

Scaling Digital Solutions in Healthcare: Paradoxical Tensions in Provider–Customer Relations and Coping Strategies

Jonathan Roesler , Lukas Budde , Thomas Friedli , Pejvak Oghazi , and Maximilian Palmié 

Abstract—An aging population, a lack of qualified medical staff, and rising costs in the healthcare sector pose major challenges to many societies. Implementing digital solutions in hospitals is a promising response to these challenges without compromising the quality of patient care. Nevertheless, the adoption of digital solutions in the healthcare environment is progressing more slowly than might be desirable. Adopting a paradox perspective, we study tensions in the relationship between the providers of digital solutions and hospitals (their customers) that can explain the slow uptake. Drawing on 39 interviews, our findings reveal nine tensions related to the three dimensions of a business model (value proposition; value creation and delivery; value capture). We also identify four coping strategies that allow solution providers to deal with these tensions, especially when building digital solutions in new ecosystems. The strategies to cope with paradoxical tensions in interorganizational relationships include accommodation, avoidance, concession, and confrontation.

Index Terms—Coping strategies, digital servitization (DS), digitalization, healthcare, interorganizational relationships, paradox theory, paradoxical tensions.

I. INTRODUCTION

DUE to an aging population, inefficiencies in care delivery, and the rising cost of drug development, global healthcare spending is projected to reach staggering heights in the upcoming decade [17]. Health expenditure as a share of their gross domestic product (GDP) is projected to rise to 10.2% by 2030 across the member states of the Organization for Economic Cooperation and Development (OECD) countries, compared to 8.8% in 2015 [58]. Healthcare systems all over the world are, therefore, facing the challenge of finding ways to contain costs while improving patient outcomes.

Digitalization, through technologies such as Internet-of-things, advanced analytics, machine learning, and artificial intelligence (AI), represents a promising means to tackle this

challenge [1], [27], [32]. It supports organizations in establishing more intra- and cross-industry partnerships, strengthening interoperability and connectivity, and creating a delivery system without walls (care delivery across boundaries), and other means [16]. Digitalization can lead to improvements in diagnostics, patient experience, prevention, and patient therapy, ultimately advancing an evidence-based approach to clinical decisions and supporting the efficient utilization of healthcare resources [1], [27], [63]. Medical technology and pharmaceutical companies are gradually changing their business models (BMs) from drugs and medical devices to the provision of smart products and services that are enabled by digital technology [14], [34], [56]. Examples include electronic health records, condition monitoring of medical devices, or AI-based diagnostics [3], [33].

However, various factors—such as dominant reimbursement schemes, legacy IT systems, disparate data sources, limited adoption of data standards, data security, and privacy concerns—impede the adoption of digital solutions among hospitals [12], [35], [47], [68]. At the same time, many medical technology and healthcare companies struggle to develop new offerings and business models [8], [78]. Recent research has started to study the paradoxical tensions that organizations face when they seek to adopt smart solutions [22], [23], [79], [81]. To date, most of this research has focused on the technological design and development of digital solutions or smart services but neglected the organizational issues evolving due to the needed interaction between people, processes, and technology [2]. In particular, existing research has mainly discussed solution providers and customers separately. Such separation, however, does not fully grasp the challenges surrounding digital servitization (DS). Digitalization initiatives are known to transform provider–customer relationships and often involve intense collaboration and cocreation between providers and customers [38], [54], [74], [79].

Thus, tensions *between* providers and hospitals—their customers—may explain why the digital transformation of the healthcare sector is progressing only slowly and lagging expectations [18]. These tensions can arise from different actors' goals and business models around the use of technology and collaboration, especially when the solutions are going to scale [29], [71]. While research on relational tensions between providers and customers of smart solutions remains limited, a sound understanding of these tensions and insights into strategies to cope with these tensions would support firms in managing relations with their customers more effectively and help them

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leverage the potential of DS. Besides societal benefits (lower healthcare expenses and better care), this potential also includes benefits for individual solution providers as DS can unlock new revenue streams and create lock-in effects for customers [48], [55].

The purpose of our study is to identify the paradoxical tensions that exist between the providers and customers of digital healthcare solutions and to examine how these tensions can be addressed to facilitate scaling. To this end, we follow an exploratory approach and interview 39 respondents representing medical technology firms, pharmaceutical companies, and hospitals. We applied in-depth data analysis with inductive coding and qualitative case analysis to derive first-order codes, second-order themes, and three aggregated dimensions. We draw on paradox theory [11], [75] to analyze interorganizational tensions associated with DS. Our findings show the existence of nine interorganizational tensions, which are related to the three dimensions of a business model (i.e., “value proposition,” “value creation and delivery,” and “value capture,” cf., [59]). We also identify four coping strategies that allow solution providers to deal with these tensions.

Our findings make important contributions to the literature. First, they respond to recent calls for further research on paradoxical tensions in DS [39], [44], [57], [79] and on how providers cope with them [67]. Second, our findings address the calls for more comprehensive studies that cover the provider as well as the customer perspectives [80], [84], for more research on DS in specific industries [51], [61], [62] and, more generally, for empirical insights on digital transformation in healthcare (e.g., [12], [25], [52]).

II. THEORETICAL BACKGROUND

DS describes the process that allows product-centered firms to transform toward service-led smart solutions (smart product-service-software systems) enabled by digital technologies [23], [39]. Embedded sensors making products connectible, remotely accessible, and monitorable enable innovative customized data-based services [4], [21], [88]. DS is associated with ample strategic and financial benefits, but many firms struggle with mastering the transition successfully due to various intra- and interorganizational challenges [21], [73]. Table I summarizes these challenges by showing an overview of tensions from the servitization literature. The existing literature has mostly focused on intraorganizational tensions, investigated either the provider or customer side, and paid little attention to the specifics of the healthcare sector [43].

