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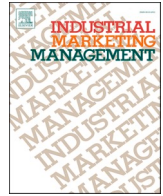
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Research paper

Uncertainty driving the dynamic development of inter-organisational relationships in engineering services over time

Melanie E. Kreye*

Department of Technology, Management and Economics, Technical University of Denmark, Denmark

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ABSTRACT

This paper explores the dynamic development of inter-organisational relationships between provider and buyer over time. We specifically study how uncertainty drives relationship strength and contributes to intended future relationship strength in engineering service relationships due to the suitability of this setting for our purpose. From the literature, we derive a conceptual framework of three uncertainty types (environmental, relational and organisational uncertainty), which we investigate over the contract life cycle. We present four case studies of 10–17 semi-structured interviews each and secondary data. We show how pre-contract environmental uncertainty drives relationship strength depending on the pre-contract experienced organisational uncertainty. We further show how relationship strength affect early contract experienced organisational uncertainty. Depending on the development of this uncertainty during contract operation, the intended relationship strength is increased or decreased. We derive theoretical propositions regarding these three connections. This study contributes to the existing literature by demonstrating the dynamic effects of different uncertainty types and their respective interactions with relationship strength over time. We move beyond existing theory towards a nuanced understanding of the dynamic interaction between uncertainty and relationship strength over time.

1. Introduction

Uncertainty, defined as a lack of understanding, is a central factor in the development of inter-organisational relationships (Kreye, 2018; Yan & Dooley, 2013). Uncertainty becomes an increasingly important issue for industry as demonstrated by events, such as the Coronavirus pandemic or the container ship Ever Given blocking the Suez Canal and hence disrupting international cargo transport. Events such as these shape the business environment and in turn affect how companies operate within their relationships with customers and suppliers (Kreye, 2018; Yan & Dooley, 2013). Existing theory highlights the role of uncertainty for creating inter-organisational relationships (Liu, Wei, Ke, Wei, & Hua, 2016) and as a consequence of these relationships (Park, Kim, & Ryu, 2020; Yan & Dooley, 2013) respectively. The latter is often described in terms of the potential to undermine intentions for relationship continuation (Williamson, 2008), providing further evidence that uncertainty affects the development of inter-organisational relationships over time. Exploring this role in more detail is particularly important as observations show that some inter-organisational relationships between provider and customer span multiple decades and

thereby follow dynamics of increasing and decreasing relationship strength, i.e. the contractually agreed level of operational dependence and relational ties (Autry & Golobic, 2010; Gorovaia & Windsperger, 2018). In contrast, other relationships end after one contractual agreement (Gorovaia & Windsperger, 2018; Jap & Ganesan, 2003). In response, many researchers call for more detailed investigations of relationships within their time-based context to capture the role of prior experience, commitment and trust in this context (Alinaghian, Kim, & Srai, 2020; Panda, Srivastava, & Pandey, 2020; Sting, Stevens, & Tarakci, 2019).

Despite this, theoretical understanding of the influence of uncertainty on the dynamic development of inter-organisational relationships over time is still nascent offering research opportunities. Existing studies typically emphasise the time-constrained characteristic of inter-organisational relationships by focusing on the direct effect of uncertainty on specific decisions, such as contract signature (Jia, Wang, Xiao, & Guo, 2020; Kreye, Newnes, & Goh, 2014). These studies ignore the long-term ‘memory’ that is formed based on prior interactions and dynamics (Autry & Golobic, 2010). Specifically, the effect of uncertainty (Yang, Gao, Li, Shen, & Zheng, 2017) and ability to successfully manage

* Corresponding author at: DTU Management; Akademivej, Building 358; 2800 Kgs. Lyngby; Denmark.

E-mail address: mkreye@dtu.dk.

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this uncertainty (Liu et al., 2016) can in turn affect the relationship between provider and customer. This raises the question about the micro-dynamics of uncertainty across the development of inter-organisational relationships over time as follows: *How does uncertainty develop dynamically over the contract life cycle in inter-organisational relationships in terms of driving relationship strength and contributing to intended future relationship strength?*

This research explores service relationships within manufacturing contexts (engineering services) for the following three reasons. First, focusing on one specific type of service and the resulting type of inter-organisational relationship offers an empirically homogenous basis for this research. Engineering services focus on the application of engineering knowledge – such as technologies, skills, and expertise – to solve customers' problems (Zhang, Gregory, & Neely, 2016). Second, engineering services are of particular importance in practice and hence form a meaningful basis to generate practically relevant research insights. Many manufacturers have extended their offering to include engineering services (termed servitization (Vandermerwe & Rada, 1988)), offering a particularly relevant setting for investigating our research question due to the novelty as well as dynamic nature of inter-organisational relationships in this context (Zhang & Banerji, 2017). Third, engineering services represent a suitable empirical focus for this research due to the significant impact of uncertainty on performance (Kreye, 2018; Nullmeier, Wynstra, & van Raaij, 2016; Zhang & Banerji, 2017).

Based on an initial conceptual framework, we study the interconnections of three uncertainty types (environmental, relational, and organisational uncertainty) and relationship strength across the contract life cycle. Offering insights from four engineering service dyads, this study provides evidence from both partners (i.e., provider and customer). The findings reveal the nuanced effects of the connections between uncertainty types and relationship strength over the contract life cycle. Specifically, we show how different uncertainty types of uncertainty affect relationship strength of service contracts and how relationship strength drives these uncertainty types in turn. We summarise these insights in propositions and discuss their relevance for theory elaboration.

The main contributions of this research arise from the identified dynamics between uncertainty and relationship strength over the contract life cycle. This research extends existing theory on inter-organisational relationships (Crosno, Dahlstrom, Liu, & Tong, 2021; Friend, Malshe, & Fisher, 2020; Jia et al., 2020; Kreye, 2018; Shen, Su, Zheng, & Zhuang, 2020), which has largely focussed on short-term developments of these relationships. Our research demonstrates that the three uncertainty types play distinct roles over the contract life cycle and respectively drive or restrain relationship strength and intended future relationship strength. This research hence forms a first step into understanding the dynamic development of inter-organisational relationships over extended time horizons, shaping the development of clusters and networks (Aarikka-Stenroos, Jaakkola, Harrison, & Mäkitalo-Keinonen, 2017; Kreye & Perunovic, 2020). This research enables us to link existing findings of focussed time horizons within inter-organisational relationships to the dynamic development of these relationships over time (Friend et al., 2020; Panda et al., 2020; Sting et al., 2019). This research thus forms an important step in furthering our understanding of the 'memory' in inter-organisational relationships, with a specific focus on the intrinsic dynamics within inter-personal relationships and individual organisational concerns.

2. Literature review

Inter-organisational relationships connect manufacturing companies with other value chain activities, such as supply, research and development, and market (Ketokivi, Turkulainen, Seppälä, Rouvinen, & Ali-Yrkkö, 2017). While some of these relationships are transactional in nature, many are “close, complex and frequently long-term” (Ford, 1980,

p. 339) and require committed and integrated relations (Alghababsheh & Gallear, 2020; Blessley, Mir, Zacharia, & Aloysius, 2018). Uncertainty has been highlighted as a central concept for driving inter-organisational relationships and their development over time (Jindal, Sivadas, & Kang, 2021; Kreye, 2018; Zhang, Tse, Wang, & Gu, 2020). For example, environmental uncertainty determines the strategic dependence of organisations on core resources (Pennings, 1975). Similarly, relational uncertainty can arise from co-dependence on external partners (Melanie E. Kreye, 2017b; Yan & Dooley, 2013). However, studies tend to focus on a specific stage of the relationship, such as the formation (Liu et al., 2016) or the development after contract agreement (Williamson, 1979; Yan & Dooley, 2013) with little understanding of the processual characteristics and effects (Panda et al., 2020). This research aims to provide insights of uncertainty across the dynamic development of inter-organisational relationships over time.

