

Essays on the Management of Servitization

Inaugural-Dissertation

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Heiner Lütjen, Master of Science
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Dekan: Prof. Dr. Till Requate

Erstbegutachtung: Prof. Dr. Carsten Schultz

Zweitbegutachtung: Prof. Dr. Stefan Hoffmann

Drittbegutachtung: Prof. Dr. Christina Raasch

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Vorwort

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Kiel im Juli 2018

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Abkürzungsverzeichnis

| | |
|-------|----------------------------|
| AVE | Average Variance Extracted |
| B2B | Business to Business |
| B2C | Business to Customer |
| CEO | Chief Executive Officer |
| EnWG | Energiewirtschaftsgesetz |
| F | Forschungsfrage |
| H | Hypothese |
| IT | Informationstechnologie |
| TMT | Top-Management-Team |
| OLS | Ordinary Least Squares |
| PLS | Partial Least Squares |
| PSS | Produkt-Service-System |
| R^2 | Erklärte Varianz |
| r | Korrelationskoeffizient |
| VIF | Variance Inflation Factor |

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Abstract

Das klassische Kerngeschäft vieler produzierender Unternehmen verändert sich zu Gunsten der Entwicklung digitaler und branchenübergreifender Produkt-Service-Systeme (PSS). Neben vielfältigen Chancen führt die Entwicklung von PSS zu Veränderungen auf mehreren Ebenen innerhalb des Unternehmens. Diese betreffen sowohl interne Organisationsstrukturen und damit die Anpassung etablierter Geschäftsmodelle und Unternehmensstrategien, als auch externe Faktoren, wie beispielsweise die gemeinsame Entwicklung von PSS mit externen Partnern in sogenannten Business Ökosystemen. Obwohl dieser als Servitization bezeichnete transformative Prozess der Wertschöpfung hin zu einer verstärkten Dienstleistungsorientierung auch in der betriebswirtschaftlichen Managementforschung zunehmend an Bedeutung gewinnt, ist der wissenschaftliche Diskurs über den Servitization-Prozess und dessen zugrundeliegenden Barrieren noch stark fragmentiert.

Die vorliegende Dissertation beschreibt einen wissenschaftlich fundierten Weg zur Identifikation relevanter Barrieren, den daraus resultierenden Konsequenzen und notwendigen Fähigkeiten für das Management des Servitization-Prozesses. Die Arbeit setzt sich aus fünf Artikeln zusammen, die die zentrale Relevanz der systematischen Gestaltung des Servitization-Prozesses zeigen. (1) Im Rahmen der Servitization durchlaufen Unternehmen in der Regel einen dreistufigen Prozess (*service initiation, service anchoring und service extension*), der abhängig vom Umsetzungsgrad der Servitization spezifische Barrieren (*strategie-, implementierungs-, markt- und ökosystembezogene*) hervorruft. (2) Die Erfahrungen des Top-Management-Teams haben einen signifikanten Einfluss auf den Umsetzungsgrad der Servitization. Insbesondere führt die Rekrutierung externer Führungskräfte zu einem positiven Effekt auf die Entwicklung innovativer Dienstleistungen. (3) Der Umsetzungsgrad der Servitization spielt eine wichtige Rolle bei der Nutzung und Wirksamkeit von IT-Instrumenten. Dabei profitieren insbesondere stark serviceorientierte Unternehmen von IT-unterstützten Innovationsprozessen. Aufgrund der steigenden Komplexität bei der Dienstleistungsentwicklung weisen jedoch gerade diese Unternehmen große Probleme bei der Adoption relevanter IT Instrumente auf. (4) Für eine erfolgreiche Servitization muss eine Vielzahl an zu integrierenden Komponenten und benötigten Kompetenzen in einem Netzwerk aus privatwirtschaftlichen und öffentlichen Institutionen gebündelt werden. Erst die auf diese Weise entstehenden „Business Ökosysteme“ ermöglichen den Aufbau von gemeinsamen Kompetenzen, breite Akzeptanz und letztlich die geforderte branchenübergreifende Innovationskraft. Basierend auf diesen Ergebnissen liefert die vorliegende Arbeit für Forschung und Managementpraxis neue Erkenntnisse darüber, wie die Servitization in produktorientierten Unternehmen erfolgreich umgesetzt werden kann.

1. Einleitung

1.1 Problemstellung und Hintergrund

Während sich die betriebswirtschaftliche Innovationsforschung in den letzten Jahren zumeist auf die Entwicklung und Einführung neuer Produkte konzentrierte, spielen gegenwärtig vermehrt auch Produkt-Service-Systeme (PSS) eine bedeutende Rolle (Baines, Lightfoot, Evans, Neely, Greenough, Peppard et al., 2007; Kuijken, Gemser, & Wijnberg, 2016; Tukker & Tischner, 2006). PSS können als hybride Leistungsbündel verstanden werden, die klassische Produkte eines Unternehmens mit zusätzlichen Dienstleistungen erweitern und damit Gegenstand einer interaktiven Wertschöpfung werden (Parida, Sjödin, Wincent, & Kohtamäki, 2014; Tukker, 2004). Sie können stark produktorientiert (z. B. Wartung und Installation), nutzungsorientiert (z. B. Leasing) oder ergebnisorientiert (z. B. Pay per Unit) sein, wobei die Dienstleistung sogar das klassische Produkt ablösen kann (Greenstein, 2010; Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2016).

Dieser als Servitization bezeichnete transformative Prozess der Wertschaffung hin zu einer verstärkten Dienstleistungsorientierung ist mit vielfältigen Barrieren behaftet, die ein Management von Servitization-Prozessen notwendig machen (Baines, Ziaee Bigdeli, Bustinza, Shi, Baldwin, & Ridgway, 2017; Kowalkowski, Gebauer, & Oliva, 2017; Luoto, Brax, & Kohtamäki, 2017). Empirische Studien zeigen, dass Verbesserungen der Unternehmenserträge durch neue PSS oft nur begrenzt sind (Fang, Palmatier, & Steenkamp, 2008; Gebauer, Fleisch, & Friedli, 2005; Valtakoski, 2017; Visnjic Kastalli & Van Looy, 2013). Beispielweise ist der Entwicklungsprozess von PSS im Gegensatz zu klassischen Produkten häufig dynamischer, unvorhersehbarer und weniger standardisiert (Den Hertog, Van der Aa, & De Jong, 2010; Gallouj & Weinstein, 1997; Nijssen, Hillebrand, Vermeulen, & Kemp, 2006). Merkmale und gleichzeitig Hemmnisse innovativer PSS sind die Integration verschiedener Akteure in den Innovationsprozess und die damit einhergehenden erheblichen Veränderungen der bestehenden Wertschöpfungssysteme. Insbesondere erfordern PSS die Integration des externen Faktors Kunde (co-creation of value) und die Erzeugung und Einbettung von Werten in den Anwendungskontext (value in use) (Vargo & Lusch, 2008).

Die Energieversorgung als historisch gewachsene Branche steht exemplarisch für eine produktorientierte Industrie, die aufgrund wachsender Kundenanforderungen und sinkender Margen im klassischen Vertrieb von Gas- und Stromprodukten vor der Herausforderung steht, sich zu einer dienstleistungsorientierten Branche zu wandeln. PSS bieten Energieversorgern die Möglichkeit, ihre klassischen Produkte mit Dienstleistungen zu verknüpfen und ihre häufig nicht vom Wettbewerb zu differenzierenden Energieprodukte (commodities) durch wertstiftende

Dienstleistungen zu bereichern. Das Spektrum reicht gegenwärtig von einfachen Beratungsangeboten zur Energieeinsparung bis hin zu umfangreichen Smart Home und Elektromobilitätsdienstleistungen. Darüber hinaus bieten erste Energieversorger auch energieferne Dienstleistungen an, die mit dem eigentlichen Kerngeschäft nur bedingt in Verbindung stehen, wie z.B. Aktivitäten in den Bereichen Telekommunikation, Datenfernübertragung oder Ambient Assisted Living.

Neben vielfältigen Chancen bringt der Wandel jedoch auch zahlreiche Herausforderungen für Energieversorger mit sich. Beispielsweise kann das Angebot von Energieeffizienzdienstleistungen für Energieversorger eine „Kannibalisierung“ eigener Umsätze bewirken, da sie zu mehr Effizienz und weniger Verbrauch führen, und somit zumeist klassische Produkte der Stromlieferung substituieren. Der Wandel zu einem dienstleistungsorientierten Unternehmen geht ebenso mit erheblichen Veränderungen der Unternehmenskultur und Ressourcenbasis einher. „Wir können nicht innovativ sein, weil wir nicht die richtigen Mitarbeiter dafür haben.“ „Wir sind schon auf einem guten Weg, wir brauchen aktuell keine weiteren Innovationen.“ „Die Kapazitäten sind ausgeschöpft. Meine Mitarbeiter können neben dem Tagesgeschäft nicht noch mehr Zeit investieren.“ Jene Aussagen von leitenden Mitarbeitern deutscher und österreichischer Energieversorger, die im Rahmen des europaweiten Benchmarkings innovate! new der Christian-Albrechts-Universität zu Kiel und der Plattform für Innovationsmanagement geäußert wurden, zeigen, dass insbesondere auch kulturelle Barrieren zu überwinden sind.

Besondere Barrieren existieren darüber hinaus, wenn Unternehmen nicht nur neuartige Technologien und Dienstleistungen einsetzen, sondern wie im Fall vieler digitaler Dienstleistungen in neue Märkte vordringen und die dafür erforderlichen Wertschöpfungssysteme entwickeln müssen. Dabei sind in die Entwicklung und Entscheidung über die Nutzung von Dienstleistungen unterschiedliche Akteure mit divergierenden Interessen in einem dynamischen Regulierungsumfeld einzubinden (Adner, 2017; Bergek, Hekkert, Jacobsson, Markard, Sandén, & Truffer, 2015). Der Fokus des sich wandelnden Unternehmens muss daher auch durch die Perspektive des Innovationssystems und dessen dynamischer Interaktionen bei Lernprozessen ergänzt werden. Vor diesem Hintergrund bleibt festzuhalten, dass das Management des Servitization-Prozesses zur erfolgskritischen Eigenschaft von produktorientierten Unternehmen wird.

1.2 Zielsetzung und Forschungsfragen

Die in dieser Dissertation enthaltenen Artikel vereint das Ziel, neben der Beantwortung der inhaltlichen Forschungsfragen, auch konzeptionell-theoretisch und methodisch einen Beitrag zur empirischen Forschung zu liefern. Der theoretische Beitrag dieser Arbeit ergibt sich aus der

mangelnden theoretischen Verankerung der empirischen Beiträge in der noch jungen Servitization-Forschung (Valtakoski, 2017). Bisherige Servitization-Studien verwenden zwar marktorientierte (Cusumano, Kahl, & Suarez, 2015; Vandermerwe & Rada, 1988), ressourcenbasierte (Ulaga & Reinartz, 2011), evolutionstheoretische (Finne et al., 2013) und beziehungsorientierte (Mathieu, 2001) Perspektiven, haben jedoch bisher nur wenig zum Aufbau neuer Theorie beigetragen. Insbesondere liegen bisher keine Führungstheorien über den Einfluss von Top-Management-Teams (TMT) im Rahmen des Servitization-Prozesses vor. Dies ist überraschend, da die Organisations- und Strategieforschung weithin zu dem Ergebnis kommt, dass TMTs eine zentrale Rolle bei der Formulierung und Umsetzung von Strategien spielen und daher häufig als Motor organisatorischer Transformationen angesehen werden (Bromiley & Rau, 2016; Certo, Lester, Dalton, & Dalton, 2006). Die in dieser Arbeit verwendeten Perspektiven und Theorien erweitern die bestehenden Ansätze der Servitization-Forschung.

Die konzeptionellen Beiträge dieser Arbeit rühren aus dem bisher begrenzten Verständnis von Barrieren und deren Wirkung auf die Umsetzung der Servitization (Baines et al., 2017; Kowalkowski et al., 2017). Zwar hat die Servitization-Forschung eine große Zahl von potentiellen Barrieren identifiziert, die Auswahl ist jedoch häufig nicht nachvollziehbar, fragmentiert und unterliegt häufig keiner systematischen Ableitung. Ferner wurden in der empirischen Forschung einige Ansätze zur Konzeptualisierung des Servitization-Prozesses entwickelt, jedoch haben diese zum Teil zu widersprüchlichen empirischen Befunden geführt (Finne, Brax, & Holmström, 2013; Finne, Brax, & Tanskanen, 2015; Kowalkowski, Windahl, Kindström, & Gebauer, 2015). Einige Studien weisen sogar auf negative Erfolgswirkungen der Servitization („Service Paradox“) (Gebauer et al., 2005) oder eine De-Servitization hin, die einen Wandel des PSS-Anbieters zurück in Richtung einer produktorientierten Unternehmung beschreibt (Finne et al., 2013). Insgesamt sollte festgehalten werden, dass bisher keine umfassenden Konzeptualisierungen zur Beschreibung der Phasen und den zugrundeliegenden Barrieren der Servitization in der empirischen Forschung vorliegen. Vor diesem Hintergrund soll mit der ersten Forschungsfrage Klarheit über den Ablauf des Servitization-Prozesses und der relevanten Barrieren geschaffen werden.

F1: Wie sieht ein typischer Servitization-Prozess aus und was sind die relevanten Barrieren, die der erfolgreichen Servitization entgegenwirken?

