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POSITION PAPER

Towards customer-induced service orchestration - requirements for the next step of customer orientation

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Abstract

This position paper acknowledges that customer orientation is a key requirement for companies to be competitive in the marketplace. Customer orientation has led to concepts, such as personalization, one-to-one-marketing, mass customization and co-creation, which all strive for a strong alignment of individual customer demands and encounters with a company's offerings. Despite the customer is increasingly regarded as an active partner, the overall perspective of customer orientation is still mainly provider-oriented. Adopting the perspective of customers, as argued in this position paper, would help recognizing that customer problems are often broader and more complex than the solutions of single providers. While intermediaries and, more recently, assistants based on artificial intelligence, have emerged to address this demand, their approaches are typically little transparent and follow a black-box paradigm. Using examples from multiple application domains, this position paper proposes elements that need to be addressed to overcome these shortcomings. The concept of customer-induced service orchestration and management shall empower customers to combine services from multiple service providers in order to address their problems in a transparent and white-box way. This approach could represent an important next step in customer orientation.

Keywords Customer orientation · Service orchestration · Customer empowerment · Customer-induced services · Electronic intermediary

JEL classification L22 · L8 · O14 · D26

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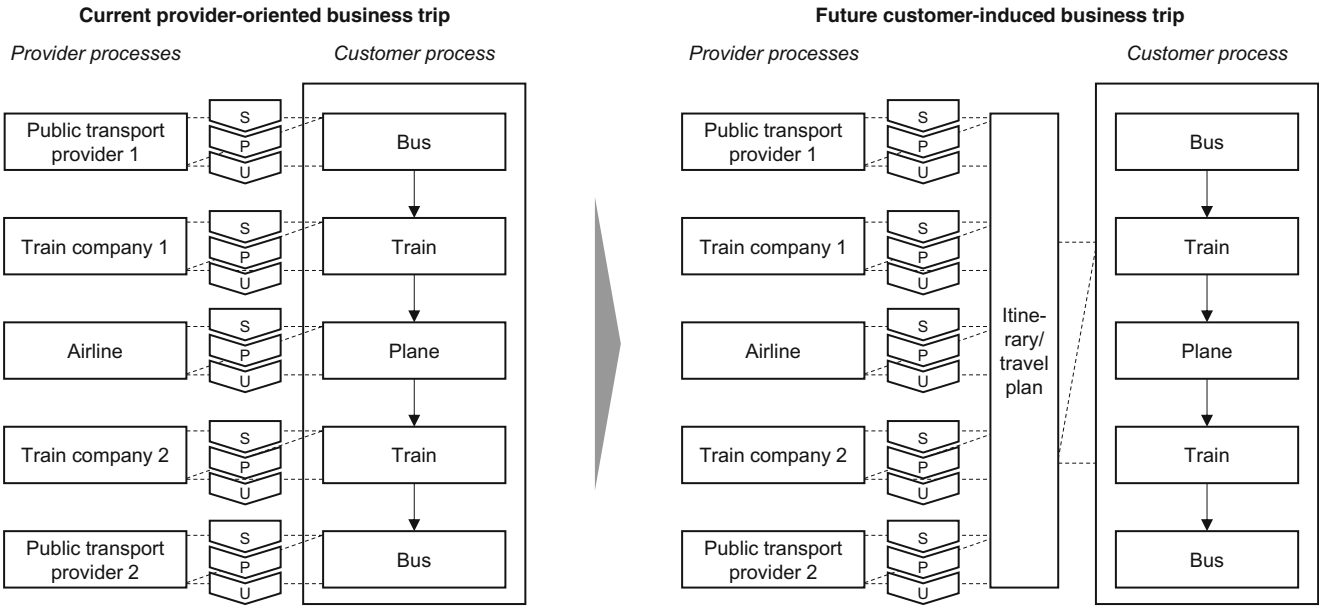
Introduction

Customer orientation has been stressed in research and practice for a long time. Which company would not claim being customer-oriented? Customer orientation means that companies offer products that correspond to a high degree with what customers demand. Through increased customer value, companies aim to increase their sales volume and their revenues. This reflects the classical view of marketing, which has primarily been driven from a provider perspective. The idea is that companies listen to their customers and are able to eventually come up with valued products and services that would in turn lead to repeated purchases (e.g. Slater and Narver 1998). For a long time, the world was clearly divided into providers and consumers of products and services. This has largely changed with the arrival of information technology (IT) at individuals. Starting in the late 1970s, with technologies such as videotext, a development has been initiated that allows individuals to access service offerings remotely not only by phone or catalog, but also interactively. This development has continued with the advent of personal computers, the internet, mobile technologies, and the social web (e.g. Alt and Zimmermann 2014). Today, individuals have almost ubiquitous access to businesses, which meanwhile operate many of their customer-facing processes also via electronic channels. The advantages for companies may be illustrated by an example from the travel industry in which "US Airways has succeeded in shifting 50% of its routine check-in transaction to self-service kiosks and reducing boarding pass printing by 96%" (Dong and Sivakumar 2017, p. 944).