Knowledge-intensive services, as a type of inter-organisational relationships, require long-term relationships between manufacturers and their customers (Kohtamäki, Partanen, & Möller, 2013). Of particular relevance to manufacturers are engineering services, which are knowledge-intensive offerings surrounding core technology and include problem-solving activities such as maintenance, construction, training, and development (Zhang et al., 2016). Engineering services are increasingly outsourced as non-core activities by customers such as hospitals, investors, and other organisations. Many manufacturers learn to develop and provide these services as they engage in servitization and thereby increasingly add services to their offerings (Kuijken, Gemser, & Wijnberg, 2017). Here, buyer and provider both need to develop the relevant capabilities for providing and receiving the service, including the need to engage in a service-based relationship in contrast to prior product-based engagements (Eloranta & Turunen, 2016). In addition, service relationships are typically long-term commitments between provider and customer (Kreye, 2018; Kuijken et al., 2017), making them a particularly interesting setting for the purpose of this research.

2.1. Uncertainty in inter-organisational relationships

This research applies a broad conceptualisation of uncertainty as a lack of understanding of performance-relevant factors and forces as a result of indefinite, unknown, or unreliable information (Kreye, Goh, Newnes, & Goodwin, 2012). This definition integrates prior conceptualisations of uncertainty as both a form of unpredictability (in terms of dynamism and complexity [Knight, 1921; Milliken, 1987]) and variability (in terms of quantitative and qualitative variations, sometimes also described as equivocality [Flynn, Koufteros, & Lu, 2016]). These conceptualisations are interdependent (e.g., variability in input can lead to unpredictability in outcomes [Flynn et al., 2016]), but are often distinguished and partially excluded in specific definitions of uncertainty (e.g., Knight, 1921). In contrast, some studies include both unpredictability and variability in terms of the ambiguity of changes in the market (Zhang et al., 2020). A definition of uncertainty that integrates both conceptualisations therefore enables analysis of inter-organisational relationships across their time-based development consistent with existing explanations on this topic.

Based on existing works, three uncertainty types can be distinguished. While environmental uncertainty is most frequently described (e.g. Park et al., 2020; Zhang et al., 2020), relational uncertainty has emerged more recently to describe the lack of understanding regarding partner behaviour and motives (Melanie E. Kreye, 2017b; Yan & Dooley, 2013). Similarly, organisational uncertainty has emerged as an important topic for service provision and relationships (Kreye, 2018), contributing the third uncertainty types for our analysis.

Environmental uncertainty is defined as a lack of understanding of external developments and changing conditions in the market (Milliken, 1987). It arises from unpredictability (Milliken, 1987) in terms of market dynamism or a lack of patterns (Zhang et al., 2020), market instability, or unpredictable technology developments (Melander &

Lakemond, 2015). It can also relate to variability demand (Park et al., 2020). Thus, environmental uncertainty is related to both uncertainty conceptualisations of unpredictability and variability.

Relational uncertainty is defined as the inability to predict or explain a partner's actions (Melanie E. Kreye, 2017b) due to a lack of confidence in describing, explaining, and predicting partner behaviour (Yan & Dooley, 2013). Relational uncertainty has recently emerged as a stand-alone concept through refinements of existing theoretical propositions. The definition of relational uncertainty emphasises unpredictability related to a lack of trust between partners (Shen et al., 2020), possibility of opportunistic behaviour (Jia et al., 2020), or differences in integration between partners (Blessley et al., 2018). However, relational uncertainty can also arise from variability in the relationship, including variations in the knowledge flow between provider and customer (Yang et al., 2017) and in communication intensity (Yan & Dooley, 2013). Variations in knowledge flow are particularly relevant for services for which the outcomes are difficult to control and evaluate due to fluctuations in customer input, creating the potential for disputes between provider and customer (Kreye, 2017b).

Organisational uncertainty is defined as the lack of understanding of firm resources (e.g., assets, capabilities, organisational processes, knowledge flow) by organisational members, which results in variations in organisational effectiveness and efficiency over time. This definition of organisational uncertainty connects conceptualisations of both unpredictability and variability. Unpredictability is captured through changes in organisational priorities via the implementation of new strategies, which results in resource re-allocation (Ramirez Hernandez & Kreye, 2021) and (temporary) internal inconsistency in terms of changes to internal integration and coordination. Variability can also be connected to organisational effectiveness or efficiency (Kreye, 2018), as adjustments and updates to firm resources may create variability in internal information and knowledge flows. Table 1 provides an overview of the three uncertainty types and their potential operationalisations in services.

2.2. Dynamic development of inter-organisational relationships

Inter-organisational relationships can be characterised by their time-based dynamics with variations in level of commitment based on the experience in the dyad (Panda et al., 2020). This can be captured by relationship strength, which captures the contractually agreed level of operational dependence and relational ties (Autry & Golicic, 2010; Gorovaia & Windsperger, 2018), including structural elements, such as coordination systems and points of contact and engagement (Alinaghian et al., 2020). Relationship strength can vary over long time spans according to explicit decisions made by the provider or customer to strengthen or loosen relational ties. For example, Autry and Golicic (2010) contended that experience in prior engagements affects these decisions to strengthen or loosen relational ties, suggesting that the time around contract signature determines the relationship strength (Gorovaia & Windsperger, 2018). While relationships often follow long-term trends of exploration, build-up, maturity, and decline (Jap & Ganesan, 2003), they also exhibit shorter-term developments defined by the contract life cycle of contract negotiation and agreement (pre-contract) and execution of the agreement, including reflection and evaluation of the relationship (contract operations) (Jap & Ganesan, 2003). Dynamic developments of relationships have often been reported in the contract management literature, focusing on the phase of contract operations (Crosno et al., 2021; Gorovaia & Windsperger, 2018; Kreye, Roehrich, & Lewis, 2015). Repeated contract life cycles create a relationship spiral (Autry & Golicic, 2010) of increasing and decreasing relationship strength forming an interesting framing for analysing the micro-dynamics based on uncertainty.

An early time-based framework of inter-organisational relationships was provided by Ford (1980) indicating specifically how uncertainty may develop within the period of contract operation as joint norm and

Table 1
Definitions and operationalisation of uncertainty types.