Information systems researchers’ proposed that the challenges of DS can be understood as paradoxical tensions [72], [76]. According to paradox theory, paradoxes consist of “contradictory yet interrelated elements (dualities) that exist simultaneously and persist over time; such elements seem logical when considered in isolation but irrational, inconsistent, and absurd when juxtaposed” (see [69], [70], [75, p. 387]). Paradoxical tensions may take the form of paradoxical dilemmas and paradoxical dialectics (see [75, p. 387]). A dilemma denotes the presence of competing alternatives, each with advantages and disadvantages, while dialectics involve the “ongoing process of

resolving tensions [between contradictory elements (thesis and antithesis)] through integration [...] into a combined element (synthesis)” (p. 386). While not all dilemmas and dialectics are paradoxical, dilemmas are paradoxical when any choice between the competing alternatives is “temporary and tension will resurface” because the alternatives possess contradictory, yet interrelated elements (p. 387). Similarly, dialectics are paradoxical when the synthesis stresses similarities among contradictory and interrelated elements while “neglecting valued differences, [...] is [only] temporary [...] as the need for the elements’] disparate qualities persists” (p. 387). In other words, paradoxical dilemmas and paradoxical dialectics cannot be decided for good. Paradoxes embrace complexity and ambiguity, and firms must manage or mitigate them instead of trying to solve them [36].

The enduring and profound nature of paradoxical tensions can pose a threat to the prosperity of organizations if not effectively addressed. In the case of digital solutions in healthcare, it is also likely that failing to manage the paradoxical tensions they imply adequately will further jeopardize the ability to provide quality care [2]. In contrast, the effective management of paradoxical tensions can promote organizational learning and be a powerful source of competitive advantage, financial returns, and non-financial success [20]. For this reason, Beech et al. [7] emphasize that paradoxical situations should be seen as opportunities by decision-makers in firms. The existing literature discusses two broad ways to deal with paradoxical tensions: defensive (“either-or”) responses and active (“both-and”) responses (see [30], [69]). The former can perpetuate escalating tensions and result in poor performance, whereas the latter can effectively manage tensions and foster long-term prosperity (see [69], [75]). Instead of selecting one or the other element or searching for compromises between them, managers should thus explore ways to simultaneously comply with apparently opposing forces [75].

In sum, paradox theory can help capture the complexity involved in DS by decomposing these tensions into interrelated elements [31], [77], [85]. Moreover, it offers a theoretical foundation for identifying responses to these tensions and considers their suitability. Notwithstanding the growing interest in a paradox perspective, to the best of our knowledge, only a few studies have so far addressed paradoxical tensions in the context of DS (e.g., [22], [67], [81], [86]), with none specifically covering interorganizational, relational tensions between providers and customers. Our article, therefore, looks at customer-provider relationships in DS in healthcare through a paradox theory lens [45], [65]. While the existing literature has predominantly identified strategies for coping with paradoxical tensions by analyzing organizations, teams, and individuals, we focus on the interorganizational context. Finding appropriate response strategies to the emerging tensions at the interorganizational interface plays a crucial role in the long-term performance and viability of DS in healthcare.

III. METHODOLOGY

A. Data Collection

The healthcare sector provides a fruitful empirical setting for studying relational paradoxes in DS because it is characterized by pronounced tensions. For example, it involves tensions

TABLE I
CHALLENGES OF DS

Level	Category	Selected complexities	Indicative references
Intra-organizational	Strategy and BM definition	<ul style="list-style-type: none"> • BM definition and alignment • Strategic objectives • Roadmap and time horizon • Exploration versus exploitation 	[21], [89], [90], [91], [92], [93], [94]
	Structure and processes	<ul style="list-style-type: none"> • Separation versus integration • Centralization versus decentralization • Service network design • Customer involvement • Process formality • Authority and reporting structures 	[95], [96], [97], [98], [99], [100], [101], [102], [103], [104], [105], [106]
	Management	<ul style="list-style-type: none"> • Management buy-in • Leadership style • Digital affinity • KPI setting • Incentive systems 	[44], [99], [107], [108], [109], [110], [111], [112], [113]
	Culture	<ul style="list-style-type: none"> • Service orientation • Customer centricity • Agile mindset • Entrepreneurial spirit • “Digital” culture • Long-term orientation • Risk aversion 	[79], [83], [99], [114], [115], [116], [117], [118], [119], [120], [121], [122], [123], [124]
Intra-organizational	Resources and capabilities	<ul style="list-style-type: none"> • Knowledge management • Digital capabilities • Value-based pricing and selling • Relational capabilities • Cross-functional collaboration • Design-for-service • Human resource management • Service innovation capabilities • Merger and acquisitions • Risk assessment and mitigation • Standardization vs. customization • Data sharing and privacy concerns • Knowledge sharing 	[77], [125], [126], [127], [128], [129], [130], [131], [132], [133], [134], [135], [136], [137], [138], [139], [140], [141], [142], [143], [144], [145], [146]
Inter-organizational	Not applicable	<ul style="list-style-type: none"> • Coordination and integration • Co-creation/Co-production • Business vs. political ties • Individual vs. shared business goals • Goodwill vs. opportunism perception • Cultural readiness • Contract design • Performance management • Coopetition vs. competition • Trust and transparency • Understanding stakeholders’ BMs • Third-party involvement 	[2], [40], [41], [67], [73], [81], [86], [146], [147], [148], [149], [150], [151], [152], [153], [154], [155], [156], [157], [158], [159], [160], [161]

between doctors and patients [87], financial objectives versus quality of treatment [9], [15], [64], or between practices and professional standards [46], [53]. We collected data with an in-depth interview technique with 39 mid-senior-level respondents from the Swiss healthcare sector using semistructured interview guidelines. In terms of costs, the strictness of regulation, the population’s high life expectancy, and per-capita spending, the Swiss healthcare system can be compared with other Western healthcare systems [10]. Interviews were chosen because they reveal how actors perceive and make sense of the world [49]. Our interviewees represent 14 medical technologies and six pharmaceutical companies on the provider side, as well as 11 hospitals on the customer side. The companies and interview partners were selected based on random sampling, taking criteria such as experience level (>3 years), management position, digitalization interest, and membership and role in the healthcare ecosystem (medical, pharmaceutical, or hospital) into account. The interviews had a duration of 58–126 min and were conducted face-to-face, by phone, or remotely between January 2021 and

October 2022. Table II provides an overview of the interviewees (pseudonyms), their positions, and the backgrounds of their organizations to illustrate the context of the statements regarding the identified tensions and individual goals and motivations. Alphanumeric codes are used in the text body to link respondents to their statements. The data on the organizations correspond to the fiscal year in which the interviews were conducted.

