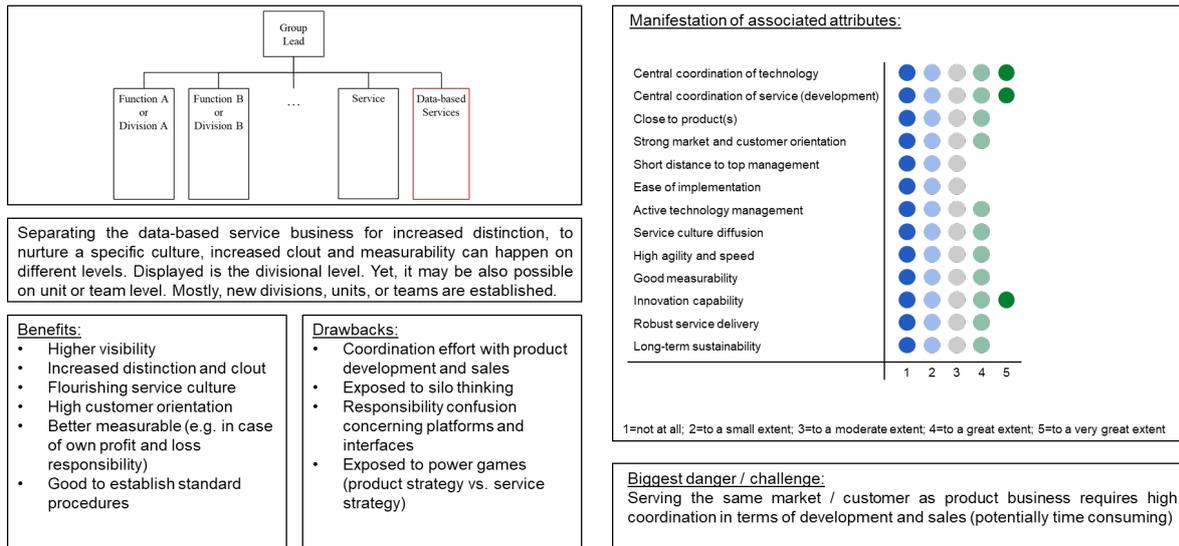


Figure 18: Breaking Up set card. Own illustration.

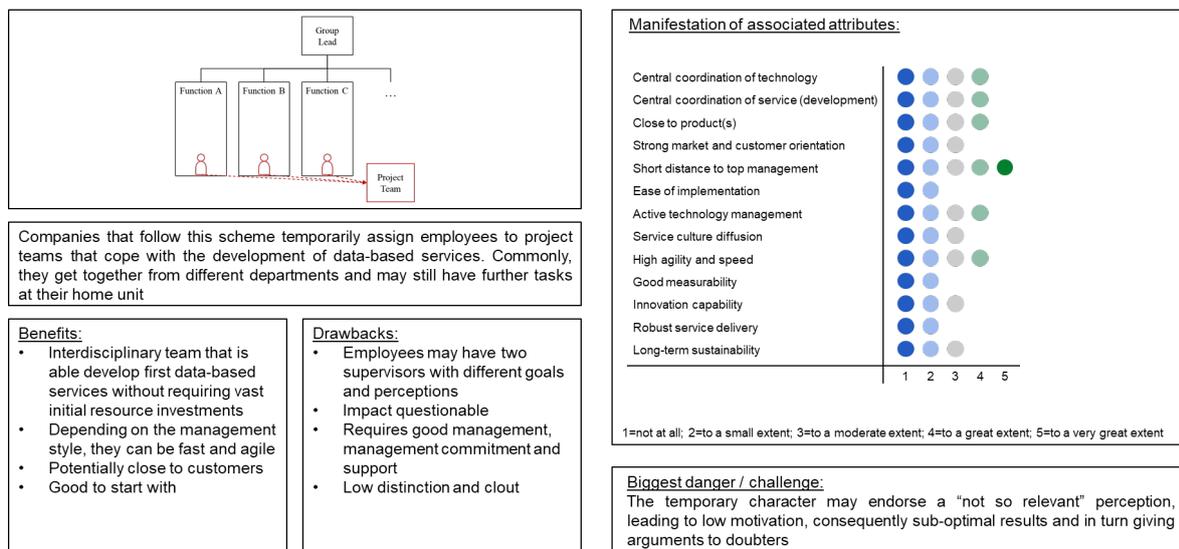


Figure 19: Zipper Organization set card. Own illustration.