Uncertainty type	Definition	Operationalisation for services
Environmental uncertainty	Lack of understanding of external developments and changing conditions in the market (Milliken, 1987)	Unpredictable changes in the business environment and market (Zhang et al., 2020) Variations in supply availability in terms of material and spare parts Unpredictability of future customer needs due to shifts in the market (Park et al., 2020) Unpredictability of dependence on the institutional environment due to extension of operational contingency through servitization (Kreye, 2017a) Competitor actions increasing or decreasing the competitiveness of the focal company (Ramirez Hernandez & Kreye, 2021)
Relational uncertainty	Inability to predict or explain a partner's actions (Kreye, 2017b) due to a lack of confidence in describing, explaining, and predicting partner behaviour (Yan & Dooley, 2013)	Unpredictability of partner behaviour due to potential lack of inter-organisational trust (Jia et al., 2020) Variation in customer demand in terms of timing and amount (Sampson & Spring, 2012) Unpredictability of staff behaviour in partner organisation due to lack of joint practice and inter-personal trust (Kreye et al., 2015)
Organisational uncertainty	Organisational members' lack of understanding of firm resources (i.e., assets, capabilities, organisational processes, knowledge flow), which results in variations in organisational effectiveness and efficiency over time	Varying need for internal collaboration and communication in provider and customer organisations to have service-relevant information available (Kohtamäki et al., 2013) Variation in service performance due to need for operational flexibility and heterogeneity related to service delivery (Kastalli & Van Looy, 2013) Unpredictability of operational challenges in service provision in comparison to manufacturing company background (Eloranta & Turunen, 2016)

commitment are developed and cultural distance between the partners decreases. Ford also acknowledges the importance of pre-contract experiences aligned with later descriptions mentioned above.

2.3. Framework construction

To investigate the research question posed in this study, we connect the time-based dynamics of uncertainty with relationship strength over time. We construct a conceptual framework (Fig. 1) from the literature. We use the conceptual framework to guide our empirical investigations. The basis of the framework is the contract life cycle from pre-contract negotiation, contract agreement specifying the relationship strength, contract operation to execute the agreement, which we separate into early contract, development and late contract to differentiate the often long-term time spans of contractual agreements (Gorovaia & Windsperger, 2018), and intended relationship strength based on relationship reflection. This aligns with existing descriptions (e.g. Jap & Ganesan, 2003). Existing cross-sectional models of uncertainty in inter-organisational relationships focus on specific phases of the contract

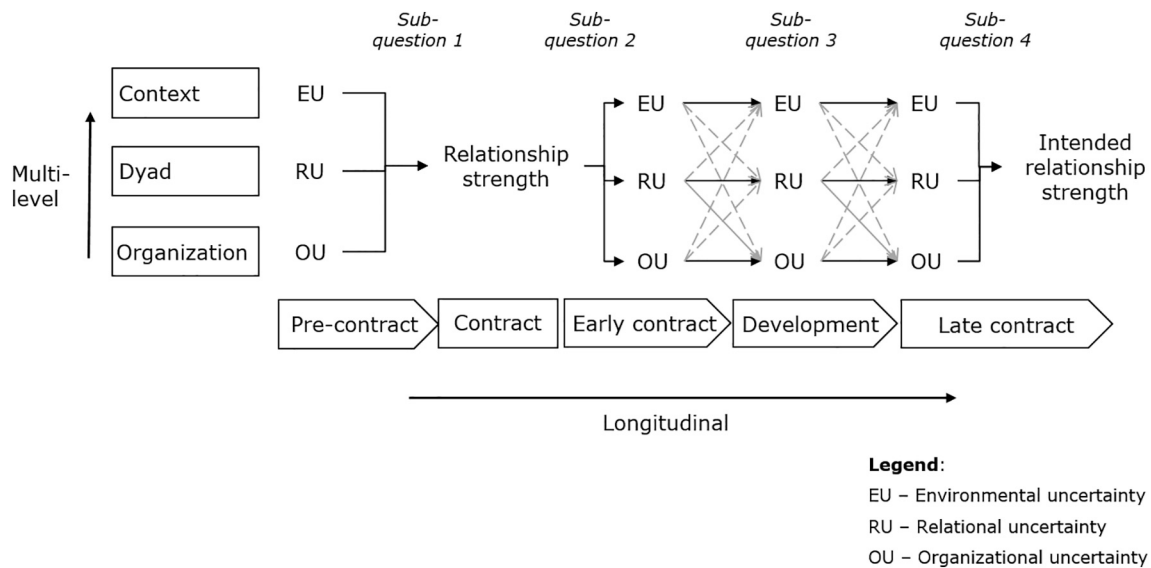


Fig. 1. Conceptual framework of uncertainty and relationship strength across the contract life cycle.

life cycle, resulting in a breakdown of our overarching research question into four sub-question as follows.

The first sub-question is: How do different uncertainty types affect relationship strength when formalising relationships from the pre-contract negotiations? This sub-question regarding the link between uncertainty as a driver for inter-organisational relationships is based on existing studies (Liu et al., 2016; Zhang & Banerji, 2017). This study specifically examines uncertainty during the pre-contract stage when contracts are negotiated. Relationship strength is defined in the contract through the relational obligations of both partners (Crosno et al., 2021).

The second sub-question is: How does relationship strength affect the experienced uncertainty in the early stages of contract operation? This connection has been assumed in prior studies. For example, Ford (1980) assumes that uncertainty is unilaterally high during early contract operation. However, relationship strength may create differences. For example, contracts that require close and frequent interaction between the provider and customer, such as performance-based contracts, may reduce the uncertainty due to goal alignment and close social ties (Nullmeier et al., 2016). However, the large amount of performance parameters in these contracts may also increase uncertainty (Gorovaia & Windsperger, 2018). This suggests potential effects of relationship strength on uncertainty in early contract operations.

The third sub-question is: How does uncertainty develop dynamically over the development of contract operations? Existing models typically assume that uncertainty reduces automatically as joint processes are developed and commitment and experience is built (Ford, 1980; Yan & Dooley, 2013). More recent insights, however, suggest a need for active relationship management to avoid resolving of inter-organisational relationships (Gorovaia & Windsperger, 2018; Jindal et al., 2021). Similarly, uncertainty may in fact increase over time due to knock-on effects between uncertainty types (Kreye, 2018). This research hence aims to expand these insights by showing how uncertainty experienced in early contract stages affects experiences during the development.

The fourth sub-question is: How does uncertainty during contract operations drive intentions for future relationship strength through examining actual and intended contract renewals, additions, or discontinuations? This sub-question is based on the notion that the ability to resolve the uncertainty experienced during contract operation can affect intentions for relationship continuation through follow-up contracts, which may differ in relationship strength (Yan & Dooley, 2013).

3. Method

3.1. Research design

This research is theory elaborating in nature (Ketokivi & Choi, 2014), as it expands upon an existing body of literature and the underlying theories, including transaction cost economics (Williamson, 2008), resource dependence theory (Dess & Beard, 1984) and relational view (Dyer & Singh, 1998). A multiple-case design is appropriate in this research (Siggelkow, 2007), because it allows the researcher to immerse him or herself within the empirical context and facilitates in-depth investigations of the researched phenomenon (Yin, 2018). Adequate investigation of complex issues such as uncertainty requires complex methods to study an integrated image of reality through simultaneous study of qualities (Miller, 1992). The multiple-case design allowed for inductive examination of the research question while also seeking a degree of generalisability (Voss, Tsiriktsis, & Frohlich, 2002). As performance in engineering services depends on the organisational and industrial context, including the real-world context was crucial (Kowalkowski, Gebauer, & Oliva, 2017). The collection of four case studies enabled this research to provide sufficient in-depth insights while comparing across empirical and industrial contexts (Yin, 2018).