B. Data Analysis

Guided by the literature, data analysis was undertaken in *three steps* using ATLAS.ti. First, we performed an in-depth analysis of the raw data. The interview transcripts and notes were repeatedly read, flagging quotes relevant to the research objective. Inductive coding [24] and qualitative content analysis [6] were applied to the data to ensure the emergence of first-order codes. As the data analysis progressed, codes were iteratively added and refined. Second, we distilled thematic patterns from the data. The analysis of links and patterns between first-order codes

TABLE II
OVERVIEW OF INFORMANTS

Informant	Position	Organization	Employees
Matthew	Director Digital Ecosystem	MTC1	125 000
Marco	New Business Developer	MTC2	82 000
Lorenzo	Head of Digital Solutions		
Daniel	Vice President Global Sales		
Mario	Digital Business Manager	MTC3	3 200
Thore	Digital Health Solution Manager		
Thomas	Director Channel Management		
Emil	Product Manager Digital Health	MTC4	64 000
George	Vice President Digitalization	MTC5	10 000
Sandra	Director Data-Driven Solutions	MTC6	15 000
Beatrice	Director Business Innovation	MTC7	1 900
Flavio	Senior Advisor Digital Business	MTC8	55 000
Mathias	Head of Healthcare Platform	MTC8	55 000
Olga	Head of Research and Development	MTC9	8 000
Silvia	Digital Transformation Manager	MTC10	90 000
Philip	Reimbursement Manager	MTC11	95 000
Galina	Program Manager	MTC12	95 000
Heinrich	Business Development Director	MTC13	1 000
Eleonore	Digital Innovation Manager	MTC14	35 000
Steven	Digital Innovation Expert		
Hannes	Software Sales Manager		
Ursula	Product Manager Digital Health	PC1	29 000
Vanessa	Head of Digital Health Solutions	PC2	29 000
William	Director Digital Health	PC3	125 000
Raul	Director Digital Transformation	PC4	32 000
Sarah	Digital Transformation Manager	PC5	31 000
Nico	Director Digital Health	PC6	10 000
Michael	Chief Radiologist	H1	5 800
Tom	IT Senior Director	H2	2 800
Daniel	Head of IT	H3	600
Mark	Head of IT	H4	180
William	Chief Radiologist	H5	1 100
Andrew	Chief Radiologist	H6	3 500
Theodore	CIO	H7	7 100
Steven	Radiology Assistant	H8	5 500
Timothy	Chief Radiologist	H9	1 400
Robert	CEO	H9	1 400
Leonard	Professor of Medical Informatics	H10	9 100
Niklas	CDO	H11	1 500

MTC: Medical Technology Company; PC: Pharmaceutical Company; H: Hospital.