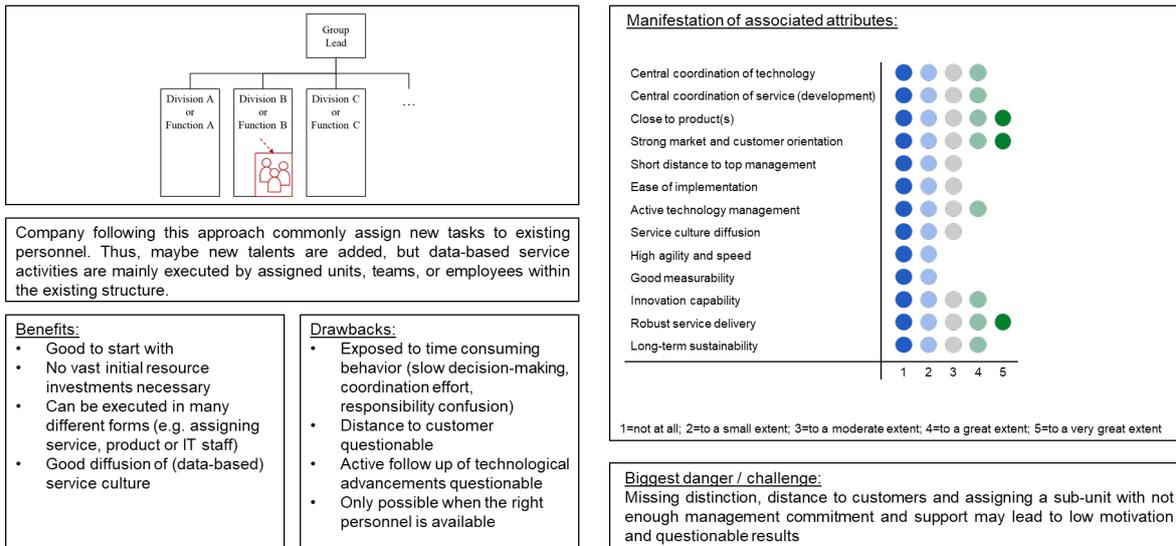


Figure 20: Leveraging the Existing set card. Own illustration.

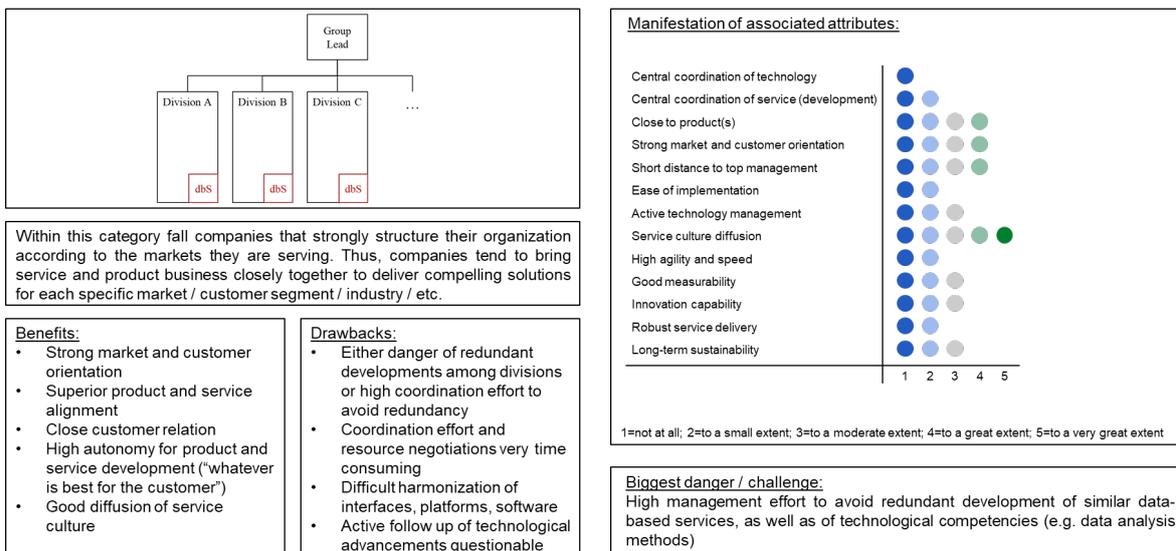


Figure 21: Market Rationale set card. Own illustration.