This research applies an embedded design to reflect the different levels of analysis within inter-organisational relationships: the dyad and the individual partner organisation (Alghababsheh & Gallear, 2020; Blessley et al., 2018). This embedded design enables in-depth understanding of the empirical setting and dynamics in terms of the researched concepts, which in turn enables the generation of rich and reliable research models (Ketokivi & Choi, 2014). This design also reflects the varying focal points of the three uncertainty types (Table 1) based on the business environment, dyad and individual organisation.

3.2. Case selection

The unit of analysis in this research is the inter-organisational relationship between provider and customer. The sub-units of analysis are organisational and inter-personal links. Four cases were selected (Table 2), which is aligned with the suggested 4–10 cases for multi-case research (Eisenhardt, 1989). The cases were selected based on purposive sampling. In alignment with the servitization literature, the cases were selected in different industrial sectors – wind energy, electronics, chemical production, and the healthcare industry – in order to embrace

Table 2
Summary of case studies.

	Case A	Case B	Case C	Case D
Industry sector	Wind energy production	Water treatment technology	Chemical production	Healthcare
Economic sector	14% annual growth (European Environmental Agency, 2016); Stable growth since 2005	4.3% annual growth globally, with predicted increase to 8.5% annual growth from 2015 (M&A Review, 2017)	2% annual growth in 2013 with large fluctuations in the global market; Regional growth between 1.4% and 4.1%; Demand driven primarily by public investments	3% annual growth with stable long-term predictions (Johansson, Guillemette, & Murtin, 2012); Mainly public sector investments
Regulatory developments	Support schemes to encourage development of the wind energy sector within the EU (González & Lacal-Arántegui, 2016); Cuts in governmental subsidy payments for electricity from renewable sources	Increasing regulations, such as the UK's 'Water Act 2014', to ensure quality in water supply and suppliers	Emissions regulations to reduce pollution from production processes	EU regulations aimed at creating a single market for medical equipment and fostering a long-term stable environment for businesses; Large government investments to modernise the sector in terms of equipment technology and performance
Engineering service	Availability of wind turbines, including preventative and corrective maintenance activities	Preventative and corrective maintenance for electronics such as actuators	Operation and maintenance of chemical production plant, including energy and resource use	Ensure uptime of scanning equipment, including maintenance and updates
Product complexity	Wind farm with multiple individual wind turbines	Multiple individual actuators distributed across several sites within a geographical region	Variation of chemical production equipment situated within a production plant	Individual pieces of medical scanning equipment situated within one hospital
Provider (P)	Manufacturer of wind turbines; Operating globally; 21,500 employees; Revenue: 6.01 b€ total, 0.95 b€ from services	Manufacturer of electronics such as actuators; Operating nationally; 3500 employees; Revenue: 670 m€ total, percentage of service business not detailed	Manufacturer of chemical plants and equipment; Operating globally; 13,000 employees; Revenue: 26.9 b€ total, 7.6 b€ from services	Manufacturer of scanning equipment such as MRI scanners; Operating globally; 45,000 employees; Revenue: 14.5 b€ total, percentage of service business not detailed
Customer (C)	Electricity provider; Operating nationally in Nordic country; 25 employees	Provider of water services to regional community; Operating regionally; 2500 employees	Provider of chemical products to business clients; Operating nationally; 3000 employees	Hospital; Public institute; 6500 employees
Contract length	10 years	3 years	10 years	4 years
Prior relationship to case contract	Installation of product base on customer site	Ad-hoc service visits based on call-outs	Installation of product base on customer site	Installation of product base on customer site
Interviewees (Provider)	Service agreements for other wind parks	Delivery and installation of equipment on customer site	No service engagement prior to case agreement	Service agreements for prior scanners and for other pieces of equipment
Interviewees (Customer)	Manager of Customer Service Customer Service Manager 1 Customer Service Manager 2 Customer Service Manager 3 Finance and Administration Manager Regional Manager Site Manager Quality Performance Expert Senior Business Manager	Service Engineer Senior Service Engineer Service Manager Sales Manager General Manager	Vice President O&M Head O&M Chemical General Manager O&M Sales Performance Manager Procurement Manager Mechanical Maintenance Manager Operations director General Maintenance Manager Material Manager Regional Finance Manager Chief Operation Officer Plant Manager Technical Director Production & Process Manager Maintenance Manager Quality Control Manager Health, Safety and Environment (HSE) Manager	Service Manager Business Controller Invoice Administrator 1 Invoice Administrator 2 General Manager Sales Manager Account Manager Service Engineer 1 Service Engineer 2
Interviewees (Customer)	Managing Director Service Operations Manager Operations Manager Procurement and Project Manager	Electrician 1 Electrician 2 Technical Manager 1 Technical Manager 2 Engineering Supervisor	Chief Operation Officer Plant Manager Technical Director Production & Process Manager Maintenance Manager Quality Control Manager Health, Safety and Environment (HSE) Manager	Strategic Buyer Chief Physicist Physicist 1 Physicist 2 Physicist 3

the potential influence of contextual factors. Including different industrial contexts in the research design enables replication (Ketokivi & Choi, 2014) and increases the external validity of our findings (Gibbert, Ruigrok, & Wicki, 2008). The industry sectors were selected based on theoretical criteria to ensure suitability to the purpose of our research (Yin, 2018) and internal validity (Gibbert et al., 2008). The theoretical criteria included factors within the business context, such as economic growth and regulatory developments; organisational characteristics, such as the provider firm's focus on service provision; and the nature of the specific service offering. These theoretical criteria ensured comparability between the cases and thereby the methodological rigour of our research (Gibbert et al., 2008).

The cases were selected following three steps. First, we selected relevant industry sectors that have experienced recent trends towards

servitization as a relevant setting for our investigations (Kowalkowski et al., 2017). This includes regulatory and economic drivers (see Table 2) as well as company moves towards engaging in service-based relationships, leading us to identify industry sectors that have previously been described within the servitization context (Pereira, Kreye, & Carvalho, 2019). Second, we identified relevant providers based on theoretical relevance in terms of their manufacturing background and the overall service focus of their business (Eloranta & Turunen, 2016). All four chosen providers had a successful service-based business with a good reputation in the market and with substantial contribution of their service business to the overall turnover. Therefore, all four providers represent relevant case organisations for the purpose of this research. Third, a specific service contract was identified for each case based on the choice of a relevant service offering and specific customer

organisation. This step was completed via discussions with the provider based on theoretical relevance criteria, including operational complexity of the service offering (Kreye, 2019) and level of experience in the engineering service relationship (Panda et al., 2020). At this stage, potential parallel service contracts were excluded from analysis. For example, in Case A, the provider and customer had further service contracts (in parallel to the one analysed in this paper) for different product sites, which were managed and administered by different employee teams. We excluded these parallel contracts to enable comparability between the four cases. Furthermore, the use of practical criteria regarding the availability of and access to the customer for data collection helped us to prioritise relevant cases in collaboration with the providers, in alignment with the research design and theoretical framing. The identities of the case companies (providers and customers) were kept anonymous due to data sensitivity.