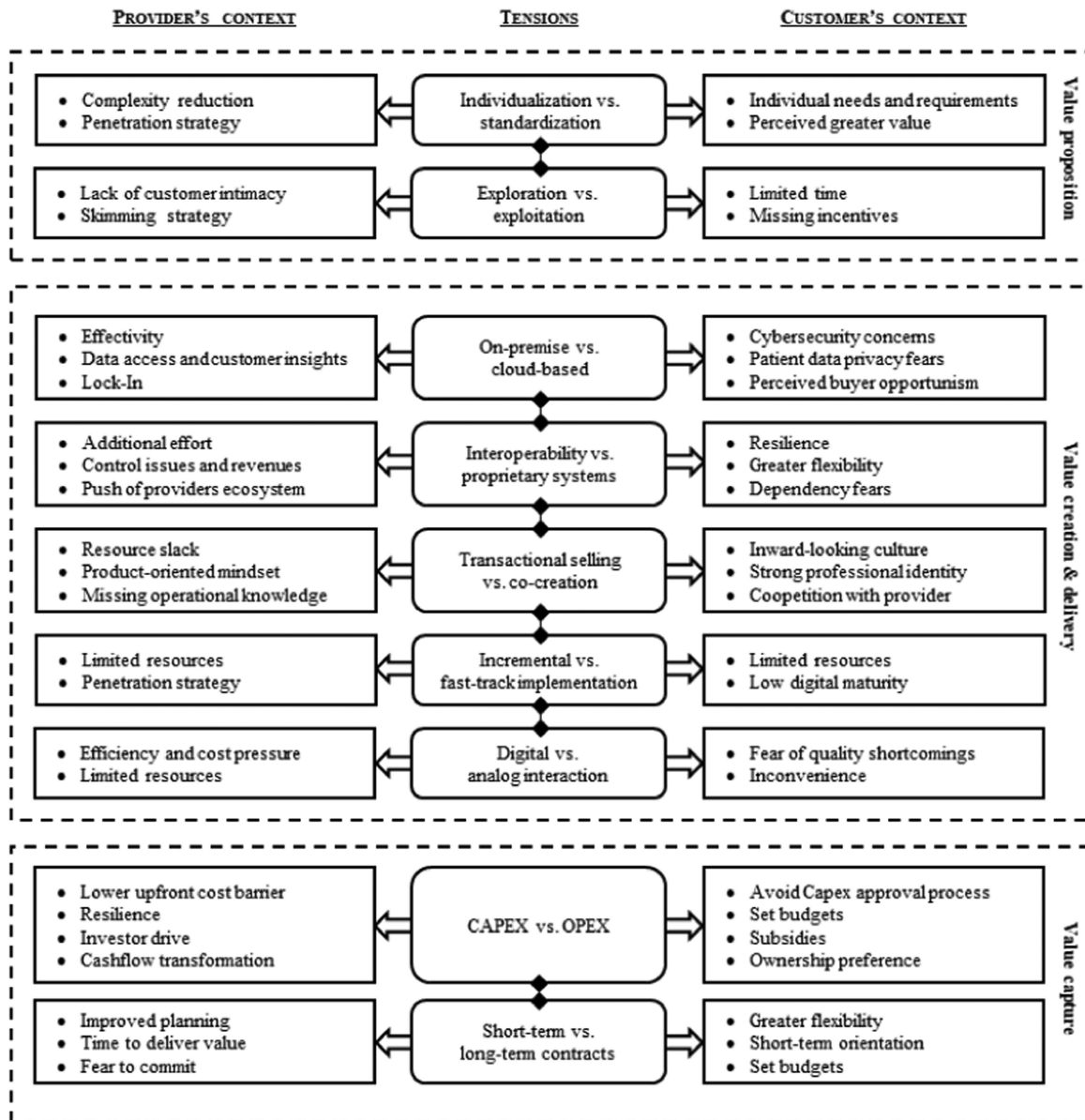


Fig. 1. Data structure.

yielded second-order themes, which were refined based on prior literature. Third, we generated a set of aggregate dimensions. We formed these dimensions based on the second-order themes and prior literature. We ultimately derived three aggregate dimensions grounded in empirical data and theory, namely “value proposition,” “value creation and delivery,” and “value capture.” Continuously comparing our findings with the literature allowed us to evaluate the validity of the framework.

We triangulated the interview data using diverse archival material covering respondents’ organizations, including internal documents such as project reports and publicly available information. Among these materials are internal strategy documents, go-to-market plans, and sales materials designed to persuade potential customers and give them an insight into the company’s offering. These materials include brochures, product catalogs, case studies, or presentations. Moreover, we conducted

two interviews with the regulatory body and the leading Swiss health insurance company. For validation purposes, the research findings were presented to and discussed with the interviewees in a three-hour webinar. Individual follow-up discussions were arranged with selected informants, typically of 90 min duration. Fig. 1 displays the final data structure.

C. Reliability and Validity

We assigned different researchers to independently code the data. This allowed for an intercoder reliability assessment by comparing the coding results of the different researchers. If discrepancies arose between researchers, we resolved them through discussions and consensus-building, also with the integration of further experts. Furthermore, we monitored and reviewed the coding process throughout the study to identify any potential

issues or drift in coding consistency. Furthermore, the discussion in the webinar has sharpened our understanding of certain tensions and other aspects, which has been integrated into the findings. Feedback from the webinar further shaped the coping strategies.

IV. FINDINGS

A. Value Proposition

1) *Individualization Versus Standardization*: Tensions regarding the individualization versus standardization of functional features of smart products appeared frequently between providers and customers. Providers, both medical technology and pharmaceutical companies, proved to be driven by ambitious targets to sell the solution to as many customers as possible while trying to keep complexity and efforts per customer low, given their shortages of skilled service and sales representatives. They, therefore, tended to focus on standardization during the scaling phase.

“We concentrate on specific use cases. Penetration is our clear strategy. We hope to increase our revenue in the future, building on the insights we generate from our installed base.” (Emil, MTC4)

In contrast, hospitals typically expressed their needs for individualization. This demand had its roots in the prevailing internal resistance toward digital solutions. Such a reluctance surfaced as a critical view on the value of any solution offered by providers as well as the effort implementation would take. Also, customers perceived individualization as an option that would provide greater value for them.

“We do not need things that work on paper or in other hospitals but [we need things] that create clear value added in our day-to-day operations.” (Michael, H1)

With both preferences colliding, providers admitted that standardization is more of a vision than a definitive strategy to follow. In this sense, providers acknowledged the great variety of needs across different customer segments (e.g., across regions, private versus public hospitals, etc.). Providers typically responded in two ways to minimize individualization efforts. On the one hand, providers tried to satisfy customer needs to a reasonable extent, even providing specific options for customers to choose from, particularly for options where complexity could be handled.

“[T]he specific ways of working, the specific set up structures, the systems that the customers are working with are different from market to market, from one customer to another, from a big hospital to a smaller one [...] [This constellation] requires a lot of customization.” (Matthew, MTC1)

On the other hand, providers made “extra wishes” unattractive for customers.

“If the hospital wants something special, we will normally fulfill such wishes. But of course, they need to pay for everything they ask us to do.” (George, MTC5)

2) *Exploration Versus Exploitation*: Tensions regarding exploration versus exploitation relate to the preferred innovation approach. Two different approaches followed by providers were identified. On the one hand, adopting exploration, providers

approached customers primarily to openly identify customer pain points and discuss potential ways forward:

“The business cases are developed together with the customer in multiple iterations. [...] That takes time.” (Heinrich, MTC13)

In such an approach, providers offered a broad range of smart products, services, and software to customers, addressing many different issues on the part of the latter. Typically, exploration was linked to individualization, an incremental innovation approach, and a skimming strategy. On the other hand, providers following an exploitation approach addressed customers with a clear value proposition and a limited offering targeting specific customer pain points (e.g., the reduction of scan time for magnetic resonance imaging). Exploitation was often linked to bundling, standardization, and a penetration strategy.

Both approaches found support on the customer side. However, conflicts occurred frequently when the innovation approach chosen by providers did not match the expectations of customers. For instance, respondents from hospitals in favor of exploitation articulated that providers should solve “*painful problems*” (Michael, H1), “*[don’t] steal [...] time*” (Mark, H4), and “*get the job done*” (Robert, H9). In contrast, hospitals facing pressure to “*become more digital*” (Andrew, H6) often expressed the need to get holistic solutions from a single vendor, as doing so allows them to reduce the complexity of managing external stakeholders and purchasing.