The airline check-in example also highlights main characteristics of existing electronic services. First, it shows that electronic services rely upon the interaction between a service provider (the airline) and a service consumer (the passenger). This interaction may occur in each phase of the service creation process (Straus et al. 2016, p. 500 f.): during the *specification phase*, customers may contribute to shape the service; in the *production phase*, they may contribute to configure or "assemble" the service; and in the *usage phase*, they experience and finally evaluate the service. Obviously, the mentioned airline check-in example is part of the usage phase, but passengers were typically involved in the configuration of their itinerary during the prior production phase. In general, the more parts of the service process are supported with aligned IT-based services, the more digitalized and responsive the service may be. For example, problems occurring due to a late arrival of an incoming aircraft may be communicated to the passenger quickly including a recommendation or an alternative itinerary. Second, the airline check-in is a service offered by a single service provider. As shown in Fig. 1, the airline covers only one element in the customer process, since the itinerary might also include other transportation service providers. Traditionally, customers would either organize the bundling of these individual services themselves or mandate an intermediary (e.g. a travel agent) to assemble the services along the itinerary (see right in Fig. 1). From a customer perspective, these intermediaries are helpful agents that possess domain-specific knowledge of the involved offerings and the underlying booking processes. However, the selection and bundling tends to remain little transparent and out of direct control for the customers. In addition, the support provided by travel agents is often limited to the specification as well as the production phase. As soon as customers encounter problems during the usage phase, they will typically have to settle these on their own with the respective service provider(s).

Electronic intermediaries, such as travel portals, reservation systems or comparison sites, have already attracted a large percentage of the total booking volume in the travel industry as well as a large percentage of transactions in other industries (e.g. the financial or the retail industry), which feature largely standardized services. However, the ubiquity of mobile technologies, in particular of smartphones and tablets, as well as the advances in smart technologies that apply artificial intelligence (AI) concepts, are promising in targeting the shortcomings of service creation processes as mentioned above. Contrary to existing approaches which are characterized by "inside-out" and "black-box" service orchestration and which are largely defined by the service providers themselves, these technological advancements pave the way for an "outside-in" and a "white-box" philosophy. They would eventually empower customers to initiate and control the entire service creation process (see right in Fig. 1). In the business travel case, for example, customers should be able to specify the service elements and obtain a transparent view on the assembly (or orchestration) of services to the degree that they desire. This includes the possibility of influencing and controlling the service creation process at any stage.

This position paper refers to the above "white-box" approach as *customer-induced service orchestration*. It will first embed the concept in the existing literature and provide examples from multiple application domains. To sharpen the argumentation, the domains will be limited to service industries, and the service creation process will be restricted to the specification and the production phase. For the sake of simplicity, both will be referred to as service orchestration and - unless explicitly specified differently - customers will be used as general term for other roles such as citizens, patients or students. The third section elaborates on four key elements that are considered necessary for the realization of customer inducement. It also discusses two alternative scenarios as examples how different degrees of customer inducement may emerge in practice. Finally, the fourth section concludes the paper.



Legend: S (specification), P (production), and U (usage) denote the three phases of the service creation process

Fig. 1 Example for provider and customer processes in a business travel case

Towards customer-induced service orchestration

Several streams from the literature, in particular prior research on marketing and service management, are helpful in shaping the idea of customer-induced service orchestration. Although they pursue a primarily provider-oriented perspective, they provide a broad understanding of the increasingly active role of customers. This chapter discusses these streams and provides some examples of how customer-induced services might differ from existing provider-oriented services.

Research on customer orientation

In general, marketing research conceives on the interaction between a company and its market as a "fit" of the organizational resources on the one hand and the requirements of the customers on the other hand. Thus, "customer-oriented firms outperform competitors by anticipating the developing needs of consumers (i.e., by learning) and responding with goods and services to which superior value and greater satisfaction are consistently attributed […]. That is, being customer-oriented allows firms to acquire and assimilate the information necessary to design and execute marketing strategies that result in more favorable customer outcomes" (Brady and Cronin 2001, p. 241). This quote illustrates that customer orientation is considered a key strategic ingredient to attain higher revenues. It has become accepted that organizations, which focus on the needs of their customers perform better than companies that do not (Narver and Slater 1990; Jaworski and Kohli 1993; Donavan et al. 2004; Wang et al. 2016; Giannikas et al. 2019). When analyzing existing research, four enhancements to customer orientation may be observed.

First, an "outside-in" *business perspective* complements the traditional inside-out model and calls for an increased relevance of customer requirements. Whereas the inside-out model includes the manufacturing of products for a more or less anonymous market, the outside-in thinking posits to "rally the entire organization around an outside-in vision by reconnecting strategy with customers" (Day and Moorman 2013, p. 18). An outside-in example may be recognized in the definition of Daniel and Darby (1997, p. 134), who conceive customer orientation "as the ability of the service provider to adjust his/her service to take account of the circumstances of the customer". At the same time, the literature cautions against becoming a "customer-led" company, since this strategy "tends to be reactive and short term" and it "provides insufficient stimulus for the significant innovation that discontinuous change requires" (Slater and Narver 1998, p. 1005). Instead, a market-oriented attitude may support customer orientation when "the entire organization embraces the values implicit therein and when all business processes are directed at creating superior customer value" (Slater and Narver 1998, p. 1003). In addition to simply declaring customers as the center of business activities (Shah et al. 2006), this stream recommends that organizations aiming to develop and sell services should strive for a "best" mix of inside-out and outside-in activities (e. g. Saeed et al. 2015, Mu et al. 2018).