3.3. Data collection

The primary data source for this research was interviews. An interview protocol with semi-structured questions based on the conceptual framework was developed and tested (Yin, 2018) before engaging in the data collection process. All interviews were conducted by one researcher with one participant, were conducted in person, and took between 45 and 90 min. The questions followed the structure of the conceptual framework (Fig. 1) and focussed on concepts related to the three uncertainty types (Table 2). Follow-up questions reflected the nested nature of the service dyads, for example, discussing issues related to the two sub-units of analysis (organisation – provider and customer – and inter-personal relationships). The discussed topics related to the business strategy, service operations, and service relationship over the contract life cycle; contract negotiations; contract operations; and intentions (see interview guide in the Appendix). During the interviews, the researcher prevented bias by avoiding terms such as ‘uncertainty’ or ‘risk’ which are aligned with distinct theories (Kreye, 2019). Instead, the interviewees were asked to characterise specific topics, and the relation of the responses to our conceptualisation of uncertainty was established during data analysis. The semi-structured structure of the interviews enabled the researcher to follow up on specific topics and clarify responses to provide further depth.

Fifty-four semi-structured interviews were conducted (13 for Case A, 10 for Case B, 17 for Case C, and 14 for Case D). The interviewees were selected on the basis of their involvement in the service operations and engagement in the provider-customer relationship. The initial interviewees included service managers, service engineers, general managers, and heads of product lines, who then recommended further interviewees based on the discussions in the interviews (e.g., service engineers, administrators, procurement managers). This iterative process resulted in the collection of in-depth data for each case (Miles, Huberman, & Saldaña, 2014; Yin, 2018). All interviews were recorded and transcribed. The data collection was suspended when conceptual saturation was achieved, in other words, when no new insights emerged (Yin, 2018). The interviews were conducted in employees' offices, designated meeting rooms, or, in exceptional cases, via telephone or video conference.

To achieve further depth of study for each case, additional data sources were used, including meetings; field notes; and documentation from the organisations, such as service contracts, annual reports, presentations, marketing material, and announcements on webpages (Ketokivi & Choi, 2014; Yin, 2018). Multiple site visits to the companies' head offices and the service sites of the provider and customer increased the researcher's understanding of the cases (Miles et al., 2014) and enabled the researcher to triangulate insights and ensure internal validity (Gibbert et al., 2008).

3.4. Data analysis

Aligned with the theory-elaborating nature of this research, the analysis applied an abductive approach (Ketokivi & Choi, 2014; Miles et al., 2014). All data were carefully analysed in an iterative process through within-case and then cross-case analyses (Ketokivi & Choi, 2014). For the within-case analysis, an abductive approach was applied using systematic combining (Dubois & Gadde, 2002). Starting with the emergent insights from each individual case, we developed an initial understanding of the service dyads and their development over time across the different sub-units (individual organisation and inter-personal) and unit of analysis (dyad). Initial codes were created from the empirical data based on the researcher's understanding and interpretation of the data and were developed in combination with data collection (Miles et al., 2014). This initial coding relates specifically to the uncertainty experienced across the contract life cycle, including relative timing during contract operation (early or late). The theoretically derived concept definitions and operationalisations (Table 1) were then used to further refine the codes following a back-and-forth process between data and the literature (Gibbert et al., 2008; Miles et al., 2014). Relationship strength assessed in the respective service contracts and was coded as low, medium, or high based on theoretical criteria of service complexity regarding the operational interdependence between the partners (Kreye, 2019). Intentions for relationship continuation were similarly coded on a three-point scale (reduce, retain, increase) based on the partners' intentions for ending the engagement or reducing dependence on the provider (=reduce relationship strength), renewing or extending the service contract (=retain relationship strength), or adding to the service contract (=increase relationship strength). Table 3 presents the coding structure with examples from the case evidence.

The data were coded by one researcher following theoretical approaches to facilitate validity and reliability (Gibbert et al., 2008). To ensure validity, the framework provided by Gibbert et al. (2008) was followed. The researcher ensured that all data were triangulated across the multiple data sources, that interview transcripts and early draft versions of the case descriptions (especially based on the initial coding described above) were reviewed by key informants from the case companies, and that early draft versions of this paper were reviewed by peers. Furthermore, to ensure the reliability of the findings, the researcher utilised a case study protocol (Yin, 2018), in which the process of the individual case studies was recorded and a case study database was maintained to store all documents. This within-case analysis resulted in in-depth understanding of each individual case with regard to experienced uncertainty during the pre-contract and contract operation phases and relationship strength, including intentions for relationship continuation.

In the cross-case analysis, the findings from each case were compared to analyse the connections according to the conceptual framework (Fig. 1) and identify patterns across empirical settings (Miles et al., 2014). The codes from the within-case analysis were connected and compared in an iterative process, following an abductive approach across the units and sub-units of analysis. The researcher continuously referred to the empirical data and the literature, reflecting the theory-elaborating nature of this research (Ketokivi & Choi, 2014). In this process, the researcher ensured that the observed differences between the cases were attributed to the research focus via in-depth understanding of each individual case (Gibbert et al., 2008). The combination of within-case and cross-case analysis offered a comprehensive picture of the cases with regard to the research focus.

4. Findings

The results are described with respect to the four sub questions (Section 2.3) based on the within-case results and cross-case comparison (Table 4).

Table 3
Coding table with sample quotes.

Second + primary order codes	Sample quotes
Environmental uncertainty	
Competition in equipment sales	'The size has changed a lot. There has been a very dominant market on the part of suppliers.'
Competition in service provision	'We were aware that our competition was picking up all the service work.'
Business environment	'We are leading the market (and because of the cuts), we are looking for ROI (return on investment) in a deeper way.'
Relational uncertainty	
(Level of) Conflicts/tensions	'The biggest issue was to get the confidence of our guys in the field.'
Reduction	'The project manager was responsible for the on-site activities and I was coordinating things with him. He had either daily or weekly meetings with the client. And when things were piling up and they could not reach an agreement, then I came in. I think in the beginning I was there every second week discussing internal issues but also [customer-] related issues.'
Lack of reduction	'they will work to infinity to delay delivery, purposely sometimes it seems.'
Organisational uncertainty	
Business dependence	'It was part of the business strategy getting service work for [Customer].'
Process novelty	'We had to change the dynamics of how we work. [For example, we needed to] get more service vehicles in [to enable timely response].'
Lacking capabilities for effective service provision	'They [provider staff] are trying to help, but do not have the resources or deep knowledge that this role needs. They [the provider organisation] are lacking both technical and commercial understanding.'
Internal process flow	'We just have to request a job and send it off. And then it might take three or four week before [PB] get in touch with me.'
Internal organisation structure	'(Now), we have set up a much bigger organisation. (...) In the beginning, the distance between decision makers was quite big.'
Relationship strength	
High	'a framework containing the essential elements required to ensure the long-term safe, reliable and profitable operation of (the equipment). It offers solid risk management (...) measured against an agreed threshold.'
Medium	'preventative maintenance, a quality assurance programme, safety inspections, refine and updates, response guarantee, telephone support, spare parts, (...) virus protection, remote services, multiple annual site visits, guaranteed response time of six hours, (...) hiring of spare machinery, technical development courses, and application of new equipment of 1 day/ year.'
Low	'The [Customer] shall contact the [Provider] if it feels that Good or Services may be required.'
Intended relationship strength	
Reduce	'The [provider's] prices were unhealthy, so that was the reason that we have started for ourselves. We wanted more competition in the market.'
Retain	'The parties may agree at the end of the term to a further two-year extension, subject to written agreement and under the current terms.'
Increase	'[Now] we are running the two full lines.'