Wie empirische Studien zeigen, führt der strategische Erneuerungsprozess hin zu einem Dienstleistungsanbieter zu Veränderungen auf mehreren Ebenen innerhalb des Unternehmens, die eine Entwicklung neuer organisatorischer Fähigkeiten erfordert (Kowalkowski et al., 2017; Baines et al., 2017). Diese betreffen zum einen interne Organisationsstrukturen und damit die

Anpassung etablierter Geschäftsmodelle und Unternehmensstrategien, zum anderen aber auch externe Faktoren, wie beispielsweise die gemeinsame Entwicklung von PSS mit externen Partnern in sogenannten Business Ökosystemen (Adner, 2017; Adner & Kapoor, 2010; Weiller and Neely, 2013). In der Konsequenz sind häufig substantielle Veränderungen etablierter Geschäftsmodelle und Unternehmensstrukturen sowie neue Formen der Kundenintegration notwendig (Schuh, Fabry, & Jussen, 2014). Trotz zunehmender Anstrengungen von produktorientierten Unternehmen neue Dienstleistungen zu entwickeln, ist heute weitgehend unklar wie beispielsweise Energieversorger als relativ konservative Akteure in regulierten Märkten zu tragfähigen serviceorientierten Geschäftsmodellen befähigt werden können (Helms, 2016). Vor diesem Hintergrund sollen in der zweiten Forschungsfrage auch notwendige Fähigkeiten für Unternehmen in den einzelnen Phasen der Servitization abgeleitet werden.

F2: Welche Fähigkeiten benötigen produktorientierte Unternehmen in den spezifischen Phasen der Servitization, um diese erfolgreich umzusetzen?

Der methodische Schwerpunkt der Arbeit ist der Bestimmung eines Maßes für den Umsetzungsgrad der Servitization gewidmet, welches innerhalb der einzelnen Artikel entwickelt wird. Die Motivation geht aus der Tatsache hervor, dass in der empirischen Dienstleistungsforschung bisher wenige überzeugende Messansätze für die Umsetzung und den Erfolg der Servitization existieren (Benedettini, Swink, & Neely, 2017; Kohtamaki, Partanen, Parida, & Wincent, 2013). Der Großteil der vorhandenen empirischen Studien greift zur Bestimmung des Dienstleistungsanteils auf Datenbanken wie Worldscope oder Compustat zurück (Fang et al., 2008), die häufig auf der Standard Industrial Classification (SIC) basieren. Andere Studien verwenden dichotome Servicemerkmale (Homburg, Fassnacht, & Guenther, 2003) oder unterschiedliche Dienstleistungsangebote (Kohtamaki et al., 2013; Windahl & Lakemond, 2010) als Maß für den Umsetzungsgrad der Servitization. Damit einher geht jedoch die Problematik des uneinheitlichen Ausweises der Dienstleistungsaktivitäten von Unternehmen sowie der häufig fehlerhaften Zuordnung von finanziellen Kennzahlen (Kessler, 2011). Als Ursache ist insbesondere die zunehmende Verschmelzung von produkt- und serviceorientierten Geschäftsmodellen im Rahmen der PSS-Entwicklung zu nennen (Lusch & Vargo, 2014). Ebenso existiert in vielen Unternehmen bisher kein umfassendes Controlling der Dienstleistungsaktivitäten, da diese noch einen geringen Anteil am Unternehmensumsatz ausmachen. Vor diesem Hintergrund gestaltet sich auch die Ermittlung des konkreten Dienstleistungserfolges häufig schwierig. Im Rahmen dieser Studie soll daher ein Ansatz zur Überwindung der dargelegten Problematik entwickelt werden und somit ein alternatives Surrogat für den Umsetzungsgrad der Servitization bestimmt werden.

F3: Wie können bestehende Ansätze zur Messung des Umsetzungsgrades der Servitization erweitert werden?

Die Beantwortung der drei Forschungsfragen erfolgt theorie- und empiriegeleitet. Aus den methodischen und inhaltlichen Zielsetzungen leitet sich der konzeptionelle Bezugsrahmen der Arbeit ab, der im folgenden Abschnitt beschrieben wird.

2. Theoriebasis und konzeptioneller Bezugsrahmen der Arbeit

Auf Basis des konzeptionellen Bezugsrahmens wurden fünf Artikel angefertigt, die inhaltlich aufeinander aufbauen und in den folgenden Abschnitten detailliert beschrieben werden. Alle Artikel vereint das Ziel der Identifikation relevanter Servitization-Barrieren und der damit einhergehenden Bestimmung notwendiger Fähigkeiten für das Management des Servitization-Prozesses. Die Ergebnisse von Artikel I (Lütjen et al., 2017) bilden dabei die Grundlage der weiteren Artikel und den inhaltlichen Bezugsrahmen der Arbeit (Abbildung 1).

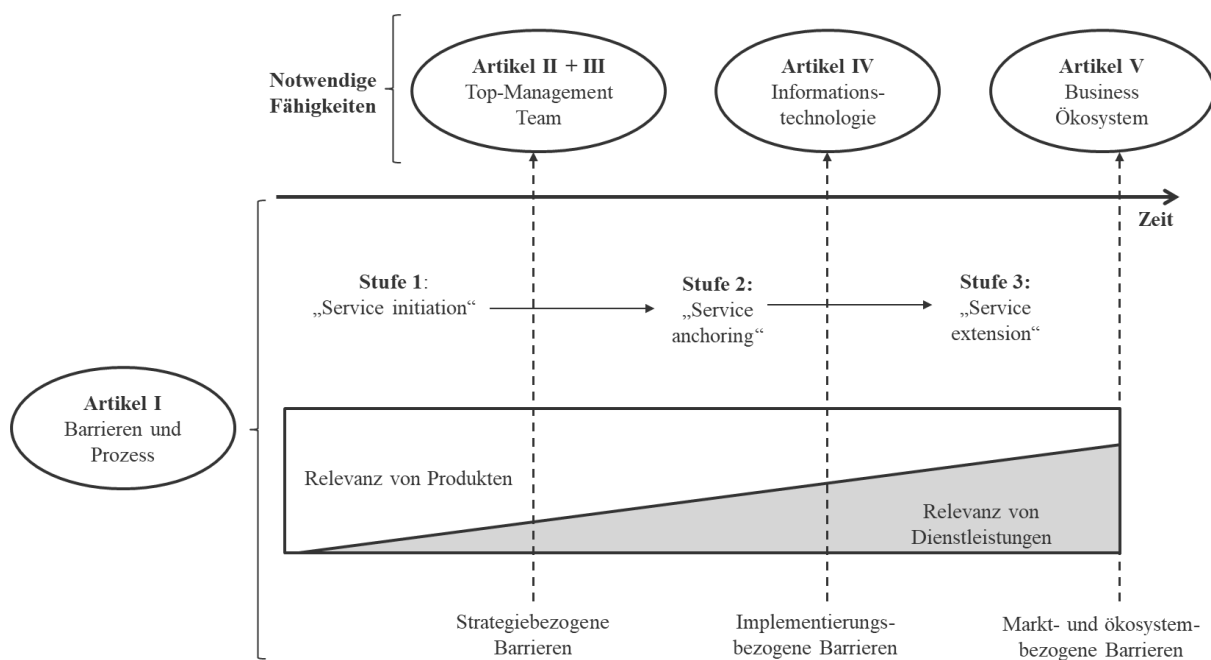


Abbildung 1: Bezugsrahmen der Dissertation

Die Theorie der zugrundeliegenden Arbeit basiert auf dem Konzept der strategischen Erneuerung (Volberda et al., 2001). Aufgrund der vielfältigen Einflussfaktoren der Servitization, werden im Rahmen der Artikel unterschiedliche Perspektiven zur Ausdifferenzierung der theoretischen Basis verwendet, um den bisher wenig untersuchten Servitization-Prozess zu analysieren. Artikel I (Lütjen et al., 2017) fußt auf einer innovations- und ressourcenbasierten Perspektive (Barney, 1991), um zunächst in einem explorativen Forschungsdesign relevante Barrieren und

den Prozess der Servitization zu identifizieren. Auf Basis einer aus der Literatur abgeleiteten Typologie werden die PSS-Angebote, deren Innovativität und das Ausmaß der investierten internen und externen Ressourcen von Energieversorgern analysiert. Dabei konnten drei aufeinanderfolgende Stufen der Servitization (*service initiation*, *service anchoring* und *service extension*) ermittelt werden, bei denen der Dienstleistungsanteil der Unternehmen kontinuierlich ansteigt. Darüber hinaus konnten vorherrschende Barriere-Typen in den entsprechenden Stufen identifiziert werden. Während in der *service initiation* Stufe insbesondere strategiebezogene Barrieren überwunden werden müssen, treten in der *service anchoring* Stufe insbesondere implementierungsbezogene Barrieren und in der *service extension* vor allem markt- und ökosystembezogene Barrieren auf. Die nachfolgenden Artikel greifen die drei spezifischen Barriere-Typen der Servitization auf und analysieren diese an konkreten Beispielen.

Der Fokus von Artikel II und III liegt auf der detaillierten Analyse strategiebezogener Barrieren. Als konkretes Beispiel zur Analyse von strategiebezogenen Barrieren dient die Untersuchung von TMT-Eigenschaften. Auf Basis der Upper-Echelons-Perspektive beschreibt der Artikel detailliert die Auswirkungen der Rekrutierung externer Unternehmensleiter und des vergangenen Unternehmenserfolgs auf die digitale Servitization. Artikel III erweitert den Kontext der Servitization, indem nicht nur digitale, sondern alle relevanten PSS von produzierenden Unternehmen untersucht werden. Darüber hinaus werden auch weitere Erfahrungen des TMTs in die Analyse einbezogen. Im Detail wird der Einfluss der Länge der Amtszeit sowie der branchenübergreifenden Erfahrung von TMTs auf den Umsetzungsgrad der Servitization untersucht.

Artikel IV beschreibt implementierungsbezogene Barrieren am Beispiel des Wirkungszusammenhanges von Informationstechnologie und Servitization. Auf Basis einer organisationalen Informationsverarbeitungsperspektive (Galbraith, 1974; Tushman & Nadler, 1978) befasst sich der Artikel mit der Fragestellung, wie der Umsetzungsgrad der Servitization die Adoption von Informationstechnologie beeinflusst und darüber hinaus die Beziehung zwischen Marktverständnis und Unternehmenserfolg moderiert. Artikel V legt den Fokus auf die Überwindung von markt- und ökosystembezogenen Barrieren. Anhand des Dynamic Capability Ansatzes (Teece, 2007) untersucht der Artikel welche ökosystembezogenen Fähigkeiten von Unternehmen für einen erfolgreichen Servitization-Prozess erworben werden sollten. Tabelle 1 fasst die Titel, den Veröffentlichungsstatus und die Ko-Autorenschaft der fünf relevanten Artikel zusammen.

| Artikel | Titel | Veröffentlichungsstatus | Autoren |
|--------------------|--|---|---|
| Artikel I | Service transitions of product-centric firms: An explorative study of service transition stages and barriers in Germany's energy market. | Veröffentlicht in: International Journal of Production Economics, Vol 192, 106-119, Impact factor: 3.493, VHBQ3: B-Ranking | Lütjen, H.; Tietze, F.; Schultz, C.; |
| Artikel II | Digitale Servitization – Die Rolle der Herkunft der Unternehmensleitung und des vergangenen Unternehmenserfolges | Veröffentlicht in: Keuper et al. (Hrsg.) (2018). Disruption und Transformation Management – Digital Leadership – Digitales Mindset – Digitale Strategie | Lütjen, H. |
| Artikel III | Top Management Team Impact on Servitization: Does the TMT Experience Make a Difference? | Unter Begutachtung: Academy of Management Conference | Lütjen, H., Schultz, C. |
| Artikel IV | Use and Efficacy of Information Technology in Innovation processes: The Specific role of Servitization | Unter Begutachtung: Journal of Product Innovation Management, resubmitted after major revision | Kroh, J.; Lütjen, H.; Schultz, C.; Globocnik, D. |
| Artikel V | Managing networks and ecosystems for servitization: A dynamic capability approach | Unter Begutachtung: Journal of Business Research | Lütjen, H.; Schultz, C.; Urmetzer, F.; Tietze, F. |

Tabelle 1: Übersicht über die im Rahmen der Dissertation entstandenen Artikel

3. Methodik

Aus den aufgestellten Forschungsfragen und dem konzeptionellen Rahmen der Arbeit leitet sich das Forschungsdesign der Arbeit ab. Ein Mixed-Methods Forschungsdesign erweist sich dabei im spezifischen Kontext der Untersuchung des Servitization-Prozesses und der Barrieren als vorteilhaft. Wie eingangs beschrieben ist insbesondere darauf zu verweisen, dass die Servitization-Forschung zwar eine große Zahl von potentiellen Barrieren im Rahmen der Servitization identifiziert hat, umfassende konzeptionelle Arbeiten jedoch bisher nicht vorliegen. Wie häufig in der empirischen Forschung, werden im Rahmen dieser Arbeit daher explorativ-induktive und explikativ-deduktive Methoden der Erkenntnisgewinnung kombiniert. Zur Identifikation der Barrieren und des Prozesses wurden zunächst qualitative Daten erhoben, die als Basis für die quantitative Untersuchung verwendet werden (Teddlie & Tashakkori, 2006). Während Artikel I (Lütjen et al., 2017) und Artikel V auf einem explorativen Forschungsdesign beruhen, haben Artikel II, III und IV das Ziel theoriebasiert Annahmen zu formulieren und die aufgestellten Hypothesen empirisch zu überprüfen. Im folgenden Kapitel wird die bisher wenig im

Servitization-Kontext analysierte Energieversorgung als exemplarisches Fallbeispiel untersucht und die erhobenen Primär- und Sekundärdaten sowie die Datenanalyse zusammenfassend erläutert.