Second, the service relationship and service management literature has contributed on a more detailed level to the *participation of customers* in the service creation process (e.g. Wu 2011). Various approaches that recognize customers as active

participants in the value creation have emerged over time in this regard. A popular participation approach are customer self-service solutions which transfer tasks that were previously performed by employees to customers (Berger 2009; Åkesson et al. 2014). An example for such low degrees of customer participation is the airline check-in mentioned above. Mass customization refers to a higher degree of customer participation, since customers may configure products and services during orchestration along a defined solution space according to their needs (Tseng and Kiao 2001; Tseng and Piller 2003). "Customerization" was suggested as a more comprehensive approach that combines mass customization with customized marketing techniques such as personalization and one-to-one marketing. It argues that "a firm becomes an agent of the customer" and that customers "have more control in the exchange process" (Wind and Rangaswamy 2001, p. 15). The "co-creation" of services involves customers at different degrees within the service creation process (Straus et al. 2016; Dong and Sivakumar 2017; Beverungen et al. 2019). Co-creation has received much attention in the service-dominant logic (SDL), which claims that value is generated during the interaction between service provider and customer. In summary, the second stream comprises approaches with differing degrees of collaboration with customers. However, even approaches like customerization that were declared as "buyer-centric strategy" (Wind and Rangaswamy 2001, p. 15), are still rooted in the belief that an organization develops and sells services to customers.

A third stream that recognizes an active role of the customer is around the concept of *empowerment*. In the marketing discipline, customer empowerment denotes the influence of consumers (i.e. customers in the mass market) on the service creation process (Pires et al. 2006; Van Dyke et al. 2007; Acar and Puntoni 2016). While these ideas are similar to co-creation and follow the provider-oriented thinking mentioned above, notions such as "crowd worker" (Deng et al. 2016), "smart citizen", "citizen empowerment" and "patient empowerment" (Demiris et al. 2008; Calvillo et al. 2013; Hafen et al. 2014) follow a more distinct customer-oriented perspective. For example, patient empowerment is based on the disappearance of the 5000 years old perception of well-adapted and "believing" patients. As a contrast to this "old fashioned" type of patients, empowered patients "feel like they have got the ability and are given confidence to be able to manage their condition" (Bravo et al. 2015, p. 8). According to Bravo et al. (2015), the most cited definition is that of Funnell et al. (1991, p. 38): "People are empowered when they have sufficient knowledge to make rational decisions, sufficient control and resources to implement their decisions, and sufficient experience to evaluate the effectiveness of their decisions". Similar to the degrees of customer participation, patient empowerment may be described as a state ranging from low to high levels, and its level may be assessed using indicators such as patient capacities, beliefs or resources and activities or behaviors (Bravo et al. 2015). A review lists 19 measures for patient empowerment from which six may be considered generic (e.g. patients' experiences and capacities, their actions and behaviors, their degree of self-determination, and their development of skills), while the rest has been designed for specific conditions, e.g. for mental health patients (Barr et al. 2015). This position paper follows the conclusion of Barr et al. (2015), who state that patient empowerment is a promising but multidimensional construct which needs future research (e.g. regarding the measuring of patient empowerment).

The fourth stream addresses questions around the *delivery of services*. As described by Voorhees et al. (2017, p. 269f), service research has focused on the core service delivery "for the past three decades" and has neglected the activities taking place before and after the delivery of the core service, i.e. the time interval during which the primary service offering is provided to the customer. The authors call for a more "holistic service experience, which spans all potential service encounters (or touchpoints) with the firm" to meet customer needs better. In a similar vein, Bolton et al. (2014, p. 253) suggest that businesses should identify customer journeys to obtain a "holistic view of all interactions customers have with a company". While these approaches may still be considered provider-oriented, the customer-dominant logic (CDL) concept (Heinonen and Strandvik 2015, 2018) emphasizes the customer process, which often includes services that are delivered by several service providers as described in the business travel example above. Understanding how customers embed services in their individual lives is a focal concern within CDL. The authors therefore position CDL as counterpart to SDL and recognize the customer as an integrator of resources that are supplied by various service providers. Although CDL offers a valuable conceptual background for customer-induced service orchestration, as a contribution from the marketing discipline, CDL falls short on the implementation of service orchestration.

Customer-induced service orchestration – Term and examples

As suggested by Moeller (2008, p. 198), "customer integration enriches SDL by proposing a framework that provides an implementation perspective". Customer integration is described as a three-stage process consisting of facilities, transformation and usage. The customer-driven combination of company resources and customer resources is referred to as "customer-induced transformation". Following this terminology, *customer inducement* shall denote that the lead of the orchestration process shifts from the service providers to the customers. It captures that customer processes are broader and include multiple service providers. On the one hand, the examples of a travel plan or a medical treatment plan may illustrate that service

providers from specific domains are required for a holistic coverage of customer problems. Table 1 offers examples from four domains and shows how customer-induced service orchestration might differ from provider-oriented orchestration. On the other hand, the examples indicate that services from various domains may also be combined (e.g. a medical treatment together with a public transport service), leading to complex integrated services, i.e. service bundles.

A first limitation of existing solutions is that providers in each domain are offering customized applications ("apps") that enable customer self-service in the production and the usage phases. A combination of these services is mainly offered by intermediaries, which operate platforms that allow for a comparison and matching of various services. For example, electronic market systems such as computerized reservation systems (CRS) have been established for decades in the travel industry and provide self-services for comparing and booking travel-related services (Copeland and McKenney 1988, Merten 2007). The same may be found in finance (e.g. Mint.com) and mobility (e.g. Qixxit.de) (for mobility service intermediaries, see Ehmke et al. 2016). Intermediaries that offer support of entire customer processes have also been referred to as service integrators (Heinrich et al. 2011). However, a main limitation of these services is their lack of transparency in the orchestration process as well as their limited support across domains and during the usage phase. Transparency would imply that service creation follows a white-box principle, which reveals as much insight as desired by the individual customer. White-box approaches are known in the domain of software engineering, in particular regarding the testing of software (e.g. Nidhra and Dondeti 2012), and have also been used to denote the differences between supplier (black-box) and customer orientation (white-box) (e.g. Brun and Karaosman 2018). Even if current intermediaries such as electronic market providers or suppliers of travel packages bundle individual services, they offer only little transparency over the criteria involved in the service creation process. These systems showed repeatedly that biased or opaque rules were used for the selection and combination of services (e.g. Copeland and McKenney 1988).