4.1. Case context

The relationships represented in the four cases were long-term collaborations. The Head of O&M Chemical in Case C summarised the long-term relationship as follows: *'it's like getting married in many respects. And therefore also the cost of the divorce is quite high (...) But like any marriage, you also have ups and downs.'* This response exemplifies the long-term intentions of engineering service relationships, with dynamic developments over time. At the same time, operations were affected by uncertainty, from environmental, relational and organisational sources

as described below.

4.2. Pre contract uncertainty driving relationship strength

All cases revealed evidence of environmental uncertainty in the pre-contract phase, which drove the creation of the service relationships. For example, in Case B, the environmental uncertainty related to competitor business was the driver for PB to engage in the service relationship. As PB's General Manager explained, *'At that time we were aware that our competition was picking up all the service work. [So the decision was made for our office] to look after all the service related business with [CB] directly.'* Despite the fact that PB was offering services, competitors has stronger positions on the market and were picking up the service business, decreasing PB's performance and competitiveness. In response to this environmental uncertainty, explored CB as a strategic customer with increased efforts to bind them as a long-term customer. Thus, environmental uncertainty created a driver to increase relationship strength in this case.

Similar evidence was found in Case C, in which emerging market opportunities enabled PC to engage in the service dyad. New investors without any operational experience became potential customers as the Head of O&M Chemical (PC) explained, *'[Now] you have some new people coming in and (...) they just want to get the asset built. (...) So the landscape has changed and the newcomer just says, 'I want some good equipment. And if you can run it as well, great.'"* These new market opportunities offered the chance to PC to expand their service business and engage in a long-term service based relationship with CC. Relationship strength was high in this case as the partners agreed a performance-based service, including *"a) ensuring a smooth, economic and efficient operation of the plant, b) attaining and optimising the production and energy consumption, (...) d) implementing industrial best practices for planning and execution of operation, preventative and predictive maintenance activities, (...) e) coordinating with [CC] sales and marketing departments for the purpose of aligning [PC's] production plans with [CC's] cement sales targets, f) translating [CC's] sales plans into production and quality targets of all operating departments, g) achieving agreed production targets [...]"* (Contract). This evidence thus suggests a causal connection between environmental uncertainty and relationship strength.

This connection, however, was affected as evidence in individual cases showed. More specifically, organisational uncertainty played a key role depending on the organisation that experienced it. For example, CB experienced strong organisational uncertainty due to their inexperience with service agreements and internal changes in decision making. The Team Leader (CB) explained: *'The budget was held by operations. (...) [Now] the budget sits with Engineering Liability. So now the decision is made from an engineering viewpoint.'* "This changed the priorities of contracting service work with very little willingness to invest in a costly and highly dependent contract. This evidence suggests that customer-experienced organisational uncertainty constrained the effect of environmental uncertainty and resulted in low relationship strength.

This contrasts findings from Case A where the provider experienced organisational uncertainty during the pre-contract phase. This organisational uncertainty was connected to a lack of internal knowledge sharing and involvement of all related resources during contract negotiation as the Site manager (PA) explained: *'We have service sales working out the contract with the customer. When it is signed it is usually too late. Building a facility and hiring people within half a year is too short of a time. (...) 'Service sales' is not sharing anything outside of their department. (...) To get knowledge [about the promises made during contract negotiation], you need to be a friend with someone, otherwise it is impossible. You need to have a close contact in the organisation.'* This shows the organisational uncertainty experienced by PA from lacking internal communications and sharing of expertise. As a result, *'... the contract ended up a bit special. The [usual] intention is to more or less just attach the appendix, but that is not the case here. You have to read the whole contract. There are several strange things.'* (Customer Manager, PA). In other words, the provider

Table 4
Summary of cross-case comparison.

Case	Uncertainty pre-contract	Relationship strength	Uncertainty contract operations			Intentions for relationship continuation
			Early contract operations	Development	Late contract operations	
A	Environmental uncertainty in terms of pressures from increased competition for product sales from low-cost countries for PA Organisational uncertainty for Provider A (PA) due to lack of understanding of service delivery capabilities by service sales staff	High, guaranteed availability	Relational uncertainty in dyad in terms of identifying and implementing patterns of collaboration based on contract Organisational uncertainty for PA due to inability to develop required capabilities to comply with the contract	Continued relational uncertainty in the form of disputes between PA and CA and frustration of CA. This evolved as a knock-on effect from PA's organisational uncertainty due to their continued lacking internal capabilities to deliver bespoke service	Environmental uncertainty in terms of the decreasing availability of external resources creates additional pressures for Customer A (CA) Relational uncertainty in dyad in terms of disputes and disagreements because of PA's inability to deliver contractually agreed service	Reduce; CA unhappy with provider's failure to fulfil contract terms; CA working on insourcing substantial parts of service in the future
B	Environmental uncertainty creating increasing pressures on equipment functioning due to increasing incidences of extreme weather Organisational uncertainty for Customer B (CB) due to lack of experience in evaluating competitive service bids	Low, framework for individual repairs	Relational uncertainty in dyad and between individual Provider B (PB) and Customer B (CB) employees due to lack of prior engagement between partners Organisational uncertainty for PB due to need to develop service delivery capabilities Organisational uncertainty for CB because of lack of capabilities to provide necessary service information	Reduced relational uncertainty as trust is built Reduced organisational uncertainty for PB as service capabilities are developed and implemented Reduced organisational uncertainty for CB as internal communication channels are improved	Organisational uncertainty for CB because of lack of capabilities to provide necessary service information	Increase; partners engaging in negotiations to further strengthen relationship, as PB able and willing to absorb further organisational uncertainty of CB
C	Environmental uncertainty due to increasing pressures from competition and new market opportunities Organisational uncertainty of Customer C (CC) in terms of internal disagreements over provider preferences	High, performance-based O&M	Environmental uncertainty in dyad during initial phase of contract operation to establish supply lines to the plant Relational uncertainty in dyad manifested between specific individuals (PC National Manager and PC Customer Service Manager) in interpreting and enforcing contract terms Organisational uncertainty for PC during ramp-up of contract operation to organise available resources for service delivery	Reduced relational uncertainty as joint procedures and communication patterns are developed Reduced organisational uncertainty for PC as service organisation is built and implemented	Low relational uncertainty for resolving operational issues in the dyad	High, contract renewal as customer happy with provided service
D	Environmental uncertainty for PD due to increasing customer requirements in terms of equipment availability Environmental uncertainty in dyad in terms of tendering and contract negotiation procedures	Medium, combination of maintenance and upgrade services	Low organisational and relational uncertainty due to long-standing relationship between PD and CD	Low organisational and relational uncertainty due to long-standing relationship between PD and CD	Low organisational and relational uncertainty due to long-standing relationship between PD and CD	High, repeated contract renewal with increase in relationship strength

experienced organisational uncertainty in Case A seemed to increase relationship strength.