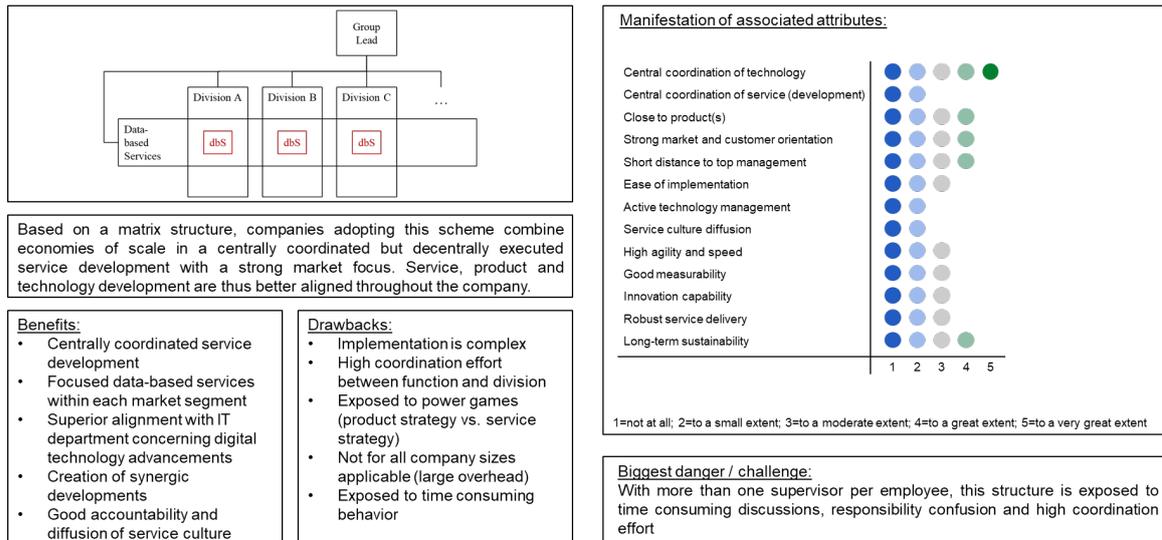


Figure 22: Service Nexus set card. Own illustration.

## Curriculum Vitae

Name	Philipp Osterrieder
Date & place of birth	June 26, 1990 in Memmingen, Germany
Nationality	German

## Work Experience

04/2017 – 07/2020	<b>University of St.Gallen – Institute of Technology Management</b> <i>St.Gallen, Switzerland</i> Research Associate in the division of Production Management
03/2016 – 09/2016	<b>BMW AG</b> <i>Munich, Germany</i> Master Thesis on Manufacturing Innovations
01/2015 – 01/2017	<b>Georg &amp; Phil Innovations GbR</b> <i>Munich, Germany</i> Co-Founder
11/2015 – 03/2016	<b>Porsche Consulting GmbH</b> <i>Bietigheim-Bissingen, Germany</i> Intern as Consultant in the Aviation Industry
02/2015 – 11/2015	<b>BMW AG</b> <i>Munich, Germany</i> Working Student for the Patent Campaign
04/2013 – 08/2013	<b>Technical University of Munich</b> <i>Munich, Germany</i> Tutor for Fluid Dynamics

## Education

04/2017 – 03/2020	<b>University of St.Gallen, St.Gallen, Switzerland</b> <b>Doctor of Philosophy in Management</b> focusing on Business Innovation
04/2014 – 10/2016	<b>Technical University of Munich, Munich, Germany</b> <b>Master of Science</b> focusing on Mechanical Engineering
01/2014 – 06/2014	<b>Kungliga Tekniska Högskolan, Stockholm, Sweden</b> <b>Exchange Semester</b> focusing on Mechanical Engineering
10/2010 – 06/2014	<b>Technical University of Munich, Munich, Germany</b> <b>Bachelor of Science</b> focusing on Aerospace Engineering
09/2000 – 06/2009	<b>Bernhard-Strigel Gymnasium Memmingen, Memmingen, Germany</b> <b>Abitur</b> (German equivalent for A-Level)