A second limitation may be seen in the support across various application domains. As mentioned above, the

Table 1 Examples for provider-oriented and customer-induced service orchestration in four domains

Provider-oriented orchestration	Customer-induced orchestration
Education	
Universities and other service providers in the education sector operate their own curricula and student information systems. Students taking courses at different institutions need to collect their ratings themselves and might be unable to select courses at other institutions due to heterogeneous services and systems.	Students may flexibly combine education services from different service providers by themselves. An intermediary knows the different structures of study programs with identical degrees and provides a selection of them in an education plan, which has been composed based on the qualifications of the student.
Finance	
Typical retail banks offer a wide range of services from payment (checking account) and financing (credit) to investing (depot). Every financial service provider has its own solution for customer interaction (e.g. an e-banking system) with a distinct user interface and distinct handling steps. A holistic management of accounts at multiple banks remains difficult for customers.	Customers are able to select their financial services flexibly from different providers and manage them in an integrated solution. This solution covers all financial areas (payments, investments, financing, insurances, Fintech services) and leaves the control with the customer (i.e. the degree of automatic service support is defined by the user and not the providers).
Health	
Oncological patients require ambulant and stationary services, which are included in a complex treatment plant that has been determined by specialists, e.g. in a tumor conference. Although the patient receives the treatment plan, (s)he has only limited possibilities to select alternative treatments or service providers. Although this might be reasonable in a difficult situation, alternatives that are more suitable may remain unknown to the patient.	After a consultation in a tumor conference, the physician suggests a treatment plan to the patient. This plan considers data from the patient file and personal preferences (customer context), as well as data about the qualification of potential physicians. The patient receives explanations to the suggested treatments and may select alternatives and request second opinions. Suggestions for transportation to upcoming treatments are included.
Mobility	
Journeys from door to door often require the combination of multiple mobility services. Existing mobility providers offer single services that customers have to combine themselves, and travel agents are often restrictive in revealing the selection of the travel plan. A similar situation is present in logistics, where the orchestration of services is often performed by forwarders and left little transparent to the shippers.	An overall view on transportation alternatives is offered by a mobility service intermediary, which considers different modes of transport (low-cost airlines, car sharing agencies, long-distance trains, last-mile services, etc.) and different offers (early-bird rates, special offers, normal fares, etc.). Customers have transparency on the composition of transportation services and may monitor as well as re-schedule in cases of urgency/critical events.

customer perspective recognizes that customer processes involve multiple providers. Already customer processes within a single domain (e.g. mobility) involve the combination of several service providers and the creation of complex service bundles. The problem is aggravated when multiple domains (or customers' life areas) are considered (see Table 2). Existing solutions in these domains are either technological in nature by focusing on the interoperability of internet of things (IoT) services from various domains (e.g. Gyrard 2015) or provide rather simple features. For example, the mobility service "DynAPSys" (Wienken et al. 2014) is based on the matching of timetables of public transport with a simple task calendar that includes appointments from various domains such as medical or work appointments.

Requirements for customer-induced service orchestration

This position paper argues that customer-induced services will have to meet four requirements (see Fig. 2). It starts with the observation that customers are seldom experts in the various domains that they are confronted with. They would typically use non-domain-specific terminology to express their desires, problems or needs (Alt 2016). For example, customers would describe their requirements with non-functional terminology, such as "reliable", "fast" and "cheap", instead of using precise terminology, such as "quality levels", "delivery terms" or "pricing conditions". In addition, customers would usually utter their demand in a certain setting (e.g. at home, at work, underway) and also possess preferences as well as a prior transaction history. The entire set of this data may be summarized in a customer context and a customer journey. The second element is the "provider's world" where service offerings would be specified through precise, functional wording. These service descriptions would have to be formulated in a common language and would require a common service model to ensure compatibility within service bundles. The third element is the matching between the customer's and the provider's perspective occurring during service

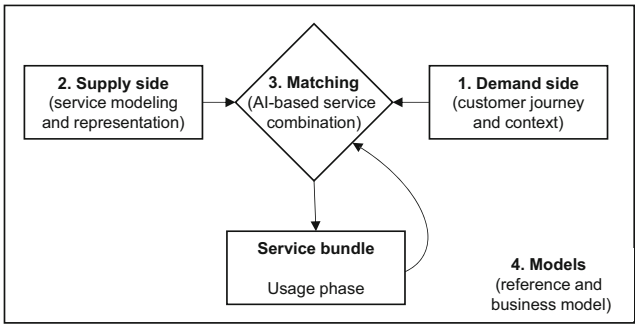


Fig. 2 Elements of customer-induced orchestration (following Sachse 2018, p. 64)

combination. Customer data needs to be mapped to service offerings following a defined and traceable logic. During service usage, reconfigurations may occur (e.g. when a train is delayed), which indicates that service bundles need to be dynamic in nature and require a rebound to the matching step. In particular, time-critical situations (e.g. when a flight is cancelled or an emergency treatment is needed) will require an ability for a recombination in (almost) real-time. The fourth element refers to implementation aspects, in particular models regarding the prerequisites for matching services from heterogeneous domains and the realization of the matching logic.