4.3. Relationship strength driving uncertainty in early contract operation

As observed in all cases, entering the contractual relationship created organisational and relational uncertainty. Relationship strength seemed to specifically affect the level of organisational uncertainty. For example, relationship strength in Case B was low, and customer-experienced organisational uncertainty persisted. Here, CB needed to provide much of the input information for service delivery but lacked the internal capabilities for information processing. Electrician 1 (CB)

explained: “[Now] we have to request [PB] on a job and send it off. And then we do not know what happens. It might take three or four week before [PB] get in touch with me and say, ‘Oh, I just heard from your office.’ It’s such a long-winded process [within CB].” This suggests that the low relationship strength in Case B created customer-experienced organisational uncertainty in the early contrast stages. In contrast, cases with high relationship strength (Cases A and C) only demonstrated evidence of provider-experienced organisational uncertainty. For example, PC needed to start up their service operations, including the need to hire a full service organisation within a short period of time. The General Manager Sales O&M (PC) explained: “there was a risk of having the right people because we were new to the business and we did not have any structure

in place. But when we got to the contract, we found out that there was a big market already in the [country] and a lot of experienced people were already available.” PC’s experienced organisational uncertainty related to the need to set up the operations of high complexity due to the high relationship strength.

The cases also showed evidence of relational uncertainty during the early contract stage. This suggests that relationship strength did not directly affect the level of relational uncertainty experienced during early contract operation. Instead, the findings suggest a connection with the longer term joint experience with service delivery. Instead, there seems to be a connection between relationship strength and joint experience with service delivery. For example, in Case B high relational uncertainty was described because of lacking experience with each other. The Technical Manager (CB) explained: “*The biggest issue was to get the confidence of our guys in the field, our electricians and fitters. Having the confidence in a change of direction from [Competitor] to [PB] because obviously they built up relationships with engineers from the [Competitor] and so they had to start again. And some people don't like change.*” This suggests that relational uncertainty was caused through the lack of experience of working with each other in service-based activities. In contrast, Case D was based on a long-standing service-based relationship between PD and CD, with a corresponding low level of relational uncertainty.

4.4. Uncertainty during development of contract operations

The cases showed differences in terms of the uncertainty during the development of contract operations. In Case A, relational uncertainty remained high throughout contract operation and seemed to arise from the provider-experienced organisational uncertainty in early contract stages. Despite the strong relationship strength through the customised service contract, PA’s internal processes were set-up for standard service delivery only with lacking flexibility in their service capabilities. As a result, “*I do not believe that we deliver what the contract says. I do not know if it is above, besides or under, but we do not understand our own contract enough to deliver what the contract says.*” (Service sales manager, PA). This created relational uncertainty with regular disputes and disagreements between CA and PA. CA’s contract manager expressed their frustrations as follows: “*The sad lesson is that in some cases it does not even help to write something in the contract. For example, we should have the toolkit or we should have work instructions. Because they will work to infinity to delay delivery, purposely sometimes it seems. We put it in the contract because we need it. In negotiations [they said that] of course we can have it. But when it then goes into operations phase they find 35 reasons to why we cannot have it.*” The situation grew further acute when regulations changed and government subsidies for wind-based electricity were cut because CA increased their focus on operational performance even further. CA’s Procurement and Project manager explained: “*The prices for energy are declining. (...) There was more focus on cost of developing and maintaining turbines the last three years. There is a lot more focus on operations costs.*” In sum, the development of contract operations in Case A was characterised by continuously high provider-experienced organisational uncertainty and high relational uncertainty.

In contrast, the partners in Cases B, C, and D were able to resolve relational uncertainty. For example, PB’s diligence and reliability as a service provider reduced the level of relational uncertainty according to CB’s Team Leader: “*Every time I rung them, they responded. They had craft available, technicians available, they’ve come out of hours, they’ve given advice (...) So, certainly for me, how long I’ve been dealing with [PB], they provided me with the service that I wanted. You started getting a relationship with the people, the managers and their technicians down there.*” These actions showed PB’s commitment to the dyad and signalled their wish to build a long-term relationship (Ford, 1980; Villena, Choi, & Revilla, 2019). As these experiences accumulated, relational uncertainty reduced during the development of contract operations.

4.5. Uncertainty in late contract operations driving intended relationship strength

The ability to resolve uncertainty during the development of contract operations and hence the uncertainty the partners faced during late contract operations affected the intended relationship strength. Specifically, the ability to resolve relational uncertainty had a central role for intended relationship strength. For example, the low relational uncertainty in Case B drove the partners to explore the possibility of increasing relationship strength in follow-up contracts. Provider B’s (PB’s) Sales Manager explained, “*Now, we have proposed one step further to update their asset inventory for them. But obviously they will have to commit some cost. Because we would have to deploy an engineer in advance to go around each individual site and index and catalogue all the [pieces of equipment] and create what is called a preventative maintenance and asset database.*” In other words, the partners in Case B were discussing specific additional service activities to further increase relationship strength during future contract agreements.

In contrast, the high relational uncertainty in late contract operation in Case A motivated CA to reduce the relationship strength in follow-up contracts (if any). Customer A’s (CA’s) Managing Director explained, “*We have been servicing ourselves for 2.5 years. I think we have better control of our own technicians. I think they report errors and defects better than [PA]. (...) Small leaks or small defects are not reported to the customer.*” As a result, CA sought to reduce dependence on PA by insourcing some of the service activities to their internal service team.

5. Discussion

In our analysis, we sought to understand the dynamic development of uncertainty and relationship strength over the contract life cycle in inter-organisational relationships. Our goal was to understand the time-based dynamics across the development of inter-organisational relationships. While some fundamental assumptions of existing theories and models are supported by our empirical work, the provided insights offer a more detailed and nuanced view of the micro-dynamics of their time-based development. This section provides a discussion of the results and analysis and the contribution to theory and practice.

The presented study offers some confirmatory evidence for the positive connection between environmental uncertainty and relationship strength (e.g., Narayanan, Narasimhan, & Schoenherr, 2015; Williams, Roh, Tokar, & Swink, 2013; Wong, Boon-Itt, & Wong, 2011). However, based on the presented evidence, our findings suggest a moderating role of organisational uncertainty in the pre-contract phase on relationship strength. This connection had not been discussed in the literature, with organisational uncertainty being a relatively young concept. Our study suggests that the nature of this role of organisational uncertainty depends on the partner who experiences the uncertainty – supplier or customer. Our first proposition is therefore two-fold:

Proposition 1a. Customer-experienced organisational uncertainty in the pre-contract phase negatively moderates the positive link between environmental uncertainty and relationship strength.

Proposition 1b. Provider-experienced organisational uncertainty in the pre-contract phase positively moderates the positive link between environmental uncertainty and relationship strength.

Following contract signature, our findings indicate a connection between relationship strength and organisational uncertainty. While this confirms prior cross-sectional studies specifically in service provision (Kreye, 2018; Nullmeier et al., 2016), our findings provide an in-depth connection related to who experiences the organisational uncertainty – provider or customer. Based on the findings, the second proposition is as follows:

Proposition 2a. Relationship strength defined in the contract increases provider-experienced organisational uncertainty.

Proposition 2b. Relationship strength defined in the contract reduces customer-experienced organisational uncertainty.

In addition, contract operations were characterised by relational uncertainty confirming descriptions in the literature (Ford, 1980; Yan & Dooley, 2013). However, the case insights suggest that relational uncertainty is connected to the level of joint experience between the partners in the service dyad instead of relationship strength. More specifically, our study suggests that it is the nature of the operations within the relationship in terms of the similarity of prior activities to the contracted activities (e.g., service-based engagement before the service contract) that drives the experienced level of relational uncertainty. This provides more details to the typical descriptions in the literature. We therefore offer the following proposition:

Proposition 2c. Relational uncertainty experienced during contract operation is driven by the joint operation-specific experience of both partners in the long-term inter-organisational relationship and is not affected by the agreed relationship strength of the present contract.