Providers reacted in three ways to these tensions. First, some providers, typically those with less advanced portfolios, tried to ignore customer complaints. Second, a few providers segmented their customers to ensure a fit between customer needs and their own innovation approach, thereby deciding for either exploration or exploitation. Third, providers sometimes made use of both exploration and exploitation, depending on the customer segment.

“The approach and effort we spend on customers depend on many factors, but revenue potential is certainly a key factor.” (Heinrich, MTC13)

B. Value Creation and Delivery

1) *On-Premise Versus Cloud*: Data collection, storage, and analysis are topics of utmost importance for business models around smart products, services, and software. But pivotal questions, such as whether to connect assets, where to conduct data storage and analysis and from where to run applications, posed strong tensions between providers and customers. In essence, such issues can be abstracted as a conflict between on-premises and cloud-based infrastructure.

Providers demonstrated a clear interest in maneuvering customers onto cloud infrastructure for three reasons. Working with the cloud can be seen as a cost-saving measure as it substantially reduces providers’ necessity to deal with the overly complex and idiosyncratic IT infrastructures of hospitals. Moreover, a cloud-based infrastructure also supports the implementation of plug-and-play features and updates.

“[I]n the future we want [...] to] have a cloud-based system [so that] updates just come automatically like Gmail updates.” (Niklas, H11)

Second, providers considered customers that migrated to the cloud as strategically locked-in to a certain extent.

“You don’t change your cloud provider easily. If you have the customer on your platform, every year it gets more difficult for [... them] to leave.” (Matthew, MTC1)

Third, providers highlighted that a cloud-based approach typically allowed much easier access to customer data, enabling the generation of further insights and upselling opportunities.

“Our [cloud-based] solution allows us to understand our customer’s [software] users. We know what the individual users are doing in our systems and through this, we can address these individual user needs specifically. This means [...] a completely different business relationship.” (Marco, MTC2)

Many customers, however, were extremely skeptical about cloud-based applications. Convincing IT departments of such solutions presented a huge pain point not only for providers’ sales force but also for medical professionals in customer organizations who would like their employer to source a specific solution. The reasons behind such skepticism are manifold. For example, customers expressed concerns that providers would use such data opportunistically for their benefit and that losing control over data stored on the cloud could reveal internal shortcomings or failures, thereby hurting the hospital or individual employees.

“Practitioners are very afraid to lose their power over patient data and open the possibility of being judged based on evidence.” (Vanessa, P2)

Moreover, unclear regulations, the fear of accidentally releasing patient or clinical trial data, and cybersecurity threats let providers prefer on-premise solutions. Many customers, thus, insisted on on-premise solutions. Providers and customers reacted to the resulting tensions in three ways. First, some providers decided to offer customers on-premise solutions if requested but charge a high-margin price for doing so. Second, some providers and customers found a compromise between provider-hosted cloud databases and on-premise solutions in the form of hosting data and applications on hospital servers. Third, other providers, particularly those following penetration strategies, did not offer on-premise alternatives at all.

2) *Interoperability Versus Proprietary Systems:* Integrating smart product-software-service systems into the existing infrastructure and process landscape at hospitals led to tensions between providers and customers. A particularly critical topic of discussion relates to the question of to what degree a sourced solution must be easy-to-integrate and compatible with existing systems (e.g., building on open data sharing protocols or APIs). Providers aim at boosting proprietary systems, thus promoting their solution ecosystem, and trying to avoid or make it difficult for third parties to access data collected from their products or use their software’s functionalities without compensation. However, many providers are well aware that interoperability with the existing product and software landscape is often beneficial for their customers.

“I encounter a relatively large amount of integration work until the data flows properly and is integrated, and only then can you start to work well and gain additional value.” (Galina, MTC12)

Customers, indeed, articulated a strong preference for interoperability. The reasoning behind this is twofold. First, hospitals highlighted the importance of not becoming dependent on a single supplier or platform. Second, to leverage efficiencies in their daily work, hospitals pinpointed the necessity of having integrated workflows where data between devices and software of different manufacturers can be easily exchanged, processed internally, and shared with external institutions:

“Our suppliers and partners have different systems and interfaces. It starts with health insurance; they have [...] systems with brokers that do nothing but send the data to the health insurance companies. Also, [... governmental agencies and state-level authorities] want [...] data.” (Michael, H1)

The strategies of smart solution providers to cope with these customer requirements were driven by their market positioning and “standing.” Providers with a high market share, a long tradition of operating in the market, well-established relationships with customers, or highly innovative products tend to be able to focus less on the mentioned concerns. In contrast, for providers offering noncore, uncritical processes, assets, and services, and for providers with a small market share facing intensive competition, interoperability becomes essential. These providers put the interoperability of their solutions at the center of their communication with customers.

“We offer customization and support in terms of how [customers] can integrate our digital tool into the various systems they have in place.” (William, P3)

Beyond the two previously described options, some companies tried to use partnerships with other providers to ensure the benefits of a proprietary strategy while offering a compromise on customers’ demands regarding interoperability.

“We work together with one of the large MRI manufacturers and two of the biggest workflow management software providers. Collaboration is key to pushing your ecosystem.” (Philip, MTC11)

3) *Transactional Selling Versus Cocreation:* The implementation of smart product-service-software systems required providers and customers to define a common working model. Such a decision caused tensions in deciding on the optimal way between a traditional, sell-and-forget transaction approach versus a cocreation approach, acknowledging the importance of collaborating intensively over time to ensure value-in-use.

Some smart solution providers see cocreation as a great way for exploration and individualization, particularly because many customers are not aware of the potential of different solutions offered to them.