Customer journey and context

Customer-induced service orchestration obviously needs to start on the demand side. It comprises two main elements: The first is the specification of the customer process or the "journey" across various service providers. It may be depicted as a sequence of activities and events, which have been specified in a travel or a treatment plan, for example (Wind and Rangaswamy 2001, p. 31). Customers may develop this plan on their own or may be assisted by a qualified (electronic or human) intermediary, e.g. a travel agent or a physician. One possible technique is customer journey mapping, which depicts the events and channels during a customer's interaction with service providers. In addition to structured verbal specifications (e.g. Rosenbaum et al. 2017), visual representations for modeling customer journeys have emerged (e.g. Teixeira et al. 2012).

Table 2 Examples of domains and services from the customer perspective (following Österle and Senger (2011))

Domains	Services
Administration	Calendar, finance, social/professional life, tax
Communication	Contacts, e-mail, phone/skype, social media (e.g. profiles, networking sites)
Education	School, university, MOOCs, professional education
Healthcare	Apparel, doctors, fitness, handicapped services, hospitals, sports
Home	Crafting, cleaning, furniture, gardening, repair
Media	Blogs, books, magazines/journals, music, news, TV, video
Mobility	Bike/car ownership/sharing, public transportation (rail, air, sea, road), travel

Second, the marketing literature recognizes that service provision always occurs in a context, which may be the exchange between two or more actors (Chandler and Vargo 2011). Based on this understanding context was defined as "all situational factors relevant to the resource-integrating process, which do not become resources during that process" (Löbler and Hahn 2013, p. 259). Thus, data relevant for service provision may emerge in direct as well as in indirect contact between customers and service providers. This follows the thinking of omni-channel marketing, which posits that "All details a customer has provided previously should be known and serve as the basis for the interaction under consideration." (Barwitz and Maas 2018, p. 128). For example, social media have been recognized as valuable source for customer data (e.g. Wieneke and Lehrer 2016). The aggregate set of customer data may be represented as customer context (Bazire and Brézillon 2005) that includes two main types of data:

- *Dynamic properties*, which are specific for a certain service creation process or a customer process. They are dynamic since this data may change for each planned itinerary (e.g. scenic, fastest or cheapest itinerary) and also within existing itineraries (e.g. when services need to be rescheduled). The dynamic perspective considers the developments in "contextual marketing" (Doty 2014), which claims that customer interaction needs to consider the current context of the customer.
- *Static properties*, which are stable over a set of transactions and include master data as well as generalized and historic data. For example, businesses have established data models for customers and patients. Customer relationship management systems collect customer data in differentiated data structures, i.e. customer profiles. Well-known examples are passenger name records in the travel industry (e.g. Bennett 2005) and patient or health records in the medical sector (e.g. Sedano et al. 2011, Garets and Davis 2006).

The customer context would include standard data elements, such as name, address or contact data, and would enrich them with domain-specific data, such as taken drugs and the history of utilized services, e.g. the complete history of diagnostic and therapeutic measures. Domain-specific data is required as input for the selection as well as for the execution of integrated services. At the same time, its contents should be ubiquitously accessible, and, according to the principle of customer empowerment, customers are supposed to manage their customer context themselves, while service providers may update the offered services only when authorized by customers. Table 3 shows a possible structure of a customer context model, which may be modeled using Unified Modeling Language (UML) class diagrams (see Fig. 3) or semantic ontologies. The *static* entities reflect the history of previous and (possibly) planned integrated and individual services. They contain data about the customers and their needs, e.g. with respect to the preferred mobility and health care service provider, but also about the desired level of empowerment expected during service selection, his/her request profile, and individual requirements, which could limit or extend the selection of individual services. The *dynamic* entities contain data about the status of a service bundle (i.e. a service bundle which is currently in the usage phase), which might need to be dynamically revised. Among other aspects, this covers the current location of a customer, the relations with other customers, and current sentiments from his/her environment, which could influence his/her behavior or decisions.

Service modeling and presentation

Besides the demand side, customer-induced service orchestration also requires modeling on the supply side. As mentioned above, the "language" in the service provider's world is usually not identical with the language of customers. Providers will have to apply a precise and defined functional terminology. The service models will need to distinguish between an external presentation of services, which connects to the customer context model, and an internal representation, which makes services accessible for more formal methods of service combination. To model services, a broad body of knowledge exists in two areas:

- In *software engineering*, languages of software description may be used to connect two perspectives. As for software, the "outside perspective" on a service may be described by essential features, possibly with variants, as it is the case with regard to product lines (Pohl et al. 2005). Along these lines, customers may describe requirements through features on different abstraction levels, while service providers may describe their services through features on different abstraction levels. The "inside perspective" on a service, i.e. the steps of service execution, may follow a process similarly to software execution (Lenz and Oberweis 2004).
- In *service modeling*, an important element is research on service descriptions (e.g. Barros et al. 2012). Contrary to description languages in the web services world (i.e. the web service description language, WSDL), the unified service description language (USDL) is not driven by technology and aims to provide a language to specify functional and non-functional aspects of business functions. By providing mechanisms to model static (e.g. in UML class diagrams) as well as context-dependent dynamic data (e.g. in the semantic web rule language, SWRL), USDL also promises to be applicable for customer context models. The model in Fig. 3 illustrates the various elements ("modules") of USDL as well as their main relationships for a mobility service.