3.1 Die Energieversorgung als Fallbeispiel

Als Untersuchungsbasis wird die deutsche Energieversorgung gewählt, die sich aus drei Gründen als passendes Untersuchungsgebiet für die Forschungsfragen dieser Arbeit eignet. (1) Die Energieversorgung steht exemplarisch für eine Branche, die in den letzten Jahren kontinuierlichen Anpassungen und Transformationen ausgesetzt war. Historisch bedingt war der Energiemarkt in Deutschland Jahrzehnte von regionalen, staatlich kontrollierten Monopolen geprägt. Durch die Richtlinie der Europäischen Union Ende der 90er Jahre zur Liberalisierung der Energiewirtschaft wurde ein Paradigmenwechsel eingeleitet, wodurch Energieversorger massiven Umfeldveränderungen ausgesetzt wurden. Zusätzlich folgten in jüngerer Zeit klimapolitische Entscheidungen und der Beschluss zur Energiewende. In der Konsequenz agieren Energieversorger zunehmend in einem Spannungsfeld sozialer, wirtschaftlicher, rechtlicher und technischer Einflussfaktoren, womit in der Konsequenz hohe Unterschiede bei der Umsetzung innovativer Dienstleistungen zu erwarten sind (Kehrel & Sick, 2014).

(2) Die Entwicklung innovativer Energiedienstleistungen ist durch eine hohe Komplexität gekennzeichnet. Stadtwerke und Energieversorger sehen sich wegen ihrer besonderen regulatorischen Voraussetzungen und ihrer oft kommunalen Trägerschaft im Vergleich zu Unternehmen anderer Branchen mit zusätzlichen Innovationsherausforderungen konfrontiert. Neben der gesetzlich verordneten Entflechtung von Erzeugung, Netzbetrieb und Vertrieb wurden Netzbetreiber dazu verpflichtet, den Zugang zur ihren Strom- und Gasnetzen für Wettbewerber zu öffnen. Durch die im Zuge der Erweiterung des Energiewirtschaftsgesetzes (EnWG) im Jahr 2005 gegründete Bundesnetzagentur wurden die regulatorischen Anforderungen für den Energiemarkt deutlich verschärft. Unterschiedlichste Herausforderungen entlang der Wertschöpfungskette führen dazu, dass nur wenige Energieversorger einen bisher nicht dagewesenen Kundennutzen mit ihren Dienstleistungen generieren (Helms, 2016; Schultz, Kroh, & Lügen, 2017).

(3) Der Relevanz von Dienstleistungsinnovationen in der Energieversorgungsbranche ist in der Literatur nur wenig Beachtung geschenkt worden. Empirische Studien im Rahmen der Servitization-Forschung legen den Fokus insbesondere auf produzierende und erfolgreiche Großunternehmen (z. B. Rolls Royce, Alstom, Xerox) (Kowalkowski et al., 2017). Trotz des dyna-

mischen Umfeldes in der Energiewirtschaft, sind umfassende empirische Studien aus Sicht einer Servitization-Perspektive bisher kaum existent. Die Untersuchung der stark fragmentierten Branche der Energieversorgung in Deutschland, liefert somit einen Beitrag für ein umfassenderes Verständnis der Servitization über die häufig erwähnten Erfolgsbeispiele hinaus.

Nach Angaben des Statistisches Bundesamt (2017) sind in Deutschland 1.459 Unternehmen in der Elektrizitätsversorgung tätig. Die Unternehmen innerhalb der Energiewirtschaft unterscheiden sich jedoch erheblich in ihrer Struktur. Zweckdienlich erscheint somit die Unterteilung der deutschen Energiewirtschaft in drei Gruppen von Unternehmen (Schumacher & Würfel, 2015). Zur Gruppe der Verbundunternehmen zählen die vier größten und zugleich umsatzstärksten Energiekonzerne E.ON SE, RWE AG, EnBW und Vattenfall Europe GmbH. Die zweite Gruppe umfasst etwa 65 Regionalversorger sowie die größeren Stadtwerke. Hierzu zählen u. a. die N-ERGIE AG und die Stadtwerke München. Der dritten Gruppe gehören etwa 1200 mittlere und kleine, meist kommunale Energieversorger, größtenteils in Form von Stadt- und Gemeindegewerken, sowie ca. 150 reine Stromhändler an. Im Rahmen dieser Arbeit wurden schwerpunktmäßig Regionalversorger und kommunale Energieversorger untersucht.

3.2 Datenerhebung

Die der Arbeit zugrundeliegenden Primär- und Sekundärdaten wurden im Zeitraum von Oktober 2014 bis Juli 2017 gesammelt. Artikel I verwendet als primäre Datenbasis teilstrukturierte Interviews sowie aktuelle Geschäftsberichte, Newsartikel und Firmendokumente als Sekundärdaten. Artikel II und III verwenden ausschließlich Sekundärdaten für die Messung des Umsetzungsgrades der Servitization, wie beispielsweise Geschäftsberichte, Newsartikel und Webseiten. Für die Identifizierung der TMT-Eigenschaften wurden zudem Lebensläufe des TMTs und weitere Firmendokumente genutzt. Artikel IV fußt auf einer europaweiten fragebogenbasierten Befragung von Unternehmen. Artikel V verwendet sowohl eine fragebogenbasierte Befragung, als auch teilstrukturierte Interviews und Sekundärdaten.

Interviewdaten

Für Artikel I wurden 28 Mitarbeiter von 19 Energieversorgern in semi-strukturierten Interviews zu Dienstleistungsangeboten, relevanten Barrieren und dem Servitization-Prozess befragt. Darüber hinaus wurden in Artikel V elf semi-strukturierte Interviews mit acht Energieversorgern durchgeführt. Fokus der Interviews waren ökosystemrelevante Treiber, Barrieren und notwendige Fähigkeiten für den Wandel von Energieversorgern.

Befragungsdaten

Neben teilstrukturierten Interviews wurde ebenso eine fragebogenbasierte Befragung im Rahmen eines europaweiten Benchmarking-Projektes (innovate! new) durchgeführt. Initiator dieses Projektes ist das Institut für Innovationsforschung der Christian-Albrechts-Universität Kiel unter der Leitung von Prof. Dr. Carsten Schultz, gemeinsam mit der Danish Technical University (DTU), der Alpen-Adria-Universität Klagenfurt sowie der gemeinnützigen Plattform für Innovationsmanagement. Teilnehmenden Energieversorgern wurde dabei die Möglichkeit gegeben, sich zum einen mit anderen Energieversorgern in ihrer Innovationsleistung zu messen, zum anderen wurde ihnen aber auch die Chance gegeben, durch den Vergleich mit den innovationsstärksten Unternehmen aus anderen Branchen dazuzulernen. Die Themen reichten dabei von der Förderung einer Innovationskultur, der Implementierung von Innovationsstrategien bis hin zu Erfolgsfaktoren von Kooperationen, Netzwerken, Dienstleistungen und Big-Data.

An der Befragung nahmen insgesamt 120 größtenteils mittelständische Unternehmen (u.a. Maschinenbauer, Software-Unternehmen oder Dienstleister) teil. Die Stichprobe beinhaltet 46 Energieversorger von denen 42 ihren Unternehmenssitz in Deutschland und vier in Österreich haben. An der Befragung nahmen im Durchschnitt knapp acht Mitarbeiter pro Energieversorger teil. Insgesamt nahmen 989 Personen an der Befragung teil, darin enthalten sind 346 Mitarbeiter von Energieversorgern. Dabei wurden an Innovationen beteiligte Mitarbeiter unterschiedlicher Hierarchiestufen und Funktionsbereiche einbezogen, um ein möglichst vielschichtiges Bild über die Innovationsfähigkeit und den Servitization-Prozess der Unternehmen zu erhalten. 93 Prozent der befragten Energieversorger befinden sich mehrheitlich in kommunalem Eigentum, 65 Prozent der Energieversorger sind vollständig in kommunaler Trägerschaft. Bezogen auf die Mitarbeiterzahl nahmen etwa gleich viele kleinere und mittlere Stadtwerke (56 Prozent) und große Energieversorger, teils Regionalversorger (44 Prozent), teil. Die Ergebnisse der fragebogenbasierten Befragung sind Bestandteile der Artikel IV und V.

Sekundärdaten

Neben Primärdaten wurden zahlreiche Sekundärdaten für die Datentriangulation erhoben. Dabei wurden im Detail aktuelle Geschäftsberichte, die Webseiten der Energieversorger, Unternehmensdatenbanken (Orbis, Hoppenstedt) und branchenspezifische Artikel in der kommunalen und überregionalen Presse analysiert. Insgesamt konnten von 203 untersuchten Energieversorgern über 2000 Dienstleistungsaktivitäten in den klassischen Wertschöpfungsbereichen Erzeugung, Verteilung und Vertrieb identifiziert werden. Die Erhebung der TMT-Eigenschaften

erfolgte ebenfalls auf Basis verschiedener Quellen. Insbesondere wurden dazu geeignete Informationsportale (Moneyhouse, Xing, LinkedIn) analysiert. Zur Ergänzung und Validierung der Daten wurden Geschäftsführer via E-Mail und Telefon angesprochen. Dabei wurden fehlende und falsche Werte ergänzt bzw. korrigiert.

3.3 Datenanalyse

Qualitative und quantitative Datenanalyse

Für Artikel I und V wurden die geführten Interviews aufgezeichnet, transkribiert und anhand der qualitativen Inhaltsanalyse ausgewertet (Mayring, 2010). Für die Analyse wurden dazu die Softwares MAXQDA und NVIVO verwendet. Die Auswertung von Sekundärdaten in Artikel II und III erfolgte anhand von OLS-Regressionen mit dem Programm SPSS 24. Für den Artikel IV wurden die Hypothesen mit einem PLS Strukturgleichungsmodell überprüft. Die Berechnung der Messmodelle erfolgte mit dem Softwarepaket SmartPLS 3. Für die Bewertung der Signifikanz der Ladungen und Pfade wurde das Bootstrapping Resampling-Verfahren angewendet (Efron & Tibshirani, 1993; Henseler, Hubona, & Ray, 2016). Ferner wurden Hauptkomponentenanalysen (Varimax-Rotation) durchgeführt (Hair, Black, Babin, & Anderson, 2009b) und der Intra-Klassen-Korrelationskoeffizient (ICC) berechnet (Shrout & Fleiss, 1979).

Bestimmung des Umsetzungsgrades der Servitization

Aufgrund der bisher unzureichenden Ansätze zur Bestimmung des Umsetzungsgrades der Servitization wurde ein neuer Messansatz auf Basis einer Innovationsperspektive entwickelt. Da bisher nur wenige Informationen und Erkenntnisse über die Gesamtheit der Dienstleistungsaktivitäten von Energieversorgern vorliegen, wurden zunächst die Ergebnisse aus Artikel I als Ausgangsbasis genutzt. Dabei wurden die ermittelten Dienstleistungen in drei übergeordnete Kategorien (Erzeugung, Verteilung und Vertrieb) eingestuft. Zur Validierung der Dienstleistungsaktivitäten wurden Interviews mit Innovations- und Dienstleistungsmanagern von Energieversorgern durchgeführt, um bisher nicht identifizierte Dienstleistungsaktivitäten zu ergänzen. Zur besseren Vergleichbarkeit der Unternehmen wurde die Analyse der spezifischen Dienstleistungen an bestimmte Kriterien geknüpft. Eine Dienstleistungsaktivität wurde in die Analyse einbezogen, wenn diese sich nachweislich in der Umsetzungsphase befand. Aktivitäten die lediglich „geplant“ waren, wurden nicht in die Analyse einbezogen. Zudem wurden nur Aktivitäten aus den Kernbereichen Elektrizität, Gas Wärme und Telekommunikation betrachtet. Nach der Bestimmung der relevanten Dienstleistungsaktivitäten wurde die Anzahl der

Dienstleistungsaktivitäten jedes Unternehmens anhand der Geschäftsberichte, Webseiten und Newsartikel analysiert.

Auf Basis der Unternehmensanalyse wurde eine Clusterung der gesammelten Daten durchgeführt, um gleiche Aktivitäten zusammenzufassen oder nicht für den Untersuchungsgegenstand relevante Aktivitäten zu eliminieren. Insgesamt konnten die Aktivitäten der Energieversorger zu 85 Dienstleistungsaktivitäten zusammengefasst werden. Neben der Anzahl der Dienstleistungsaktivitäten wurde auch der Innovationsgrad der Aktivitäten bewertet. Während frühere Bewertungen des Innovationsgrades häufig einzelne technische Dimensionen zur Beurteilung des Produktes/der Dienstleistung oder des neuen Verfahrens herangezogen haben (Talke, Salomo, Wieringa, & Lutz, 2009), weist die Mehrheit der jüngeren Messansätze eine mehrdimensionale Bewertung des Innovationsgrades auf.