“You need to find a way to work together with each customer. Sell and leave is not an option for us [anymore].” (Beatrice, MTC7)

Other companies decided against such an approach as it undermined their penetration strategies and was perceived to produce unreasonably high costs. Also, the fear of not being

able to deliver value-in-use, lacking knowledge about the hospitals' processes, and lacking service capabilities led providers to decide against a cocreation approach. Indeed, informants frequently highlighted that cocreation would require a much more service- and customer-oriented culture within providing firms as well as an alignment of processes with customers and ecosystem partners.

"We [still] see services and software as products." (Sandra, MTC6)

"It is extremely difficult to define the terms of the cooperation with other stakeholders from the ecosystem as it is not clear what could give each actor a competitive advantage over the other and vice versa." (Flavio, MTC8)

On the customer side, most interviewees were skeptical about cocreation. Hospitals' internal stakeholders, particularly the IT department, considered providers "enemies" and "competitors" rather than partners. Similarly, medical personnel proved reluctant to believe that providers should tell them how to do their work better. Working too closely with too many external partners "would only create additional effort without clear benefits" (Michael, MTC1). However, a minority of hospitals, particularly those open to exploration, strived to cocreation with suppliers. This is because such customers recognized the need for external support, leveraging providers' expertise to support their digital transformation journey.

"Our IT department has the highest costs and personnel growth in the entire hospital and will probably continue to grow even larger. That has mostly to do with the many new solutions and the technological problems that arise from them. [...] However, for certain topics, we rely completely or partially on external support as we are lacking the skills and resources to do it ourselves. But we are trying to increasingly do [digitalization topics] in-house." (Tom, H2)

Trying to balance the advantages and disadvantages of an on-off versus cocreation approach, providers used segmentation. Typically, providers offered coreaction only for high-revenue, high-margin, or high-strategic-potential customers. Also, cocreation was often used for building up showcases in the pilot stages of their offering.

"We do a lot to make the pilots run well and closely collaborate with the customer." (Emil, MTC4)

To reduce the costs of interaction with the customer, many companies tried to use digital technologies (remote services and helplines, chatbots, frequently asked questions, ticketing systems, self-guided troubleshooting manuals, or customer portals) to enable an effective cocreation process with customers without the necessity of being locally present. Enabling customers to understand and operate smart products and services without much provider support is seen as a major contributor to providers' efforts to increase efficiencies and enable scaling of their solutions while keeping costs under control.

"Many customers call for every little problem. We try to reduce such requests by giving customers free training, webinars, and good documentation so that they can help themselves." (Raul, P4)

4) *Incremental Versus Fast-Track Implementation:* Tensions related to the duration of implementation emerge because smart

solutions can either be implemented in an extended incremental approach (step-by-step) or in a fast and comprehensive manner. Smart solution providers' views on this subject were shaped by the availability of resources and the number of ongoing projects at any given time. Providers, particularly those following a penetration strategy, favored fast-track implementation in most cases. This is because traveling to the customers multiple times would increase project costs and reduce the total time spent on customer projects. Smart solution customers, however, typically prefer a rather incremental implementation approach. This is because internal resources were often scarce and medical personnel could spend only part-time on supporting providers' efforts.

"Our medical staff has a job to do. There is not much time left to take over additional tasks." (Timothy, H9)

Confronted with the divergence of customer and provider expectations, providers tried to accommodate customer wishes for a more iterative process while at the same time trying to push fast-track implementation by giving financial incentives.

"[I]f we need to come ten times, we will charge ten times. It's as simple as that." (Nico, P6)

Importantly, fast-track implementation sometimes caused internal concerns among providers regarding the ability to deliver solutions of reasonable quality. Notably, most providers decided in favor of speed for services and software.

"This idea of doing it 100% right makes much sense when you sell a diagnostic instrument for hundreds of thousands [dollars]. However, [such an] approach is too extreme and restrictive to work in the software world. We need to compete with the very fast-acting big tech companies of this world." (Flavio, MTC8)

5) *Digital Versus Analog Interaction:* Digital technologies enable new forms of communication, e.g., via chat programs, AR, VR, or algorithm-based chatbots. Confronting views on how to best utilize such technologies for provider-customer communication, however, often caused tensions between providers and customers. Most providers in our sample displayed a clear preference for digital interaction on most occasions due to a lack of resources (travel would take more time), travel restrictions (pandemic rules, visa), sustainability considerations, and, most importantly, internal cost pressure. The preference for digital interaction was often linked to penetration, standardization, organizational relationships, and fast-track implementation strategies. Consequently, most providers tried to convince customers to make use of such methods as it would save costs on both sides, i.e., providers would charge for on-site visits but keep remote troubleshooting free in their basic service-level agreement package. Also, providers promised faster claim-to-fix times for customers making use of ticketing systems and offered training services for customers.

"It is not so convenient for our customers to have external visitors for reasons of hygiene. We tell the customers that through [remote troubleshooting], their issues are fixed faster, and a technician will come only if necessary but then as fast as possible. Hospitals without using our ticketing system or remote connection pay more on average." (George, MTC5)

“Product schooling is key to enabling our customers to effectively use our products. It’s a win-win. The better and more they use our products, the more value we generate, and the more we [are able to] charge.” (Ursula, P1)

Customers generally agreed on making use of digital collaboration tools. However, hospitals sometimes complain about the quality and speed shortcomings when interacting with providers through digital channels.

“I don’t have the patience to end up in some call centers.” (Daniel, H3)

Hospital informants also highlighted pain points surrounding the complexity of managing different communication channels across their diverse supplier base.

“Sometimes it’s much easier for us to have someone come, show him the issue, and let him take care of it. I see the problem that we must explain our suppliers too much. Colleagues of mine often do not report incidents or malfunctions with the equipment or software just because they don’t have the time, willingness, or even knowledge of how to do that.” (Steven, H8)

C. Value Capture

1) *Capital Versus Operational Expenditures:* Company expenditures can be divided into two main categories: capital expenditures (CAPEX) and operating expenditures (OPEX). CAPEX is typically the one-time cost of purchasing fixed assets and making long-term investments, such as acquiring a software license or paying for a long-term service contract upfront. OPEX, on the other hand, are ongoing costs incurred for daily operations that keep the business running, such as software subscription fees, break-and-fix service fees, training fees, or asset leasing fees. Agreeing on capital versus operational expenditures created tensions between providers and customers.