Table 3 Example for data in a customer context

Entities		Data elements (examples)
1. Static	Customer master data	1. General: name, address, contact data 2. Domain-specific: bank data, medication
	Service selection data	1. Basic selection settings: readiness to assume risk, preferences regarding time, cost, service providers and (maximum) complexity of service selection 2. Empowerment settings: preferences for manual/guided/automatic service selection, settings for transparency and automatic optimization 3. Privacy settings: controlled sharing of customer context data with service providers, degree of transparency regarding service providers (white-box)
	Service bundle data	Historic data: previously used/declined service bundles, transaction history
2. Dynamic	Location-specific data	Current geo-location, timestamp
	Surroundings data	Contacts, friends, service providers
	Sentiment data	Ratings, suggestions, experiences within personal network/individuals within similar situations
	Goal-specific data	Goals of current service selection (e.g. time and/or cost-efficient travel, scenic/shortest route)
	Optimization data	Forecast of events that are relevant to the customer

Domain knowledge on features and/or processes may be generated by experts and might be refined automatically by the successful creation of integrated services. Process mining techniques (van der Aalst 2011) might prove helpful in retrieving possible compositions of integrated services. Since a general "best solution" does not exist necessarily, the suggested integrated services are expected to lead to a more detailed specification of the customers' needs and, in doing so, to an iterative selection and service creation process as suggested in the following.

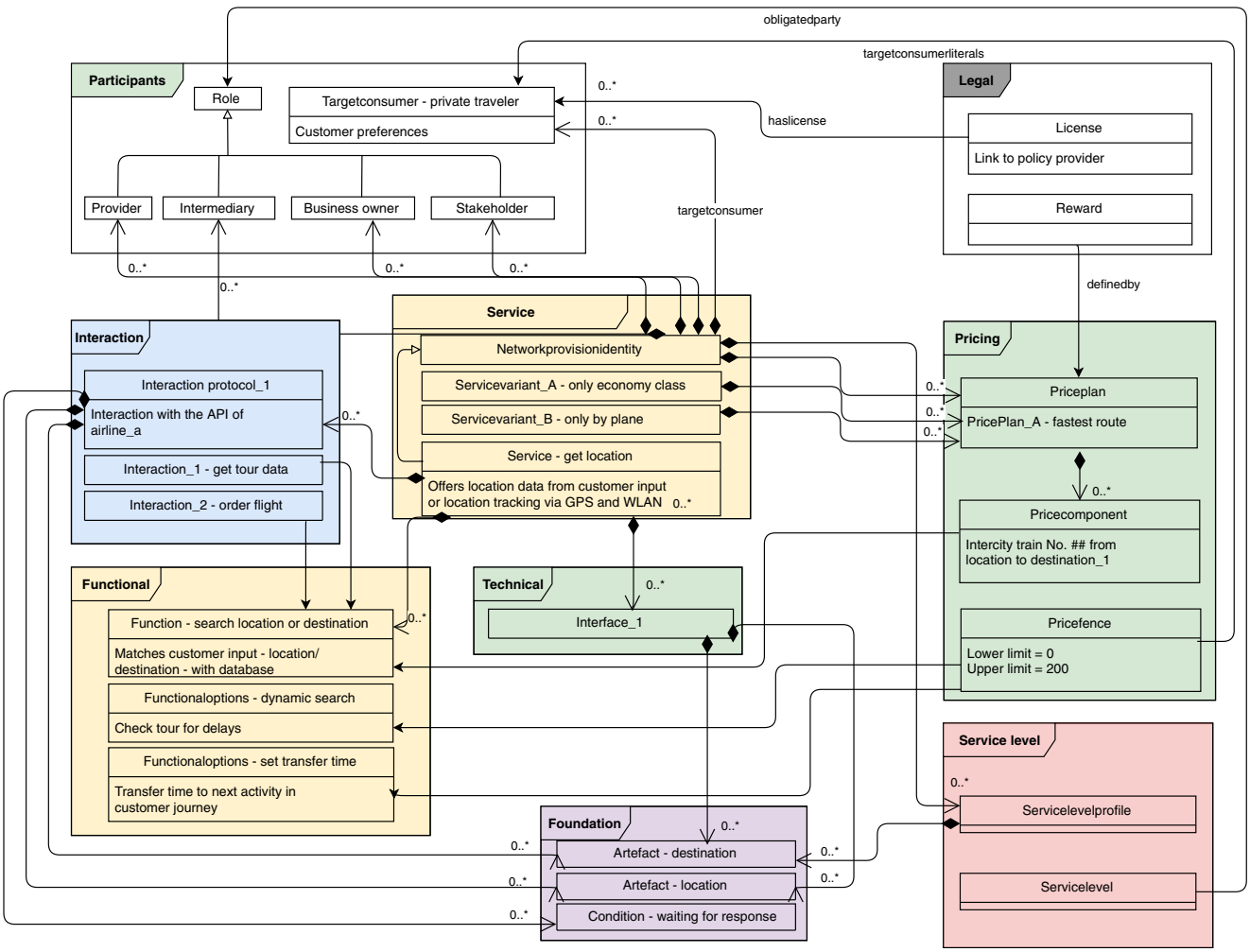


Fig. 3 USDL modules for mobility service (following Barros et al. 2012, p. 215)

Artificial intelligence-based service combination

Service combination creates a choice of integrated services by selecting and combining individual services according to the customers' needs. Depending on the particular domain, a large number of individual services with complex interdependencies will have to be considered. The main task is to match the requirements and the context of customers with the stored characteristics of the individual services. An important challenge is to combine the mostly imprecise customer requirements (also referred to as intentions by Sachse 2018, p. 80) with the precise structures of the customer context and the service models that would be specified by the service provider (see Table 4). Customers should be able to formulate their intentions via intuitive interfaces that integrate data from the customer context to reflect their current situation and preferences as well as the history of selection decisions. Furthermore, customers should be able to include additional, domain-dependent conditions in their assessment. For mobility services, such a condition might be that elderly customers would like to minimize the number of transfers. Intermediate models that collect and combine customers' needs and attributes of individual services based on an ontology may serve this purpose. The service structure may be displayed hierarchically in the model such that design decisions can be taken with respect to the selection of individual services from different domains and their integration. For instance, in an integrated health care service, the decision about the treatment path could be a pivotal dimension, which is a requirement to enable subsequent decisions about the selection of further complementary services. For mobility services, such a design decision might be the choice of a transfer point in an itinerary.