Die von Schultz, Salomo, and Talke (2013) entwickelte Skala mit 12 Befragungssitems in vier Dimensionen wird in dieser Arbeit als Basis genutzt, um die unterschiedlichen Innovationsgrade differenziert zu betrachten. Zur Bewertung des Innovationsgrades der Dienstleistungsaktivitäten wurde jede der Aktivitäten in 3-4 Sätzen möglichst objektiv beschrieben. Diese Liste wurde als Grundlage für die Bewertung durch die Experten genutzt. Zur Gewährleistung der Interrater-Reliabilität wurden dabei zwei Experten unabhängig voneinander mit der Bewertung beauftragt. Die Experten wurden auf Basis von zwei Kriterien ausgewählt. 1. Der Experte hat langjährige Erfahrung in der Energiebranche, die eine Bewertung der Aktivitäten ermöglicht. 2. Die Experten sollten einen unterschiedlichen Erfahrungshintergrund aufweisen. Auf einer Skala von 1 (trifft überhaupt nicht zu) bis 7 (trifft vollkommen zu) wurden die Innovations- und Dienstleistungsaktivitäten bewertet. Auf Basis der Ergebnisse wurde ein Unternehmens-Score berechnet, der die abhängige Variable, den Umsetzungsgrad der Servitization, operationalisiert.

4. Zusammenfassung der Artikel

Tabelle 2 beschreibt die Forschungsmethoden, den Umfang der Erhebung, die theoretische Grundlage, die relevanten Forschungsfragen und die Ergebnisse der Artikel dieser Arbeit, die im weiteren Abschnitt dieses Kapitels kurz zusammengefasst werden.

| Untersuchungsgegenstand | Artikel I | Artikel II | Artikel III | Artikel IV | Artikel V |
|----------------------------------|--|--|---|--|---|
| Forschungsmethoden | <ul style="list-style-type: none"> • Interviews • Sekundärdatenanalyse | <ul style="list-style-type: none"> • Sekundärdatenanalyse • Expertenbewertung | <ul style="list-style-type: none"> • Sekundärdatenanalyse • Expertenbewertung | <ul style="list-style-type: none"> • Standardisierte Befragung | <ul style="list-style-type: none"> • Sekundärdatenanalyse • Standardisierte Befragung • Interviews |
| Umfang (N) | <ul style="list-style-type: none"> • 19 Energieversorger | <ul style="list-style-type: none"> • 80 Energieversorger | <ul style="list-style-type: none"> • 139 Energieversorger | <ul style="list-style-type: none"> • 116 Unternehmen • 887 Mitarbeiter | <ul style="list-style-type: none"> • 181 Energieversorger (Sekundärdaten) • 28 Energieversorger (Befragungsdaten) • 11 Energieversorger (Fallstudien) |
| Theoretische Perspektiven | <ul style="list-style-type: none"> • Ressourcenbasierter Ansatz • Innovationsmanagement | <ul style="list-style-type: none"> • Upper-Echelons Theorie | <ul style="list-style-type: none"> • Upper-Echelons Theorie | <ul style="list-style-type: none"> • Informationsverarbeitungstheorie • Innovationsmanagement | <ul style="list-style-type: none"> • Dynamic Capability Ansatz • Netzwerk- und ökosystemperspektive |
| Forschungsfragen | <ul style="list-style-type: none"> • Wie sieht ein idealtypischer Servitization-Prozess aus? • Was sind typische Barrieren des Servitization-Prozesses? | <ul style="list-style-type: none"> • Welche Rolle spielt die Herkunft der Unternehmensleitung für die digitalen Servitization? | <ul style="list-style-type: none"> • Welche Rolle spielt die Top-Management Erfahrung für die Servitization? | <ul style="list-style-type: none"> • Welche Rolle spielt der Umsetzungsgrad der Servitization für die Nutzung von IT und den Unternehmenserfolg? | <ul style="list-style-type: none"> • Was sind relevante Fähigkeiten für den Servitization-Prozess hinsichtlich des Business Ökosystems? |
| Ergebnisse | <ul style="list-style-type: none"> • Drei Servitization-Stufen: <ul style="list-style-type: none"> – Service Initiation – Service Anchoring – Service Extension • Drei Typen von Barrieren: <ul style="list-style-type: none"> – Strategiebezogene – Implementierungsbezogene – Markt- und ökosystembezogene | <ul style="list-style-type: none"> • Positiver Effekt von externer Herkunft der Unternehmensleitung auf Umsetzungsgrad der digitalen Servitization • Moderierender Effekt von Vergangenheits-erfolg auf Umsetzungsgrad der digitalen Servitization | <ul style="list-style-type: none"> • Positiver Effekt von externer Herkunft auf Umsetzungsgrad der Servitization • Negativer Effekt von Länge der Amtszeit auf Umsetzungsgrad der Servitization | <ul style="list-style-type: none"> • Negativer Effekt von Umsetzungsgrad der Servitization auf IT-Nutzung • Positiver Moderationseffekt des Servitizationsgrades auf Beziehung zwischen IT Nutzung und Innovationserfolg | <ul style="list-style-type: none"> • Identifikation ökosystembezogener Fähigkeiten zur Umsetzung der Servitization (z. B. Service System Orchestrierung, Koordination der Governance-Strukturen) |

Tabelle 2: Zusammenfassung der Artikel

Artikel I: Service transitions of product-centric firms: An explorative study of service transition stages and barriers in Germany's energy market.

Heiner Lütjen, Frank Tietze und Carsten Schultz

Ausgangspunkt des vorliegenden Artikels sind die inkonsistenten empirischen Ergebnisse über den Ablauf und Erfolg von Servitization-Prozessen (Fang et al., 2008; Finne et al., 2013; Visnjic Kastalli & Van Looy, 2013). Trotz zahlreicher erfolgreicher Beispiele des Wandels hin zu dienstleistungsorientierten Unternehmen (z. B. Alstom und Rolls-Royce), weisen viele produktorientierte Unternehmen Probleme dabei auf, den strategischen Erneuerungsprozess umzusetzen (Kowalkowski et al., 2015). Der Artikel greift diese Problematik auf und beschreibt den aktuellen Stand der Forschung im Bereich der Servitization-Barrieren und leitet eine Typologie zur Beschreibung des Servitization-Prozesses und der Barrieren aus der Literatur ab. Als theoretische Grundlage dient der ressourcenbasierte Ansatz, der durch eine Innovationsmanagementperspektive ergänzt wird.

Basierend auf dem aus der Literatur abgeleiteten konzeptionellen Modell werden im Rahmen eines explorativen Forschungsdesigns der Servitization-Prozess und die Barrieren von 19 Energieversorgern in Deutschland untersucht. Die Ergebnisse weisen darauf hin, dass erfolgreiche Unternehmen drei aufeinanderfolgende Servitization-Stufen durchlaufen, die jeweils bestimmte Barrieren hervorrufen. Zu Beginn der Servitization durchlaufen Unternehmen die *service initiation* Phase. Diese beschreibt eine grundsätzlich sehr geringe Bereitschaft und häufig sogar Trägheit, in neue Innovationen zu investieren und neue Unternehmensstrukturen zu implementieren. Das klassische „Commodity“-Geschäft wird häufig als das alleinige Kerngeschäft der Energieversorger gesehen. In der Konsequenz dominieren Effizienzsteigerungen und damit Prozessinnovationen die Innovationstätigkeit dieser Unternehmen. Insbesondere strategische Barrieren sind in dieser Stufe zu überwinden. Diese betreffen unter anderem die Entscheidung eigene Kerngeschäftsfelder zu kannibalisieren (z. B. die Reduktion des Strom- und Gasverkaufes durch Energieeffizienzdienstleistungen).

In der zweiten Stufe der Servitization (*service anchoring*) sehen sich Energieversorger mit der schwierigen Verankerung von Dienstleistungen im Unternehmen konfrontiert. Beispielsweise fehlen Energieversorgern für die Entwicklung komplexer und professionell zu erbringender Dienstleistungen geeignete Vorgehensweisen, Methoden und Instrumente. Der Großteil der Dienstleistungsentwicklung wird noch durch externe Dienstleister oder Kooperationspartner

durchgeführt, um größere finanzielle und personelle Belastungen zu vermeiden. Relevante Barrieren in dieser Stufe weisen auf eine fehlende Innovationskultur und eine mangelnde Bereitstellung notwendiger finanzieller und personeller Ressourcen für Service Innovationen hin.

In der dritten Stufe der Servitization (*service extension*) haben die Unternehmen größtenteils strategie-, und implementierungsbezogene Barrieren überwunden, häufig ist ein strukturierter Innovationsprozess im Unternehmen vorhanden. Dabei ist die Innovationsstrategie häufig in die Unternehmensstrategie eingebettet, die auch explorative, zum Teil radikale Innovationen ermöglicht. Das klassische Commodity-Geschäft nimmt relativ zum Dienstleistungsgeschäft einen zunehmend schwächeren Teil der Wertschöpfung ein, da Dienstleistungen als entscheidendes Kriterium für die zukünftige Wettbewerbsfähigkeit des Unternehmens angesehen und sehr umfassend definiert werden. Mit einem zunehmenden Umsetzungsgrad der Servitization steigt jedoch auch die Komplexität der Dienstleistungsentwicklung. Durch die zunehmend individuellen Kundenbedürfnisse nimmt die Bedeutung der Integration des Kunden und weiterer Netzwerkakteure als externe Faktoren der Dienstleistungserstellung zu. Mit einer verstärkten Dienstleistungsorientierung gehen somit eine konsequente Verankerung der Kundenorientierung sowie ein zunehmendes Denken in Business Ökosystemen einher.

Artikel II: Digitale Servitization - Die Rolle der Herkunft der Unternehmensleitung und des vergangenen Unternehmenserfolges

Heiner Lütjen

Gleichzeitig mit dem Wandel in Richtung neuer Produkt-Service-Systeme nutzen produktorientierte Unternehmen zunehmend digitale Systeme, Komponenten und Technologien, um Unternehmen und Individuen zu vernetzen und somit ihre Dienstleistungserbringung zu unterstützen. Dies zeigen Beispiele aus der Musikindustrie, wo physische Produkte durch digitale Services von Spotify und Apple Music ersetzt wurden, aber auch aus dem produzierenden Gewerbe, wo Geschäftsmodelle aus einem immer größeren werdenden Anteil an digitalen Elementen wie Sensoren, Datenspeichern und Mikroprozessoren entstehen. Jedoch zeigen empirische Befunde, dass die Umsetzung von digitalen Dienstleistungen bisher häufig begrenzt ist und zudem zwischen Unternehmen deutlich variiert. Die Servitization-Forschung liefert dafür bisher nur unzureichende theoretische Erklärungen (Valtakowski, 2017). Insbesondere mangelt es an empirischen Arbeiten, die Führungstheorien für ihre Annahmen verwenden.

Dagegen befasst sich die Strategie- und Organisationsforschung seit Jahrzehnten mit der Zusammensetzung von TMTs und deren Auswirkungen auf den Unternehmenserfolg. Zahlreiche Studien bauen dabei auf dem Upper Echelons-Ansatz auf, der annimmt, dass strategische Entscheidungsträger in Unternehmen aufgrund ihrer persönlichen Charakteristika Situationen interpretieren und so den Unternehmenserfolg beeinflussen können (Bromiley & Rau, 2016; Crossland, Zyung, Hiller, & Hambrick, 2014; Hambrick & Mason, 1984). Eine Reihe von Studien konnte feststellen, dass die Unternehmensleitung und deren Fähigkeiten einen hohen Erklärungsbeitrag für Heterogenität von Unternehmensstrategien liefern (Bromiley & Rau, 2016; Crossland et al., 2014; Lewis, Walls, & Dowell, 2014). Eine Vielzahl der Studien befasst sich dabei mit den Wirkungszusammenhängen der Herkunft der Unternehmensleitung und deren Auswirkungen auf den organisatorischen Wandel und den Unternehmenserfolg (Zhang & Rajagopalan, 2010). Während ein Großteil der Studien einen positiven Einfluss der Unternehmensleiter, die von außen ins Unternehmen berufen werden, belegen (Huson, Malatesta, & Parrino, 2004), weisen andere Studien einen negativen Zusammenhang (Haveman & Khaire, 2004) oder einen nicht signifikanten Zusammenhang auf.

Vor diesem Hintergrund adressiert die vorliegende Studie die Fragestellung, inwiefern der Umsetzungsgrad der digitalen Servitization durch demografische Eigenschaften der Unternehmensleitung beeinflusst wird. Am Beispiel der Untersuchung von 80 Energieversorgern wird

im Rahmen dieser Studie ein integriertes Forschungsdesign entwickelt, das den Erfolg der digitalen Servitization bewertet, und Unterschiede auf Basis von Managementeigenschaften begründet.

Die empirischen Ergebnisse zeigen, dass der Wandel von ursprünglich produktorientierten Unternehmen zu digitalen Lösungsanbietern durch extern berufene Unternehmensleiter positiv beeinflusst werden kann. Ferner zeigen die empirischen Befunde, dass der vergangene Unternehmenserfolg einen direkten negativen Effekt auf das digitale Dienstleistungsportfolio eines Unternehmens hat, und zusätzlich den Wirkungszusammenhang von Herkunft der Unternehmensleitung und des digitalen Dienstleistungsportfolios moderiert. Die Ergebnisse lassen somit darauf schließen, dass der digitale Servitization-Prozess die Integration essentieller Unternehmensressourcen erfordert, die maßgeblich vom TMT freizugeben sind und somit letztendlich zu einer hohen Relevanz strategischer Entscheidungen im Servitization-Prozess führen.