Most providers showed a strong preference for operational revenue streams for both services and software, partly also for smart products. This preference is rooted in providers’ strategies to increase recurring revenue for the sake of improved resilience, a higher investor rating, and lower purchasing barriers.

“Our clear goal is to increase recurring revenue.” (Flavio, MTC8)

“[Our] mission is to generate recurring, high-margin revenue.” (Sarah, MTC5)

Smart Solution customers were divided in their views. On the one hand, some customers expressed a preference for operational expenditures, as this sometimes allowed stakeholders to source solutions without going through formalized investment approval processes.

“If we think a solution is helpful, we just buy it and pay per month or year for it.” (Michael, H1)

Moreover, subsidies or reimbursement policies that require expenses to be made as capital expenditures add to the attractiveness of OPEX models. On the other hand, some customers prefer

to have ownership, which undermines operational expenditure-based models. This preference was commonly caused by concerns about the long-term availability of solutions and the suboptimal individualization of solutions accessed through an OPEX model.

Providers dealt with the tension between boosting recurring, OPEX-based revenues, and the demand of many customers for one-time, CAPEX-based investments in two ways. For hardware and high investment-volume purchases, providers remained open for accepting both types of expenditure models and ensured the flexibility of their offerings, for instance, by offering leasing or hiring purchasing models. However, many providers decided to offer small-scale investment software and services only as subscription models.

“Already today, a large fraction of our equipment business is purchased in leasing or managed-service models, for instance, via [MTC8] financial services.” (Flavio, MTC8)

“Subscription will soon be the only model we offer for our software.” (Sandra, MTC6)

2) *Short-Term Versus Long-Term Contracts:* Finding a balance between short-term and long-term contracts was revealed to be a key challenge surrounding provider–customer discussions. Providers tried to balance short- and long-term commitments and highlighted their unwillingness to commit to providing services for a long time while agreeing on revenue models that might not be profitable in some years.

“We are in the early phase, we don’t know what is in 5 years [...], everything is fast-moving.” (Sandra, MTC6)

However, relatively long-term contracts enabled smart solution providers to better plan and avoid customers leaving contracts unexpectedly. Long-term contracts also help to keep transaction and setup costs low. Long-term contracts also give solutions more time to unfold their value to the customer. Moreover, long-term contracts were typically related to individualized solutions and outcome-based revenue models.

“If you take over risks and define a baseline to improve, you need multi-year contracts to account for unexpected events and let the solution demonstrate its value for the customer.” (Flavio, MTC8)

Customers preferred short-term contracts in most cases, as such a constellation goes hand in hand with greater flexibility to change a supplier, unsubscribe from a solution, and not get locked in. Also, short-term contracts were shown to be better aligned with budgets that were only known for a certain period.

“We would have huge discussions if we would want to sign a 10-year contract.” (Daniel, H3)

Additionally, customers expressed concerns about committing for a longer time as new technologies could emerge that outperform the solution they have committed to and because internal priorities could change. Often, the preference for short-term contracts was shown to be related to negative prior experiences with suppliers.

TABLE III
COPING STRATEGIES AND PRACTICES

Coping strategies	Practices of providers to cope with tensions		
	Value creation	Value delivery	Value capture
Accommodation	<ul style="list-style-type: none"> Give customers the choice to define their offer structure 	<ul style="list-style-type: none"> Turn interoperability requirements into a winning value proposition by offering “highly open” solutions Simultaneously push for personal and organizational relationships Give performance or availability promises to demonstrate a commitment to and a conviction of the provided solution’s value 	<ul style="list-style-type: none"> Provide free trials Lower entry barriers through freemium models
Concession	<ul style="list-style-type: none"> Accept “extra wishes” but charge customers additionally for such desires Remain open for cost discussions while highlighting added value for customers Offer a cloud-based solution but store and process data at the hospitals’ servers 	<ul style="list-style-type: none"> Accept an incremental innovation approach but charge customers for the resulting extra efforts The provider provides faster claim-to-fix times for customers by making use of a ticketing system. Segment customers for a cocreation approach Introduce different customer support layers consisting of different personal/organizational and digital/analog elements Offer paybacks if agreedupon targets are not met during the contract’s duration 	<ul style="list-style-type: none"> Add new features over time to ensure a competitive value proposition Provide discounts for showcase customers Consider set-up or training costs as “strategic investments”
Confrontation	<ul style="list-style-type: none"> Insist on a bundling approach for low-priority customers Explore the value of the solution and customer pain points, even when facing reluctant customers 	<ul style="list-style-type: none"> Build strategic partnerships with other suppliers to promote the providers’ ecosystems Offer “cloud-only” solutions “Customer is king. But we don’t follow every idea he wants” (Flavio, MTC8) “We are not doing compromises regarding cybersecurity and technical feasibility. If we are skeptical that it will work, we act highly conservative.” (Emil, MTC4) 	<ul style="list-style-type: none"> Offer contracts only after an extensive customer process analysis Always offer smart solutions with a price tag
Avoidance	<ul style="list-style-type: none"> Give customers options to individualize their solution packages Use segmentation to ensure a fit between the interests of the provider and those of the customers 	<ul style="list-style-type: none"> Digitalize customer interaction through ticketing systems, customer portals, or remote and helpline services Reduce service requests through chatbots, FAQs, and self-guided troubleshooting manuals Provide “free training” to create a capable customer base Price physical visits significantly higher than virtual interactions Separate sales, service, and customer-success-related roles Avoid availability, output, or outcome revenue model metrics to ease success control 	<ul style="list-style-type: none"> Avoid clear contractual promises but demonstrate an openness to discuss achievements and shortcomings with customers Only provide solutions in a charged model to underline the value of the solution