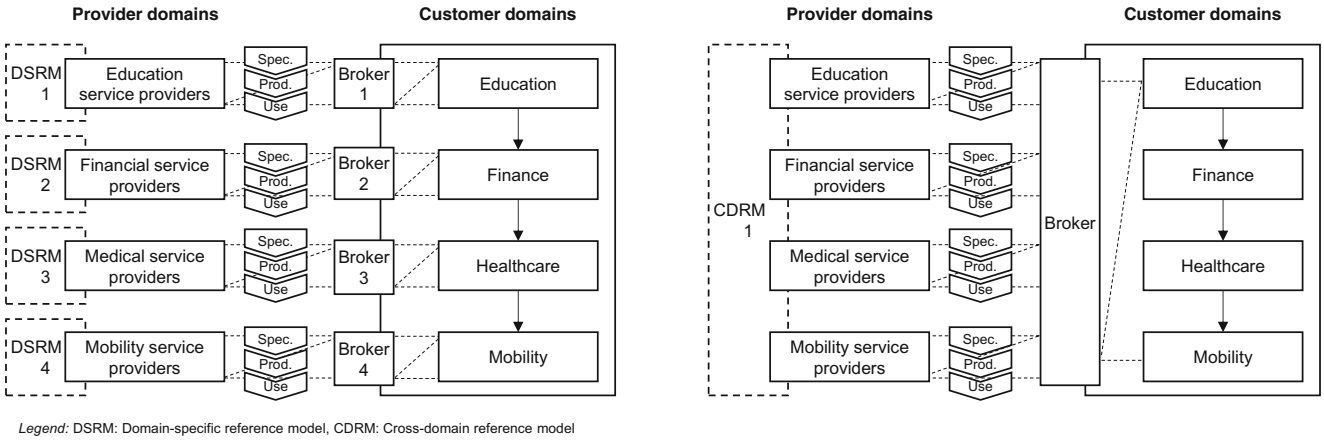
Customer-induced service combination may benefit from algorithms that are based on AI. This comprises filtering procedures from data mining and mathematical optimization, i.e. an interplay of AI-based methods, analytics, and quantitative decision making (e.g. Meisel and Mattfeld 2010). According to a pre-processing ("tagging") of customer requirements and the individual services, a first filtering of potentially suitable services could be derived by descriptive and predictive data mining methods, e.g. collaborative filtering (Breese et al. 1998). From the remaining set of services, stochastic methods of mathematical optimization (e.g. Ilhan et al. 2008) may distill a diverse set of integrated services that is presented to customers. If the filtering and combination process yields too many or too few results (e.g. if customers' requirements are very specific or unspecific), the combination process has to be repeated in an iterative manner. The intermediate model enables a quantitative formulation of the fitting of individual services' attributes with given customers' needs. Depending on the abstraction level and the degree of detail of the customers' needs, filtering procedures from data mining may reduce a large number of available services to a smaller number, which will be further considered in the ongoing combination process. In this context, it is a significant challenge to include data from customer context models such that, depending on the set of possible services and customers' needs, a suitable set of services may be provided. This selection decision should be modeled following the general idea of white-box integration, i.e. a customer-oriented presentation of the integrated service bundle.

Models for customer-induced service orchestration

The suggested approach of customer-induced service orchestration is based on the interplay of several models and algorithms. A joint meta-model may ensure the interoperability of the various models and their elements. The conceptual models for the demand side (customer context), the supply side (service model) and the matching models may each be conceived as *reference models* (Frank 2007). In addition, a combined ontology from various sub-ontologies could eliminate synonym concepts about inter-ontological relations. The reference models would be used to build systems that work as electronic intermediaries (so-called brokers) in various instantiations. Reference models and brokers could either remain domain-specific (shown left in Fig. 4) or follow a cross-domain approach (shown right in Fig. 4). For many domains, reference models are available that describe the "world" of a particular domain and are helpful in establishing service bundles (Becker et al. 2010). For mobility applications, for example, ISO 14813 contains entities, relationships, processes and data structures that provide input for generic and domain-specific service modeling based on UML concepts (ISO 2015). In this sense, Becker et al. (2010, p. 54) show how the Y reference

Table 4 Matching of customer- and provider-oriented terminology (following Sachse 2018)

Customer requirements	Matching process	Provider characteristics
Need-based (e.g. "I want a business journey with minimal layovers that matches my appointments")	Intermediate model	Product-based (e.g. a large set of particular airline, rail or tram services with given capacity, fees and booking restrictions)
Non-functional requirements (e.g. fast and simple)	Pre-processing (matching of tagged customer requirements and provider characteristics)	Functional requirements (e.g. lowest overall travel time with only one 30 min. Layover and connection on opposite platform)
Subjective requirements (e.g. cheap and reliable)	Iterative filtering and combination process	Objective requirements (e.g. total price, punctuality rating)
Open solution space (e.g. by plane, rail or bus)		Limited solution space (e.g. combination A, combination B)



Legend: DSRM: Domain-specific reference model, CDRM: Cross-domain reference model

Fig. 4 Configurations of customer-induced orchestration

models for computer-integrated manufacturing and services help configuring a customized truck fleet offer supporting a truck manufacturer and a logistics consulting agency.