Artikel III: Top Management Team Impact on Servitization: Does the TMT Experience Make a Difference?

Heiner Lütjen und Carsten Schultz

Die Upper Echelons Forschung widmet sich seit geraumer Zeit Fragen zu den Auswirkungen von Top-Management-Team (TMT) Eigenschaften auf die strategische Erneuerung und den Unternehmenserfolg (Hambrick and Mason, 1984; Bromiley und Rau, 2016). Nur wenige Arbeiten setzen sich jedoch mit den konkreten Auswirkungen von TMT-Eigenschaften auf den strategischen Wandel hin zu dienstleistungsorientierten Unternehmen auseinander. Zudem wird aufgrund der bisher uneinheitlichen Ergebnisse der Servitization gefordert, die Rolle von TMTs im Servitization-Prozess detaillierter zu untersuchen (Kowalkowski et al., 2017) und neue Theorien für die Servitization zu entwickeln (Valtakowski, 2017). Um den Forschungsstand sinnvoll zu erweitern, werden in dieser Studie die Auswirkungen der TMT-Erfahrung auf den Umsetzungsgrad der Servitization untersucht.

In unserem Beitrag argumentieren wir, dass eine zunehmende Konzentration auf Dienstleistungen auch häufig mit einem Trade-off von Nutzen und Risiken verbunden ist und die Entwicklung neuer organisatorischer Fähigkeiten erfordert. Zwar weist die aktuelle Servitization-Forschung darauf hin, dass die Servitization zu stabileren Einnahmen (Oliva & Kallenberg, 2003), geringeren Imitationsrisiken (Sasser, Schlesinger & Heskett, 1997) und höherer strategischer Flexibilität (Gebauer, Gustafsson & Witell, 2011) führt. Jedoch zeigt sich ebenfalls, dass der Wandel zu einem dienstleistungsorientierten Geschäftsmodell ebenso mit vielfältigen Herausforderungen verbunden ist. Die Herausforderungen reichen von neuen Methodenanforderungen des Innovationsmanagements, höheren Koordinationskosten, dem deutlich längeren Zeithorizont, um den wirtschaftlichen Erfolg von neuen Dienstleistungen bewerten zu können, bis hin zu einem strategischen und kulturellen Wandel im Unternehmen, der häufig durch bestehende Anreize im Unternehmen behindert wird (Nordin, Kindstrom, Kowalkowski, & Rehme, 2011; Schultz und Tietze, 2014).

Basierend auf dem Trade-off von Nutzen und Risiken steigt das wahrgenommene Risiko auf der Seite der Unternehmensleitung in die Servitization zu investieren (Baines et al., 2017) und damit in der Konsequenz die Bedeutung der Erfahrungen und Fähigkeiten der Unternehmensleiter. Vor diesem Hintergrund dient der Upper Echelons-Ansatz als theoretische Grundlage dieser Studie, der im Rahmen der Strategie- und Organisationsforschung große Anerkennung gefunden hat, jedoch in der Servitization-Forschung bisher wenig systematisch angewendet wurde.

Als Stichprobe dient die Analyse von 212 Unternehmensleitern in 139 Energieversorgern. Zur Ermittlung des Umsetzungsgrades der Servitization wurden dazu Sekundärmaterial wie Geschäftsberichte, Webseiten und Unternehmensdatenbanken sowie branchenspezifische Artikel in der kommunalen und überregionalen Presse untersucht. TMT-bezogene Daten wurden auf Basis der Webseiten, verschiedener Plattformen (u.a. Xing, LinkedIn) und der Datenbank moneyhouse bezogen. Dabei wurde die Validität durch direkte Ansprache einzelner Unternehmensleiter unterstützt.

Die empirischen Ergebnisse des Artikels weisen auf einen positiven Effekt der Rekrutierung externer Unternehmensleiter und auf einen negativen Effekt der Länge der Amtszeit auf den Umsetzungsgrad der Servitization hin. Positive Effekte auf den Umsetzungsgrad der Servitization gehen ebenfalls von einem größeren TMT sowie von der Unternehmensgröße aus. Während jüngere Forschungsergebnisse auf einen positiven Zusammenhang von branchenübergreifender Erfahrung und strategischer Erneuerung hinweisen (Crossland et al., 2014), konnte im Rahmen dieser Studie kein Zusammenhang festgestellt werden. Die Ergebnisse dieser Studie lassen darauf schließen, dass branchenspezifische und branchenübergreifende Erfahrung notwendig sind, sich jedoch im Zeitverlauf ausgleichen.

Darüber hinaus liefert die Studie einen Beitrag für die noch junge Servitization-Forschung, die bisher noch wenige theoretische Ansätze zur Erklärung des Servitization-Prozesses beinhaltet (Valtakowski, 2017). Durch die Integration der Upper Echelons-Perspektive liefert der Artikel somit ein tieferes Verständnis der bisher inkonsistenten Ergebnisse der Servitization. Ferner entwickelt die Studie einen neuen Messansatz für den Umsetzungsgrad der Servitization. Dabei reagiert diese Studie auf die in der aktuellen Forschung häufig kritisierte Messung des Umsetzungsgrades der Servitization anhand der Anzahl der Dienstleistungen oder der spezifischen Zuordnungen von Serviceangeboten zum jeweiligen Entwicklungsstand der Servitization (Kohtamaki et al., 2013). Durch die in dieser Studie vorgenommene Messung der Innovativität von Dienstleistungen (Schultz et al., 2013) ergibt sich somit eine sinnvolle Erweiterung der bisherigen Ansätze.

Artikel IV: Use and Efficacy of Information Technology in Innovation Processes: The Specific Role of Servitization

Julia Kroh, Heiner Lütjen, Carsten Schultz, Dietfried Globocnik

Der strategische Wandel von produktorientierten Unternehmen hin zu dienstleistungsorientierten Unternehmen geht einher mit einem steigenden Informationsbedarf bei der Entwicklung von Dienstleistungsinnovationen. Eine wesentliche Ursache dafür spielen die unterschiedlichen Eigenschaften von Produkten und Dienstleistungen, die im Innovationsprozess berücksichtigt werden müssen. Im vorliegenden Artikel werden anhand der IHIP Logik (intangibility, heterogeneity, inseparability, and perishability) (Hill, 1977; Zeithaml, Parasuraman, & Berry, 1985) potentielle Schwierigkeiten im Innovationsprozess abgeleitet. Trotz grundsätzlicher Kritik an den IHIP Eigenschaften (Vargo & Lusch, 2004) weisen die IHIP-Eigenschaften darauf hin, warum die Informationsverarbeitung für die Entwicklung neuer Dienstleistungen eine große Herausforderung darstellt. Beispielsweise ist eine ausgeprägte Intangibilität mit einer schwierigen Kommunizierbarkeit und Erprobbarkeit der Dienstleistung verbunden, die sich negativ auf die Artikulierbarkeit der Kundenbedürfnisse sowie die gesamte Integration des Kunden auswirken kann (Schultz und Tietze, 2014; Carbonell et al., 2009; Den Hertog et al., 2010). Eine zunehmende Komplexität ergibt sich darüber hinaus auch aus Sicht der service dominant logic (Vargo und Lusch, 2004), die eine zunehmende Relevanz der Integration des externen Faktors Kunde (co-creation of value) betont.

Vor dem Hintergrund der steigenden Komplexität bei der Entwicklung von Innovationen wächst der Bedarf an effizienter Informationsverarbeitung im Unternehmen und in der Konsequenz der Bedarf an Unterstützung durch geeignete IT-Instrumente. Trotz der steigenden Relevanz von IT-Unterstützung in Innovationsprozessen haben empirische Studien zum Nutzen und Wirksamkeit von IT-Instrumenten auf den Innovationserfolg uneinheitliche Ergebnisse geliefert. Gleichzeitig existieren bisher wenige empirische Studien, die potentielle Kontingenzfaktoren der Wirkungsbeziehung von IT-Nutzung und Innovationsleistung untersuchen. Auf Basis der Informationsverarbeitungstheorie (Galbraith, 1974) wird im Rahmen dieses Artikels ein konzeptionelles Modell entwickelt, das die Beziehung der Nutzung von IT und Innovationsleistung untersucht und dabei zwei potentielle Kontingenzfaktoren analysiert: (1) Das Marktverständnis der Unternehmen und (2) den Umsetzungsgrad der Servitization. Als Datenbasis wird eine branchenübergreifende Stichprobe von 116 Unternehmen und 887 Mitarbeitern verwendet.

Die empirischen Ergebnisse der Studie zeigen, dass eine ausgeprägte Nutzung von IT-Instrumenten das Marktverständnis des Unternehmens positiv beeinflusst. Ebenso weisen die Ergebnisse darauf hin, dass ein ausgeprägtes Marktverständnis über Kunden und Wettbewerber den Innovationserfolg verbessern kann. Da keine direkten Effekte von IT-Intensität auf den Innovationserfolg vorliegen, wird das Marktverständnis als relevanter Mediator für die Beziehung von IT-Intensität und Innovationserfolg angenommen. Damit argumentiert der vorliegende Beitrag, dass IT-gestützte Innovationsprozesse für die Zusammenarbeit, Koordination und Kommunikation im Unternehmen an Relevanz gewinnen, da sie interne und externe Informationsflüsse im Unternehmen erleichtern.

Hinsichtlich des Einflusses des Umsetzungsgrades der Servitization auf die Wirkungsbeziehung von IT und Innovationserfolg zeigen die Ergebnisse, dass ein hoher Umsetzungsgrad der Servitization zu einem großen Bedarf an IT-Nutzung führt. Gleichzeitig weisen die Ergebnisse jedoch darauf hin, dass insbesondere stark serviceorientierte Unternehmen aufgrund der gestiegenen Komplexität größere Schwierigkeiten bei der Adoption von IT-Instrumenten haben. Die Ergebnisse der Studie beschreiben somit ein Dilemma: Unternehmen mit einem hohen Umsetzungsgrad der Servitization benötigen besondere Unterstützung durch Informationstechnologien, haben jedoch im Vergleich zu stärker produktorientierten Unternehmen größere Probleme bei der Adoption der entsprechenden IT-Instrumente.

Artikel V: Managing networks and ecosystems for servitization: A dynamic capability approach

Heiner Lütjen, Carsten Schultz, Frank Tietze, Florian Urmetzer

Produkt-Service-Systeme stellen komplexe sozio-technische Systeme dar, die zahlreiche, vormals einzelne Komponenten zu einem ganzheitlichen Komplex verbinden. Um PSS zu entwickeln und anzubieten, muss jedoch eine Vielzahl integrierender Komponenten und benötigter Kompetenzen in einem Netzwerk aus verschiedenen Partnern verknüpft werden. Daraus ergeben sich nicht nur hohe Anforderungen an die Interoperabilität. Auch klassische Probleme des Netzwerkmanagements gilt es zu überwinden. Die Integration verändert die in den Branchen etablierten Rollen und erfordert daher völlig neue Wertschöpfungsprozesse und -strukturen. Am Beispiel der Energiewirtschaft wird im Rahmen dieses Artikels exemplarisch gezeigt, dass Unternehmen im Servitization-Kontext enge Wertschöpfungspartnerschaften privatwirtschaftlicher und öffentlicher Institutionen benötigen. Trotz der zunehmenden praktischen Relevanz ist die wissenschaftliche Forschung zu Business Ökosystem erst in den Anfängen. Es ist zudem wenig bekannt, wie diese sich entwickeln und welche Rollen von den Akteuren besetzt werden sollten, damit sie optimal funktionieren. Die Forschungsfrage dieses Artikels befasst sich daher mit den ökosystem-relevanten Fähigkeiten von Unternehmen für die Servitization. Das empirische Forschungsdesign besteht aus drei Studien: (1) eine sekundäre Datenanalyse von 181 Unternehmen; (2) eine quantitative Untersuchung von 133 Führungskräften aus 28 Unternehmen; und (3) eine qualitative Fallstudie mit 11 Unternehmen. Die Ergebnisse der Mixed-Method Studie zeigen, dass die Entwicklung innovativer PSS von den direkt verbundenen Kooperationspartnern (z.B. Zulieferer, komplementäre Dienstleistungsanbieter, Kunden), aber auch von einem heterogenen und nur lose verbundenen Netzwerk an Akteuren abhängig ist. Dieses Netzwerk umfasst z.B. die lokale Verwaltung und Wirtschaftsförderung, Infrastrukturanbieter, die Politik, Unternehmens- und Verbraucherschutzverbände, Bildungs- und Forschungseinrichtungen sowie andere Akteure, die Kontrolle über öffentliche Ressourcen ausüben. Das Zusammenwirken der privatwirtschaftlichen und öffentlichen Organisationen resultiert dabei in einer dynamisch-evolutionären und lokal verankerten Entstehung von Service Innovationen, wobei die Koordination durch geteilte Institutionen, inkl. gemeinsamer Wertvorstellungen und Zielsetzungen, erfolgt. Daher ist der Innovationserfolg von PSS maßgeblich durch die Bereitschaft und Fähigkeit der externen Akteure geprägt, komplementäre Innovationsaktivitäten zu erbringen.