“And when I hear the inventors of these solutions, they naturally say: ‘This is the technical revolution.’ [A]nd they have often developed a great product. But we have also seen that products are developed for things where there is no real problem and where the product or the software is not used at all or not to the extent originally planned. And if one has gone through this once, one is naturally a little more awake and more attentive to the next procurement and the next product idea.” (Michael, H1)

D. Coping Strategies

The practices with which the service providers responded to the nine tensions can be integrated into four overarching coping

strategies. Table III summarizes the identified coping strategies and practices. Each of these four coping strategies reflects one main coping mechanism: “accommodation” (finding creative solutions that best satisfy customers’ demands and the service provider’s own interests simultaneously), “concession” (trying to meet customers halfway or coming up with a solution that somewhat satisfies customers’ demands but leaves room for a compromise), “confrontation” (refusing to accept customers’ demands), and “avoidance” (trying to maneuver around tensions).

While it is too early to assess the long-term performance implications of the four coping strategies empirically, paradox

theory inherently favors the accommodation strategy as this strategy “embraces” paradoxical tensions. However, pursuing the accommodation strategy may be time-consuming and/or lead to relatively expensive and, therefore, possibly less competitive solutions. Whether—or under which conditions—the accommodation strategy yields the strongest financial performance advantages hence remains a question for additional research.

V. DISCUSSION AND CONCLUSION

A. Theoretical Implications

Although extant research predominantly focused on the intraorganizational complexities of DS [40], this study identifies nine tensions that can occur in customer–provider relationships as firms turn to DS. It, thus, follows recent calls to examine interorganizational tensions [26] and analyze the effects of DS on the dyadic provider–customer relationship [5], [38], [42], [50], [66], [73], [83].

Consistent with [81], finding that tensions can have a positive, negative, or neutral impact, our study suggests that tensions affect the provider–customer relationship differently. Some tensions invoke conflicts that stall the prosperity of provider–customer relationships and can, hence, contribute to understanding why scaling smart solutions is so challenging and their contribution to firm success often falls behind expectations (e.g., [19], [41]). Occasionally, however, tensions may lead the parties to a solution that is superior to the conventional arrangement for both of them. It is also possible that certain tensions do not impact a given relationship at all as both sides ignore them. Moreover, different providers and customers have different experiences of the severity and temporal and spatial occurrences of the observed tensions. Thus, if a tension cannot be overcome in a specific customer–provider relationship, the provider or the customer may be able to find a different partner with whom the tension can be resolved. The observed tensions can, hence, depend on organizational conditions.

While many of these tensions are specifically related to DS, some can also be linked to servitization-related challenges. For instance, individualization versus standardization, costs versus value, and digital versus personal relationships are per se questions that are not necessarily linked to digitalization and that have been frequently referred to in prior B2B literature. Thus, these identified tensions can also be found in other industries implementing digital technologies in new evolving ecosystems in which different actors have to be aligned according to a new value proposition. Also, the general complexity of bundling smart products, software, and services in a way that varying customer demands are met surfaced frequently and pinpointed the known complexities of (digital) solution selling in general [82], [83].

Extending prior research that emphasizes the close link between front- and back-end interdependencies that manifest at the providers [13], [21], we found that intra- and interorganizational paradoxical tensions cannot always be clearly distinguished. Moreover, we observe that the identified tensions are highly interrelated, confirming prior research in the domain of paradox theory [28], [45], [65]. For instance, cocreation practices are

often linked to individualization, long-term contracts, and exploration. Vice versa, “sell-and-forget” practices occur most of the time in combination with standardization and exploitation.

In addition to identifying nine tensions, we also observe four coping strategies for dealing with them. These strategies complement prior findings on how companies can manage paradoxes and respond to paradoxical tensions [69]. These avenues were identified based on the interviews and discussions (e.g., webinars). Companies may apply one of the identified coping strategies or even a combination of them to alleviate these tensions.

B. Managerial Implications

This study provides insights and practical guidance for managers to address tensions and paradoxes. Specifically, it offers three takeaways for managers. First, it can make managers aware of crucial interorganizational tensions that they should anticipate when they decide to engage in DS. It also suggests measures and coping strategies to deal with such tensions. Second, the study findings highlight the need to consider contextual factors in DS-related decision-making. For example, our study showed that hospital managers and doctors across private and public hospitals defined “quality” very differently, which creates different demands and expectations that providers must meet. Third, building up resources, developing capabilities, adapting processes, and defining new roles may reduce the relevance of certain tensions, even if not all tensions can be prevented or overcome. In practice, this can mean using resources and capabilities differently across segments and developing different strategies and offerings for different customer segments.

C. Limitations and Future Research Directions

Like all research works, our study possesses some limitations. Three main limitations offer various opportunities for further research. First, our multicase study is situated in the healthcare sector. While our industry focus allowed for a detailed analysis of provider–customer tensions, future research could examine interorganizational tensions related to DS in another industry. However, the study findings also reveal that organizational agility could be inhibited by cocreation. Activities needed to overcome tensions and foster cocreation in new ecosystems claim the resources of the companies. These effects raise the question of how companies could be agile while simultaneously cocreating with competitors, partners, and customers. This question is also relevant for other industries creating digital ecosystems.

Second, the data for this study were entirely collected in Switzerland. Studying the phenomenon in other healthcare markets could produce valuable insights on how country-specific factors (e.g., culture, legal regulations) affect relevance and intensity of certain provider–customer tensions (cf., [37]). Third, our study reveals coping practices and strategies that providers use to deal with tensions, but it does not provide insights into these measures’ effectiveness and appropriateness. Evaluating the advantages and disadvantages of these practices and strategies as well as their potential seems like a promising avenue

for future research. Future research could include the identified strategies in quantitative, possibly longitudinal studies, to better understand their relative effectiveness across different conditions. Such quantitative efforts could also explore differences across the various facets of scaling [60].

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