Relational uncertainty played a core role over the development of contract operations, showing that it may increase based on the partners' actions and subsequently affect intended relationship strength. Here, the high level of provider-perceived organisational uncertainty in pre-contract negotiations, resulting in high relationship strength in the service contract seemed to create negative long-term effects via unresolved relational uncertainty during contract operations as shown in Case A. These insights add further explanatory value to existing models, which assume that relational uncertainty automatically decreases with repeated interactions (Ford, 1980; Yan & Dooley, 2013) due to increasing trust and commitment (Shi, Zhang, Arthanari, & Liu, 2016; Villena et al., 2019). Instead, our findings are more aligned with descriptions of the need for relationship management (Marshall, Ambrose, McIvor, & Lamming, 2015) and the potential for derailing relationships due to lack of trust and commitment (Johnston & Staughton, 2009; Kim & Henderson, 2015). Based on these insights, we formulate the following proposition:

Proposition 3. The provider's ability to reduce relational uncertainty during contract operations increases intended future relationship strength; conversely, the failure to reduce relational uncertainty during contract operations decreases intended future relationship strength.

6. Conclusions

This research has important implications for theory and practice, which we describe before detailing potential for future work.

6.1. Implications for theory

This research contributes to the literature on inter-organisational relationships (Crosno et al., 2021; Friend et al., 2020; Jia et al., 2020; Kreye, 2018) focussed specifically on long-term buyer-supplier service engagements (Kohtamäki et al., 2013; W. Zhang & Banerji, 2017). This research demonstrates the time-based effects of different uncertainty types and their respective interactions with relationship strength. This research therefore elaborates upon predominantly short-term analyses of existing research (Friend et al., 2020; Jia et al., 2020; Kreye, 2018). It extends existing longitudinal conceptualisations of inter-organisational relationships, such as Autry and Golovic's (2010) relationship spiral, by demonstrating the causal role of uncertainty in the cyclical increase and decrease in relationship strength. This study hence substantially enhances current understanding of the role of uncertainty in inter-organisational relationships, showing the effects on relationship strength and connections between uncertainty types across the development of the contract operation. While some of these dynamics, such as the trust and value co-creation (Friend et al., 2020; Gorovaia & Wind-sperger, 2018; Panda et al., 2020), have been described in the wider

inter-organisational relationship literature, the specific dynamics of uncertainty are a novel contribution to the literature. Based on our work, we can explain and capture experienced uncertainty as inter-organisational relationships unfold over time, aided by our distinction of the different phases of the contract life cycle which are operationalised through contract life-cycle stages.

This research also contributes to the contract management literature (Crosno et al., 2021) by embedding the temporary focussed explanations of the contractual engagement within the long-term relationship cycle. Contracts are the formal governance of inter-organisational relationships (e.g. Jia et al., 2020), with a rich body of literature in its own right. This research demonstrates the long-term effects of organisational actions within the collaboration, presenting a broader picture of the effects of contracting decisions. An example is the initially higher relationship strength, which, if not fulfilled by the provider due to high provider-experienced organisational uncertainty, can create negative long-term performance effects in terms of intentions for terminating the collaboration. This approach extends existing descriptions of contract management based on cross-sectional studies and theorisations (Alghababsheh & Galleary, 2020; Blessley et al., 2018; Shen et al., 2020). This research therefore has important theoretical implications for the contract management literature, demonstrating the long-term effects of decisions from prior contractual engagements.

Finally, this research contributes to the service management literature by demonstrating the long-term and dynamic effects of uncertainty on relationship strength. Services form the empirical focus of our work on inter-organisational relationships and the service management literature provides rich insights on a wide range of management issues related empirical focus. While existing studies on services have highlighted the importance of uncertainty and its effects on operational performance in this context (Kreye, 2017b; W. Zhang & Banerji, 2017), this study explores the dynamic effects within the dyad. The findings on provider-experienced organisational uncertainty and its connection to relationship strength expand descriptions in the servitization literature (Eloranta & Turunen, 2016; Kuijken et al., 2017), as this uncertainty type may reflect the provider's inexperience with service offerings. Similarly, findings of knock-on effects between uncertainty types (Kreye, 2018) are placed in the dynamic context with this study. Thus, this study elaborates upon existing theoretical understanding of services by demonstrating the time-based effects within the dyad in terms of increasing/decreasing (intended) relationship strength.

6.2. Implications for practice

A key management objective in many inter-organisational relationships, and specifically in services, is often to increase customer intimacy through high relationship strength (Sampson & Froehle, 2006; Vargo & Lusch, 2004). Our results suggest that, despite the initial 'positive' effect on relationship strength, provider-experienced organisational uncertainty can result in a long-term reduction in relationship strength, as customised promises and contractual agreements cannot be fulfilled, leading to customer dissatisfaction. This finding suggests that the pursuit of high relationship strength to 'close the deal' and establish a connection with a specific customer may ultimately be misguided. As an alternative, customer managers can more strategically use their organisational uncertainty to establish valuable service contracts with providers and thereby establish long-term relationships. As trust is built over time, relationship strength can be increased through tapping into customer-experienced organisational uncertainty and utilising the provider's experience to reduce or transfer uncertainty to the provider.

6.3. Limitations and future work

We based our insights on four in-depth nested cases, each of which is positioned in a specific context. We utilised our comprehensive empirical findings to develop theoretically generalisable insights and

illuminate the underlying micro-dynamics in inter-organisational relationships. We acknowledge that some of the provided insights may not be as explicitly generalisable as described above. Quantitative follow-up studies are an important avenue for future research. Our empirical focus was specifically on engineering-service dyads as an example of inter-organisational relationships. While this focus provided a homogenous basis for this research, it also limits the generalisability of the empirical insights to other types of inter-organisational relationships. However, the theoretical rooting within relevant theories on inter-organisational relationships more generally enabled us to identify connection points and provide insights on the generalisability of our insights. We argue that the service relationships in manufacturing companies (engineering service relationships) share important similarities with other professional services (Lewis & Brown, 2012) and other long-term inter-organisational relationships, including supply partnerships, research and development partnerships, and new-product-development partnerships (Kohtamäki et al., 2013; M.E. Kreye & Perunovic, 2020).

Although we assessed performance qualitatively in our cases, we were not able to give decisive evidence regarding the role of performance in the uncertainty-driven relationship spiral. This is a limitation of our research. Autry and Golicic (2010) found that performance affects relationship strength and Yan and Dooley (2013) show that performance and uncertainty are intrinsically linked. While the presented research shows that this may be related to the specific uncertainty type, future research needs to further extend these insights by using a more direct approach on assessing and quantifying different performance indicators in relation to uncertainty. Furthermore, our case sample consisted of medium to large organisations that were established on the market as service providers. Further research could focus on Small and Medium-sized Enterprises (SMEs) as a sample to provide even more evidence of uncertainty due to their high dependence on service relationships. SMEs are generally an under-researched sample for engineering services and including these types of companies would greatly enhance academic as well as practical understanding. Finally, one emergent finding in our empirical study was the effect of sector regulations on reducing uncertainty for organisations. However, as this was not the original focus of this work, provided insights lack predictive power. Future research needs to investigate this link in more detail to refine or alter the presented observations.

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