5. Ergebnisse und Implikationen

Das Ziel dieser Arbeit war die konzeptionelle Aufarbeitung des Servitization-Prozesses und dessen zugrundeliegenden Barrieren. Darüber hinaus wurde die spezifische Wirkung der Barrieren auf die Umsetzung der Servitization untersucht und notwendige Fähigkeiten zur erfolgreichen Implementierung von innovativen Dienstleistungen ermittelt. Die Ergebnisse der verschiedenen Studien im Untersuchungsfeld der Energieversorger belegen die Relevanz des aufgestellten theoretischen und konzeptionellen Bezugsrahmens. Sowohl aus wissenschaftlicher, als auch unternehmerischer Perspektive muss der Erforschung des Servitization-Prozesses eine hohe Wichtigkeit zugesprochen werden. Basierend auf den erzielten Ergebnissen folgt im nächsten Kapitel die Beantwortung der zu Beginn formulierten Forschungsfragen, die Erläuterung der Einschränkungen dieser Arbeit und die Ableitung von Implikationen für Wissenschaft und Praxis.

5.1 Zusammenfassung der Ergebnisse

Zu Beginn der vorliegenden Arbeit wurde dargelegt, dass die bisherige Servitization-Forschung sehr unterschiedliche Ergebnisse hinsichtlich der Phasen und des Erfolges der Servitization ermittelt hat. Neben zahlreichen Studien zu negativen Erfolgswirkungen der Servitization („Service Paradox“) (Gebauer et al., 2005), weisen jüngere Studien teilweise sogar auf eine De-Servitization hin, eine Änderung des bisherigen PSS-Angebotsportfolios zurück in Richtung einer produktorientierten Unternehmung (Finne et al., 2013). Vor dem Hintergrund dieser inkonsistenten Ergebnisse wurden im Rahmen dieser Arbeit fünf Artikel verfasst, die in drei übergeordneten Forschungsfragen zusammengefasst werden können. Im Zuge des konzeptionellen und empirischen Vorgehens dieser Arbeit, konnten die eingangs beschriebenen Forschungsfragen beantwortet werden. Die erste Forschungsfrage zielt dabei auf den Servitization-Prozess und dessen Barrieren ab.

F1: Wie sieht ein typischer Servitization-Prozess aus und was sind die relevanten Barrieren, die der erfolgreichen Servitization entgegenwirken?

Während bisherige Untersuchungen häufig nur fragmentiert den Servitization-Prozess darstellen, konnten im Rahmen dieser Arbeit wesentliche Stufen der Servitization sowie dessen zugrundeliegende Barrieren ermittelt werden. Die in Artikel I gewonnenen explorativ-induktiven Ergebnisse weisen auf drei Phasen der Servitization hin: *service initiation*, *service anchoring*, und *service extension*. In der *service initiation Phase* stehen Unternehmen erst am Anfang der Entwicklung neuer Produkt-Service-Systeme, eine Verzahnung von klassischen Produkten mit neuen Dienstleistungen erfolgt noch selten. Insbesondere existieren in dieser

Stufe *strategiebezogene* Barrieren zur Implementierung von neuen PSS, häufig dominiert sogar die Ansicht, dass Dienstleistungen auf Kosten der traditionellen Produkte eingeführt würden und diese somit kritisch zu betrachten seien. In der *service anchoring* Phase gehören PSS zwar meist zum Geschäft der produktorientierten Unternehmen, weisen jedoch häufig noch einen geringen Innovationsgrad auf und werden selten gemeinsam mit anderen Marktakteuren entwickelt. Insbesondere existieren in dieser Stufe *implementierungsbezogene* Barrieren, wie zum Beispiel die mangelnde Verankerung und organisatorische Einbindung von Innovationen im Unternehmen. In der *service extension* Phase weisen Unternehmen eine hohe Serviceorientierung auf, häufig werden radikalere Innovationen in Kooperation mit branchenfremden Unternehmen angestrebt oder umgesetzt. Produktorientierte Unternehmen wie Stadtwerke und Energieversorger stehen in dieser Phase jedoch vor der Herausforderung, die Komplexität des Ökosystems und seiner Akteure vollständig zu erfassen.

F2: Welche Fähigkeiten benötigen produktorientierte Unternehmen in den spezifischen Phasen der Servitization, um diese erfolgreich umzusetzen?

Auf Basis der dargestellten Barrieren wurden im Rahmen der vorliegenden Arbeit notwendige Fähigkeiten für den Wandel zum einem Dienstleistungsanbieter identifiziert. Da zu Beginn des Servitization-Prozesses insbesondere *strategiebezogene* Barrieren hervorgerufen werden, wurde die Rolle von TMTs im Rahmen der Servitization detailliert analysiert. In zwei aufeinander aufbauenden Studien wurde sowohl der Umsetzungsgrad der digitalen Servitization (Artikel II), als auch darüber hinaus personenbezogene Dienstleistungen untersucht (Artikel III). Die Ergebnisse zeigen, dass extern berufene Unternehmensleiter die Entwicklung von innovativen Dienstleistungen - insbesondere auch von digitalen Dienstleistungen - positiv beeinflussen können. Darüber hinaus zeigen die empirischen Befunde, dass der vergangene Unternehmenserfolg einen direkten negativen Effekt auf das digitale Dienstleistungsportfolio eines Unternehmens hat, und zusätzlich den Wirkungszusammenhang von Herkunft der Unternehmensleitung und des digitalen Dienstleistungsportfolios moderiert. Ferner zeigen sich negative Effekte der Amtszeit des TMTs auf den Umsetzungsgrad der Servitization.

Hinsichtlich *implementierungsbezogener Barrieren* wurde die spezifische Rolle der Servitization auf die Nutzung und Wirksamkeit von Informationstechnologien (IT) untersucht. Die Ergebnisse zeigen, dass eine intensive IT-Nutzung für den Informationsaustausch mit internen und externen Stakeholdern das Marktverständnis des Unternehmens verbessert, was sich wiederum positiv auf den Innovationserfolg auswirkt. Darüber hinaus zeigen die Ergebnisse, dass das Marktverständnis über Kunden und Wettbewerber mit zunehmendem Umsetzungsgrad der

Servitization an Relevanz gewinnt. Jedoch zeigen die Ergebnisse, dass ein höherer Umsetzungsgrad der Servitization die Adoption von IT-Instrumenten erschwert.

Hinsichtlich der identifizierten *markt- und ökosystembezogenen* Barrieren in Artikel I (Lütjen et al., 2017), wurden die notwendigen Fähigkeiten für Energieversorgern im Rahmen der PSS-Entwicklung in Business Ökosystemen untersucht. Die empirischen Ergebnisse zeigen, dass die Entwicklung von innovativen PSS auf einer ganzheitlichen Verknüpfung heterogener Leistungsbestandteile und damit einer engen Vernetzung mit Kunden und externen Wertschöpfungspartnern beruht. Aufgrund der Heterogenität und Individualität der Dienstleistungen gehen die Partnerschaften jedoch über klassische Zulieferbeziehungen hinaus und involvieren ebenso lose gekoppelte Partner. Dabei zeigen die Ergebnisse, dass der Umsetzungsgrad der Servitization maßgeblich durch die Bereitschaft und Fähigkeit der externen Akteure geprägt ist, komplementäre Innovationsaktivitäten zu erbringen. Neben der Steuerung der externen Netzwerke bedarf es darüber hinaus auch der Einleitung organisatorischer Veränderungsprozesse. Die Entwicklung und Implementierung einer dienstleistungsorientierten Unternehmens- und Innovationsstrategie sollte eine Integration der Kunden und weiterer externer Partner sicherstellen, obwohl diese in der Regel kein Eigentum an den verwendeten Produkt-Service-Systemen erwerben und oft nur mittelbar von den Effekten betroffen sind.

F3: Wie können bestehende Ansätze zur Messung des Umsetzungsgrades der Servitization erweitert werden?

Wie eingangs beschrieben bestehen bisher kaum überzeugende Messansätze zum Umsetzungsgrad der Servitization (Kohtamaki et al., 2013; Windahl & Lakemond, 2010). Die inkonsistenten Ergebnisse zum Prozess der Servitization sowie der häufig fehlerhaft angenommene Zusammenhang von spezifischen Dienstleistungsangeboten und dem Umsetzungsgrad der Servitization belegen den Bedarf an neuen Messansätzen (Kohtamaki et al., 2013). Der in dieser Arbeit entwickelte Messansatz basiert auf einer Innovationsperspektive, die nicht nur die Anzahl der PSS-Angebote, sondern auch die Innovativität mithilfe eines mehrdimensionalen Innovationsgrades (Schultz et al., 2013) bewertet. Dies ist daher möglich, da die Implementierung innovativer PSS häufig mit einer Änderung der Organisationsstrukturen, -prozesse und -strategien der Unternehmen einhergeht (Avlonitis, Papastathopoulou, & Gounaris, 2001; Schultz et al., 2013). In diesem Sinne nimmt die Neuheit und Komplexität der PSS im Verhältnis zum Fortschritt der Servitization zu und kann somit ein valides Maß zur Bestimmung des Dienstleistungsanteils von Unternehmen darstellen. Der in dieser Arbeit entwickelte Ansatz erweitert bestehende Ansätze zur Bestimmung des Umsetzungsgrades der Servitization und schafft eine

solide Datenbasis für zukünftige quantitative Untersuchungen von dienstleistungsorientierten Unternehmen.

5.2 Limitationen

Die vorliegende Arbeit ist wie jede wissenschaftliche Arbeit mit Limitationen verbunden, die bei der Interpretation der Ergebnisse und der Ableitung allgemeingültiger Aussagen berücksichtigt werden müssen. Diese schränken zwar die Übertragbarkeit ein, zeigen doch ebenso weiteren Forschungsbedarf auf. Neben den in den einzelnen Artikeln spezifizierten Limitationen, sollen im Rahmen dieses Kapitels auch übergreifende konzeptionelle und methodische Einschränkungen der vorliegenden Arbeit dargestellt werden.

Die empirischen Ergebnisse basieren zwar auf theoretischen und vorhandenen empirischen Erkenntnissen, dennoch ist die Validität der Ergebnisse wie bei vielen empirischen Projekten eingeschränkt. Die empirischen Ergebnisse bleiben zu einem gewissen Grad explorativ, da insbesondere die Zusammenhänge in Artikel I und V erstmalig getestet wurden. Jedoch stellen auch die explikativ-deduktiven Ergebnisse aus Artikel II, III und IV nur ein Ausschnitt der Realität dar. Wie aus den Ergebnissen hervorgeht, konnte nur ein Teil der Gesamtvarianz erklärt werden, was darauf schließen lässt, dass weitere Faktoren den Servitization-Prozess beeinflussen. Dabei sollte festgehalten werden, dass im Rahmen dieser Arbeit kausale Zusammenhänge nicht festgestellt werden können, da aufgrund der empirischen Datenlage nur Querschnittsanalysen durchgeführt wurden. Beispielsweise wäre es durchaus möglich, dass TMTs nicht den Umsetzungsgrad der Servitization beeinflussen, sondern gerade der hohe Umsetzungsgrad der Servitization Ausgangspunkt für Top-Manager ist, in das Unternehmen zu wechseln. Ebenso wäre es möglich, dass nicht wie dargestellt die Adoption von IT-Instrumenten vom Umsetzungsgrad der Servitization beeinflusst wird, sondern auch hier umgekehrte Wirkungszusammenhänge existieren. Um das damit beschriebene Problem der Endogenität zu umgehen, bieten sich für zukünftige Studien Längsschnittanalysen an, um die langfristige Wirkungen der Barrieren in Servitization-Prozessen zu analysieren. Ferner könnten relevante Instrumentvariablen für die Umsetzung der Servitization identifiziert werden.

Im Rahmen der Diskussion über die Validität der Ergebnisse, spielt auch der Single Informant Bias eine Rolle, wenn die Daten nur auf Basis eines Respondenten basieren. In dieser Arbeit wurde versucht möglichst objektive Daten hinzuziehen. Demnach wurden in Artikel I und Artikel V neben Interviews auch Geschäftsberichte, Presseartikel und Webseiten der Unternehmen untersucht. Darüber hinaus stützt sich Artikel IV auf Daten von mehreren Befragten (ca. 8 Mitarbeiter pro Unternehmen), um die üblichen Methodenverzerrungen zu begrenzen. Artikel

II und Artikel III basieren auf Sekundärdaten, die von unterschiedlichen Forschern separat erhoben wurden. Trotz der Anstrengungen objektive Daten zu generieren, können Key-Informant-Bias im Rahmen dieser Untersuchung nicht vollständig ausgeschlossen werden. Beispielsweise könnten zukünftige Studien die Ergebnisse zum Innovationserfolg in Artikel IV durch Sekundärdaten validieren.

Darüber hinaus sind Non-Response Bias grundsätzlich bei der Interpretation der Ergebnisse zu berücksichtigen. Es liegt nahe, dass insbesondere Unternehmen an Innovationsmanagement-Studien teilnehmen, die schon erfolgreich in der Entwicklung von Innovationen sind oder gegenüber Innovationen positiv eingestellt sind. Somit kann davon ausgegangen werden, dass Unternehmen mit geringer Affinität zu neuen Innovationen insbesondere an der umfangreichen Befragung zum Innovationsmanagement nicht teilgenommen haben. Ein weiteres, häufig auftretendes Problem empirischer Forschung resultiert daraus, dass abhängige und unabhängige Variablen mit dem gleichen Verfahren erhoben werden. Der damit einhergehende common method bias konnte in dieser Untersuchung nur teilweise reduziert werden, indem für einige der zu messenden Konstrukte alternative Informationsquellen herangezogen wurden. Beispielsweise konnten in Artikel IV für den Umsetzungsgrad der Servitization objektive Sekundärdaten generiert werden, während für die Operationalisierung der unabhängigen Variable Interviewdaten genutzt wurden.