Regarding the *business model*, customer-induced service orchestration may be offered by intermediaries or be implemented in a completely decentralized environment. The value of intermediaries rises with the heterogeneity of actors and offerings on the demand and on the supply side, since creating compatible offers is among their main tasks (Giaglis et al. 2002; Klein et al. 2011). As shown in Fig. 4, the potential for intermediaries (i.e. brokers) exists for each particular domain as well as across domains. A variety of configurations with single/multiple domain-specific intermediaries in combination with or without cross-domain intermediaries might emerge and give rise to future business models for customer inducement. As argued already in the introduction of this position paper, intermediaries always have self-interests. They might hide the combination logic and use data for their own advantage. In this sense, Spiekermann et al. (2015, p. 165) state that "if they [the customers] learned about today's volume and business done with their data among third parties, they may be surprised and feel betrayed." White-box service combination would imply that the orchestration process is transparent and that personal data is reliably protected. In particular, the customer context should be under complete control of the customer, who may share or revoke it on a granular level with the intermediary as well as with further service providers that are included in the service bundle.

Customer empowerment tends to be even higher in decentralized scenarios. In this case, the customer context and parts of the combination logic would actually reside on devices controlled by the customer. A decentralized implementation of the broker could include functionality for configuring the customer process (i.e. a travel or treatment plan) that is required for service combination. However, making services compatible in such a decentralized scenario would require a high level of standardization regarding the customer context and the service modules. While this is already challenging for domain-specific (reference) models (DSRM), common cross-domain (reference) models (CDRM) will be even more difficult to attain. Recent advances in distributed ledger technologies that also possess application logic (e.g. smart contracts that include service combination procedures) could serve as promising technological infrastructures and research field in this context (see Subramanian 2018).

Conclusions

This position paper introduced the term "customer-induced orchestration" to propose customer inducement as a next step in customer orientation. Customer inducement differs from traditional customer orientation, which strives for customized offerings and customer integration from a provider perspective. Customer inducement goes beyond "simply" attributing the customer an active or collaborative role and claims that the customer becomes the leading and dominant actor, and that customers orchestrate services for themselves. Hence, customer-induced orchestration is neither about improving marketing strategies nor about services which better fulfill customer requirements. Rather, it is about the transparent description of the provided services, such that customers are empowered to select and orchestrate services independently and according to their needs. This development matches an open and democratic society, in which digitally supported customers continue to emancipate from and become real partners of "old authorities" such as the local bank, the family doctor or the travel agency. Tools are emerging that enable customers to orchestrate a variety of services themselves.

Enabling customer-induced solutions through IT-based integration of complex services is challenging. Even if the provider-oriented perspective is overcome and intermediaries offer comprehensive, customer-oriented services, the process of service orchestration often remains opaque or completely nontransparent. This is the case for existing solutions such as

electronic intermediaries or the more recent AI-based assistants. As a consequence, intermediaries are needed that reflect the customer's perspective to make explicit how service bundles are created and how much they fit to the customers' needs. Tools supporting customer-induced orchestration are supposed to reduce the coordination-intensive integration of services. Novel AI-based concepts could serve as enablers for empowerment, but the restriction that several AI methods fail to provide explanations for their behavior or their predictions by design (e.g. neural networks in case of AI-based methods) have been recognized early on (e.g. Haux 1989). However, innovative and iterative combinations of methods from AI, analytics and decision-making could be a promising path to create or enhance such smart, white-box intermediaries. In addition, process mining may be applied to perform a customer-induced filtering of services, and through heuristic methods from mathematical optimization, a selection of service bundles may be created (e.g. Schmid and Ehmke 2017). Finally, data-driven prediction could be used to assess the fit of the service bundles with thoroughly modeled customers' and patients' needs. In each step, customers should be able to provide feedback and hence influence the orchestration process.

Although current developments in service research, such as the role of the customer context and of a customer-dominant logic, are important for understanding customer inducement, theoretical foundations are missing that describe how combinations of AI and more explanatory selection and prediction methods could enable a customer-induced orchestration of services. Moreover, it is not known how much smart, AI-based service integration will actually contribute to customer empowerment. Hence, a sound interdisciplinary, theoretical foundation of smart, AI-based customer-induced orchestration is required. An interdisciplinary approach on service orchestration with methods from the areas of service research, business and health care information systems engineering as well as computer science could be helpful. In particular, the convergence of AI-based methods and decentralized technological infrastructures could pave the way for scenarios where service orchestration actually occurs on devices that are under the control of customers. We are only experiencing the early stages in this evolution driven by (information) technology.

However, this position paper has also emphasized the need for standardization and the relevance of the rights of the customer, which points at organizational, strategic and political issues when establishing customer-oriented service orchestration. For the mobility sector, for example, existing intermediaries are often derivatives of established travel operators (e.g. German Railways), which now offer to integrate complementary services even from competitors. In recent years, innovative startups have entered the market aiming to establish alternative intermediaries. However, it remains unclear for all players how they could create a viable business model from white-box service orchestration. If these intermediaries are unable to find a way to make customers pay for transparent service offerings including services from competitors, they would have to be funded through public authorities, or legislation would have to enforce more transparent service descriptions to make customer-induced orchestration economically viable. In the end, the open question is whether the established service providers will operate customer-induced intermediaries and become monopolists, which might counteract transparency and hence the idea of white-box service orchestration. Considering such monopolistic developments, political decision makers need to cater for more transparency. Service providers should be forced to publish the parameters of their services in a standardized way that either enables independent intermediaries to orchestrate services on behalf of the customers or to empower customers themselves based on decentralized solutions and infrastructures. This would stimulate competition and create opportunities for innovative startups. Although the customer-induced orchestration of services represents only a part of the entire service creation process, it yields an impression of what customer-induced solutions might look like in the future.

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