Ferner sollten auch Limitationen hinsichtlich des konzeptionellen Rahmens der Arbeit aufgezeigt werden. Konzeptionell steht in diesem Beitrag das Unternehmen als Untersuchungseinheit für Barrieren des Servitization-Prozesses im Vordergrund. Hieraus ergeben sich Limitationen hinsichtlich der Übertragbarkeit der Barrieren auf konkrete Projekte. Es bleibt somit offen, ob und wie verschiedene Innovationsprojekte im Rahmen der Servitization unterschiedliche Barrieren hervorrufen. Zukünftige Studien könnten beispielsweise mit Mehrebenen-Messmodellen unterschiedliche Ebenen eines Unternehmens betrachten, um die Wirkung der Servitization-Barrieren auf den Umsetzungsgrad zu spezifizieren. Vor dem Hintergrund der Übertragbarkeit der Ergebnisse sollte auch der spezifische Kontext des empirischen Anwendungsfeldes erwähnt werden. Zukünftige Studien sollten aufgrund der historischen Entwicklung der deutschen Energiewirtschaft (Marktliberalisierung, Energiewende) die gewonnenen Erkenntnisse auf größere Samples übertragen und unterschiedliche Branchen in die Analyse einbeziehen. Im folgenden Kapitel werden die Implikationen für Forschung und Managementpraxis dargestellt.

5.3 Implikationen für die Forschung

Die vorliegende Arbeit leistet mit der Konzeption eines Bezugsrahmens für den Servitization-Prozess und dessen zugrundeliegenden Barrieren zahlreiche Anknüpfungspunkte sowohl in Bezug auf die theoretische und konzeptionelle Herangehensweise als auch in Bezug auf die methodische Durchführung empirischer Studien. Dabei integriert der Bezugsrahmen verschiedene Arbeiten aus der Servitization-, Innovations- und Organisationsforschung und stellt erstmals ein umfassendes Konzept dar, das die relevanten Barrieren und Kompetenzen für die erfolgreiche Umsetzung abbildet. Es bietet sich jedoch an, den Bezugsrahmen konzeptionell und theoretisch weiterzuentwickeln und einzelne Prozesse und Barrieren vertieft zu analysieren.

Zunächst sollte festgehalten werden, dass die drei identifizierten Barriere-Typen unterschiedliche Ebenen des Unternehmens betreffen. Während bei *strategiebezogenen* Barrieren detailliert die Erfahrungen und Charakteristika der individuellen Unternehmensleitung untersucht wurden, wurden *implementierungsbezogene- und markt- und ökosystembezogene* Barrieren auf Unternehmensebene erfasst. Zukünftige Studien könnten das Studiendesign erweitern, indem die Barrieren und notwendigen Kompetenzen sowohl auf Mitarbeiter- als auch Unternehmensebene untersucht werden. In diesem Zuge könnte auch dem häufig geforderten Multi-Informant Design Rechnung getragen werden.

Für die detaillierte Analyse von *strategiebezogenen* Barrieren des Servitization-Prozesses bieten sich weitere Studien auf Basis der Upper Echelons-Perspektive oder anderer verhaltensbasierter Ansätze an, die die Bedeutung von psychologischen Eigenschaften der Führungskräfte für den Servitization-Erfolg untersuchen. Damit könnte der häufigen Kritik an der Upper Echelons Forschung entgegengewirkt werden, die eine Verwendung demographischer Charakteristika als Indikator für psychologische Eigenschaften für zu unpräzise hält. Während im Rahmen dieser Arbeit aufgrund des vorliegenden Datenmaterials beobachtbare demografische Merkmale analysiert wurden, könnten zukünftige Studien auch die Integration komplexer psychologischer Konstrukte in Erwägung ziehen. Damit bieten sich ebenfalls Anknüpfungspunkte an die psychologische Forschung und Verhaltenswissenschaft, die die Motivation und Einstellung von Führungskräften zur Servitization untersuchen könnte.

Zur Analyse *implementierungsbezogener* Barrieren bieten sich insbesondere Studien zu methodischen Instrumenten der Dienstleistungsentwicklung an. Die empirischen Ergebnisse dieser Arbeit zeigen, dass Energieversorger nur sehr rudimentär spezifische Methoden der Dienstleistungsentwicklung (z. B. Service Blueprinting) anwenden. Zukünftige Studien könnten vertieft die Weiterentwicklung von Methoden der Dienstleistungsentwicklung untersuchen, um eine systematische Entwicklung und einen frühzeitigen Test von Dienstleistungen zu gewährleisten

und Fehler zu vermeiden. Die Untersuchung von *markt- und ökosystembezogenen* Barrieren zeigt, dass Innovationen in der Energiewirtschaft Multiakteurs-Netzwerke involvieren und daher einer Innovationsökosystem-Perspektive bedürfen. Eine erfolgreiche Servitization erfordert dabei die Integration von Akteuren sowohl auf Zulieferseite (upstream) als auch auf Marktseite (downstream) der Wertschöpfungskette. Im Rahmen dieser Arbeit wurde der Servitization-Prozess anhand einer Innovationsökosystem-Perspektive analysiert. Jedoch steht die Forschung zu Business Ökosystemen erst am Anfang und ist zudem bisher wenig auf den speziellen Kontext der Servitization untersucht worden. Weitere Studien könnten diese Perspektive reflektieren und die Interdependenz der zu entwickelnden PSS von den direkt verbundenen Kooperationspartnern (z.B. Zulieferer, komplementäre Dienstleistungsanbieter, Kunden) und von einem heterogenen und nur lose verbundenen Netzwerk an Akteuren, in den Fokus stellen. Beispielsweise bieten sich für die Analyse von Ökosystemen und Netzwerken im Kontext der Servitization auch Ansätze der Institutionenökonomie (z. B. Transaktionskosten und Prinzipal-Agententheorie) oder verhaltenswissenschaftliche Ansätze an.

Weiterer Forschungsbedarf besteht auch hinsichtlich des entwickelten Messansatzes zum Umsetzungsgrad der Servitization, um die Generalisierbarkeit und Übertragbarkeit des Ansatzes zu gewährleisten. Während im Rahmen dieser Arbeit aufgrund der Datenverfügbarkeit keine finanziellen Kennzahlen erhoben werden konnten, sollten zukünftige Studien diese ebenfalls integrieren. Besondere Schwierigkeiten ergeben sich durch die schwierige Trennung von Produkten und Services sowie der daraus resultierenden problematischen Abgrenzung des spezifischen Dienstleistungserfolges.

Ferner sollte erwähnt werden, dass hinsichtlich des empirischen Anwendungsfeldes der Energiewirtschaft sektorenspezifischer Forschungsbedarf besteht. Die Energiewirtschaft steht exemplarisch für eine große Anzahl an historisch gewachsenen Branchen, in der gegenwärtig noch große Vorbehalte gegenüber innovativen und digitalen Dienstleistungen bestehen. Zukünftige Forschung sollte dies aufgreifen und zeigen, dass eine Ergänzung der bestehenden Produktangebote mit Dienstleistungen diese sogar aufwerten könnten. In diesem Zuge sollte betont werden, dass innovative Ideen häufig nicht in der eigenen Branche generiert, sondern aus der Interaktion von unterschiedlichen Fachgebieten, wie beispielsweise Telekommunikation, IT, Abrechnung oder Facility Management, entstehen. Letztendlich führen diese Entwicklungen zu umfangreichen Konvergenzen von ehemals getrennten Märkten, aber auch zu vielfältigen Chancen, die es ermöglichen, durch marktübergreifende Lernprozesse Produkt- und Prozessinnovationen zu initiieren. Dennoch besteht im Hinblick auf die Umsetzung von bran-

chenübergreifenden Dienstleistungen, der Nutzung von branchenfremdem Wissen in der Energiewirtschaft und vor dem Hintergrund der starken politischen und gesellschaftlichen Vernetzung der Energiewirtschaft, noch erheblicher Forschungsbedarf.

5.4 Implikationen für die Praxis

Aus den empirischen Ergebnissen lassen sich Implikationen für die Managementpraxis ableiten. Die vorliegende Arbeit beschreibt einen idealtypischen Verlauf des Servitization-Prozesses, der detailliert die Phasen und deren zugrundeliegende Barrieren beschreibt. Im Detail zeigen die empirischen Ergebnisse dieser Arbeit, dass *strategie-, implementierungs-, markt- und ökosystembezogene* Barrieren im Verlauf der Servitization auftreten. Zu Beginn der Servitization sollten Unternehmen insbesondere *strategiebezogenen* Barrieren Rechnung tragen. Die vorliegenden Ergebnisse zeigen, dass insbesondere in frühen Phasen der Servitization innovative PSS-Projekte häufig als Bedrohung der klassisch-produktorientierten Geschäftsmodelle wahrgenommen werden. Unternehmen sind daher gefordert, Servitization-Strategien zu implementieren, die konsequent auf widersprüchliche Aktivitätsmuster des eigenen Unternehmens eingehen. Auch sollten möglichst frühzeitig Verantwortlichkeiten und Ressourcen geklärt werden, um Anreize für PSS-bezogene Aktivitäten der Mitarbeiter zu schaffen. Dies gilt insbesondere für Energieversorger, die sowohl ihr klassisches Commodity-Geschäft aufrechterhalten müssen, auf der anderen Seite jedoch auch flexible und agile Unternehmensstrukturen benötigen, um neue Dienstleistungen und Geschäftsmodelle zu entwickeln.

Während zu Beginn der Servitization insbesondere *strategiebezogene* Barrieren zu überwinden sind, sind im Verlauf der Servitization auch *implementierungsbezogene Barrieren* evident. Während in Artikel IV dieser Arbeit die Auswirkung von IT auf die Innovationsperformance untersucht wurde, konnten auch weitere *implementierungsbezogene* Kompetenzen im Rahmen der Studie innovate!new identifiziert werden. Die Ergebnisse zeigen beispielsweise, dass es Energieversorgern für die Umsetzung innovativer PSS häufig an einem konkreten Innovationsprozess zur Ideengenerierung, -evaluierung und -entwicklung fehlt. Neben der Etablierung einer Strategie in frühen Phasen der Servitization, sollten Innovationsprozesse definiert werden, die gleichzeitig über eine gewisse Flexibilität verfügen, um möglichst, „beidhändig“ das produktorientierte Tagesgeschäft und innovative PSS-Projekte im Ausgleich zu halten. Neben klassischen Innovationsprozessen mangelt es ebenfalls häufig an relevanten Methoden und Instrumenten der PSS-Entwicklung.

Die erfolgreiche Servitization erfordert letztendlich ebenfalls die Überwindung *markt- und ökosystembezogener* Barrieren. Insbesondere in fortgeschrittenen Servitization-Phasen erhöht sich

die Komplexität der Aktivitäten. Häufig müssen für die Entwicklung von PSS eine Vielzahl zu integrierender Komponenten und benötigter Kompetenzen in einem Netzwerk aus privatwirtschaftlichen und öffentlichen Institutionen, inkl. ihrer Mitarbeiter und Kunden gebündelt werden. Daraus ergeben sich nicht nur hohe Anforderungen an die Interoperabilität – auch klassische Probleme des Netzwerkmanagements gilt es zu überwinden. Die Integration verändert die in der Energiewirtschaft etablierten Rollen und erfordert daher völlig neue Wertschöpfungsprozesse und -strukturen. Erst die auf diese Weise entstehenden „Business Ökosysteme“ ermöglichen jedoch den Aufbau von gemeinsamen Kompetenzen, einer breiten Akzeptanz und letztlich die geforderte branchenübergreifende Innovationskraft.

Die Fähigkeit den Servitization-Prozess erfolgreich umzusetzen, fußt letztendlich auf dem Reifegrad des Innovationsmanagements der produktorientierten Unternehmen. Gerade kleinere und lokal verankerte Stadtwerke und Energieversorger haben dabei zum einen durch ihre regionale und politische Vernetzung viele Möglichkeiten, aber auf Grund ihrer Größe nur eingeschränkte Innovationsmanagementfunktionen etabliert. Zusätzlich mangelt es ihnen oftmals an den notwendigen Fähigkeiten, um ein Netzwerk aus externen Partnern ganzheitlich zu erfassen, zu verknüpfen sowie systematisch zu entwickeln. Daher ist es insbesondere für Energieversorger relevant, sich mit der Evolution und der Analyse der Struktur und der Prozesse in den energiewirtschaftlichen Ökosystemen auseinanderzusetzen.

Trotz der erheblichen Herausforderungen, sollte abschließend festgehalten werden, dass Energieversorger aufgrund ihrer traditionellen Geschäftsfelder umfassende Potenziale besitzen, die künftig zur Ausdifferenzierung des Dienstleistungsangebots herangezogen werden können. Insbesondere kommunale Energieversorger sind durch ihre etablierte Rolle als lokal ansässiger Dienstleister mit breiter Kundenbasis, direktem Kundenzugang und bereits heute vorhandenen umfassenden Kundendaten auch dazu geeignet, als Betreiber neuer Dienstleistungsplattformen zu agieren. Dabei haben Energieversorger aufgrund ihrer verfügbaren Daten vielfältige Potenziale, um in einem branchenübergreifenden Netzwerk die Rolle des Orchestrators, also die eines Daten- und Dienstleistungsvermittlers mit Steuerungskompetenz einzunehmen und Kunden innovative Dienstleistungen auf Basis neuer intelligenter Technologien anzubieten. Beispielsweise könnten Energieversorger als Vermittler von Dienstleistungen (Handwerkerdienstleistungen, Facility Management etc.) jeglicher Art auftreten. Auch Pflegedienstleistungen und andere individuelle Betreuungsdienstleistungen könnten profitieren, da die Verbrauchsdaten eine Analyse von Verhaltensänderungen im häuslichen Umfeld ermöglichen. Energieversorger soll-

ten daher den stattfindenden Strukturwandel nicht nur als Gefahr für traditionelle Kernmärkte ansehen, sondern die Gelegenheit nutzen, neue Geschäftsfelder zu entwickeln und sich mittels innovativer Dienstleistungen am Markt neu zu positionieren.

Aus den dargestellten Managementimplikationen dieser Arbeit wurden mehrere Praxisartikel angefertigt. Tabelle 3 zeigt einen Überblick über die entstandenen Veröffentlichungen. Praxisbeitrag I, II, III und IV befinden sich im Anhang dieser Dissertation. Praxisbeitrag V beschreibt eine knapp 60-seitige Studie zum Innovationsmanagement von Energieversorgern.

| Praxisbeitrag | Titel | Veröffentlichungsstatus | Autoren |
|--------------------------|--|---|-----------------------------------|
| Praxisbeitrag I | Stadtwerke auf dem Weg zum Lösungsanbieter – Strategien und Barrieren | Veröffentlicht 2016 in Energiewirtschaftliche Tagesfragen, Heft 4. | Lütjen, H., Schultz, C. |
| Praxisbeitrag II | Quo vadis Energieversorger vs. Google und Co? - Eine Bedrohung für den Energiemarkt? | Veröffentlicht 2016 in Umweltschutz der Wirtschaft, No S/16, S.73-74. | Lütjen, H.; Schultz, C. |
| Praxisbeitrag III | Produkt-Service-Systeme als Chance? | Veröffentlicht 2017 in Zeitschrift Führung + Organisation (ZfO), Heft 6 | Schultz, C., Lütjen, H., Kroh, J. |
| Praxisbeitrag IV | Innovationskompetenz von Energieversorgern noch auf geringem Niveau | Veröffentlicht 2017 in Energiewirtschaftliche Tagesfragen, 67, Jg., Heft 8. | Kroh, J., Lütjen, H., Schultz, C. |
| Praxisbeitrag V | Innovationen in der Energiewirtschaft sind machbar – Innovationsmanagement als Erfolgsfaktor von Energieversorgern | Veröffentlicht 2017 (Eigendruck) | Schultz, C., Kroh, J., Lütjen, H. |

Tabelle 3: Übersicht der Praxisbeiträge

6. Erklärung über Eigenanteil

Die aufgeführten Artikel stellen einen wesentlichen Beitrag meiner wissenschaftlichen Forschungsleistung dar. Vier Artikel der Dissertation sind in Ko-Autorenschaft entstanden. Mein durchgängiger substanzieller Beitrag spiegelt sich in der Erst-Autorenschaft in vier Artikeln sowie als Zweitautor in einem Artikel wider. Artikel IV ist Gegenstand einer anderen laufenden Dissertation.

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Artikel I: Service transitions of product-centric firms: An explorative study of service transition stages and barriers in Germany's energy market.

Heiner Lütjen, Frank Tietze und Carsten Schultz

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Abstract

Although there is a rich body of empirical research that uses specific service offerings (e.g. product-related and customer-related services) as proxies for the extent of servitization, the results are inconsistent. We investigate service transitions from an innovation management and resource-based perspective, assessing the service transition stages through the service offering type, service innovativeness and the extent of invested internal and external resources. We use a qualitative approach based on interviews of managers from 19 energy utilities in Germany and complementary longitudinal secondary data. We identify three service transition stages: 1) service initiation, 2) service anchoring and (3) service extension. The findings indicate that firms concurrently experiment with different service offerings and that their services' innovativeness steadily increases during service transition. We contribute to servitization research by identifying barriers in each of the service transition stages that prevent product-centric firms from achieving a higher service transition stage. While in the service initiation stage, firms may face strategy-related barriers these are often followed by implementation-related barriers in the service anchoring stage and market-related barriers in the service extension stage. To overcome strategy-related barriers, our results indicate that firms should balance their product-oriented and service-oriented business model and can benefit from developing a clear strategic intent with relevant service offerings. We further find that implementation-related barriers can be overcome by establishing a service-specific innovation process. To overcome market-related barriers, the findings indicate that firms should integrate customers and external partners in the service innovation ecosystem.

Artikel II: Digitale Servitization – Die Rolle der Herkunft der Unternehmensleitung und des vergangenen Unternehmenserfolges

Heiner Lütjen

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Abstract

Die Trends der Digitalisierung und des Wandels von produktorientierten Unternehmen zu integrierten Dienstleistungsanbietern (Servitization) verschmelzen zunehmend miteinander. Produktorientierte Unternehmen verknüpfen verstärkt digitale Systeme, Komponenten und Technologien mit Produkt-Service-Systemen (PSS), um innovative Dienstleistungen zu entwickeln. Obwohl dieser Wandel neuartige Fähigkeiten und Kompetenzen der Unternehmensleitung erfordert, fehlen in der gegenwärtigen Forschung empirische Studien zur Auswirkung von Managementeigenschaften auf die Umsetzung digitaler Dienstleistungen. Am Beispiel der Untersuchung von 80 Energieversorgern wird im Rahmen dieser Studie daher ein integriertes Forschungsdesign entwickelt, das die Implementierung digitaler Dienstleistungen von produktorientierten Unternehmen bewertet, und Unterschiede auf Basis von Managementeigenschaften begründet. Die Ergebnisse der Studie zeigen, dass die Implementierung digitaler Dienstleistungen durch extern berufene Unternehmensleiter positiv beeinflusst werden kann. Ferner zeigen die empirischen Befunde, dass der vergangene Unternehmenserfolg einen direkten negativen Effekt auf das digitale Dienstleistungsportfolio eines Unternehmens hat, und zusätzlich den Wirkungszusammenhang von Herkunft der Unternehmensleitung und der Implementierung digitaler Dienstleistungen moderiert.

Artikel III: Top Management Team Impact on Servitization: Does the TMT Experience Make a Difference?

Heiner Lütjen und Carsten Schultz

1. Abstract

Although servitization has been considered a strategic renewal, current research provides us very few answers as to how top management team (TMT) experience may enhance the firm's degree of servitization. Building on upper echelons, strategic renewal and servitization research, this study aims to contribute to an increased understanding of the role of TMT experience in the firm's servitization journey. We theorize that an increasing focus on services goes along with substantial risks and requires the development of new organizational capabilities. As such, we argue that TMT characteristics affect strategic choices towards service-centric business models. Using data of 212 TMTs in 139 German energy utilities, we hypothesize and find evidence for positive effects of outside hires and short-tenured TMTs on the firm's degree of servitization. We empirically demonstrate that TMT experience beyond the focal industry has neither a positive nor a negative effect per se on the firm's degree of servitization, and argue that positive and negative consequences of TMT cross-industry experience may compensate each other. In proposing new research directions, we underscore the relevance of integrating determinants of managerial cognition and behaviour into servitization theorizing.

2. Introduction

One of the most striking trends on the business landscape over the last 30 years has been the strategic renewal in manufacturing firms from a product-oriented towards a service-centric business model, often referred to as servitization (Baines & Lightfoot, 2013; Kowalkowski et al., 2017b; Vandermerwe & Rada, 1988). In addition, a wealth of upper echelons and strategic change research has provided strong empirical evidence that the top management team (TMT) composition affects the firm's strategic renewal (Bromiley & Rau, 2016; Crossland et al., 2014). Given the critical role TMT members play in the servitization context (Kowalkowski et al., 2017b; Luoto et al., 2017), and the lack of research efforts to unite servitization and strategic renewal research, this study aims to contribute to a better understanding of the relationship of TMT composition and the firm's servitization journey. In this research, we propose TMT experience as a critical determinant for the firm's strategic renewal towards a service-centric business model.

Although theory suggests that servitization makes substantial contributions to a firm's performance (Benedettini et al., 2017; Gebauer, 2009; Oliva & Kallenberg, 2003), it also entails difficult trade-offs between benefits and challenges (Baines et al., 2017). Several studies have argued that firm's servitization journey is positively related to stable revenues (Oliva & Kallenberg, 2003; Wise & Baumgartner, 1999), lower imitation risks (Sasser, Schlesinger, & Heskett, 1997), and higher strategic flexibility (Gebauer, Gustafsson, & Witell, 2011). In contrast, several servitization studies found that more service offerings can also lead to higher coordination costs (Nordin et al., 2011), increasing uncertainty of investors (Benedettini et al., 2017), and even the risk to cannibalize the established product-centric business (Lütjen, Tietze, & Schultz, 2017). Further, a firm's servitization journey goes along with a higher complexity and fuzziness of service innovations compared to product innovations (Nijssen et al., 2006; Storey, Cankurtaran, Papastathopoulou, & Hultink, 2016). In the service context, firms have to cope with a stronger involvement of customers and network partners, potential incompatibilities with existing capabilities, and often a lack of clarity about the relevant goals and the allocation of resources during the new service development (NSD) process (Atuahene-Gima, 1996; Edvardsson, Haglund, & Mattsson, 1995).

Taken together, the potential challenges of servitization suggest that TMTs need to initiate the strategical renewal under conditions of uncertainty, and find themselves weighing the potential gains and losses of exploring new service business models versus maintaining the product-oriented status quo. Owing to the trade-offs between the competing product and service business,

and the needed organizational capabilities to cope with the service complexity, servitization is considered as a useful setting to study the effect of TMT characteristics.

Although scholars and practitioners agree that the TMT composition affects a firm's effort to servitize (e.g., Fischer, Gebauer, Gregory, Ren, & Fleisch, 2010; Gebauer et al., 2005; Oliva & Kallenberg, 2003), empirical evidence concerning the role of TMT experience in servitization research remains scant (Kowalkowski et al., 2017b; Luoto et al., 2017). A few qualitative studies have shown that top managers can act either as efficient champions (Washbourne & Dicke, 2001), whereas others have seen top managers as antagonists, particularly in the beginning of the servitization journey (Fischer et al., 2010; Gebauer et al., 2005).

In light of the research gap in the interface between TMT composition and the firm's servitization journey, we build on Upper Echelons Theory and define strategic choices towards service-centric business models as a function of the TMT experience (Bromiley & Rau, 2016; Hambrick & Finkelstein, 1987). Studies examining the effect of TMT experience on strategic renewal broadly define experience in terms of TMT age, tenure, career, origin, and succession (Bromiley & Rau, 2016). In this research, we focus on TMT outsider ratio, TMT tenure, and TMT cross-industry experience. Because specific industry environments will dominate the need for the implementation of strategic renewal (Crossland et al., 2014; Georgakakis & Ruigrok, 2017), we control for industry influences by performing a secondary data analysis of 139 firms and 212 TMT members in the German energy industry.

This study has several contributions to the current body of knowledge. First, while scholars have found that TMT experience clearly affects strategic renewal (for an overview see Bromiley & Rau, 2016; Busenbark, Krause, Boivie, & Graffin, 2016), empirical studies have provided largely contradictory results (Williams, Chen, & Agarwal, 2017). In this respect, we intend to portray a more precise picture of how TMT experience affects a firm's strategic renewal by using the novel servitization context. Taken together, our empirical findings suggest that a greater outsider TMT ratio and a shorter TMT tenure positively affect the firm's degree of servitization, while a TMT experience beyond the focal industry has no effect on firm's servitization journey. These results underline that strategic renewal profits from a greater distance of the TMT to the firm's current operations, and show that cross-industry experiences may also come with downsides while implementing new services strategies.

For the literature on servitization, our study responds to recent calls in research for more theoretical foundations on servitization (Valtakoski, 2017), especially in the context of TMTs (Kowalkowski et al., 2017b). Integrating upper echelons, strategic renewal and servitization research, we provide a deeper understanding of the mixed results concerning the servitization

outcome by showing that certain TMT compositions affect strategic choices towards service-centric businesses. Finally, this work responds to the call for an improved measurement of the firm's degree of servitization, which has received considerable critical attention in existing research (Benedettini et al., 2017; Kohtamäki, Partanen, Parida, & Wincent, 2013). We provide a novel and more refined conceptualization of the underlying construct of the degree of servitization by evaluating the number of a firm's service offerings and their innovativeness.

The remainder of this paper is structured as follows: We begin by briefly reviewing upper echelons and strategic renewal literature. We then present the role of TMTs in the context of servitization and derive hypotheses for TMT outsider ratio, TMT cross-industry experience and TMT tenure. Subsequently, we describe the methodology and present a multivariate regression analysis, which investigates the effects of TMT experience on the firm's degree of servitization. Finally, we discuss our main findings and conclude with theoretical and managerial implications, limitations, and suggestions for further research.

3. Theoretical Background

3.1 Strategic Renewal and Upper Echelons Theory

Strategic renewal can be defined as “the process, content, and outcome of refreshment or replacement of attributes of an organization that have the potential to substantially affect its long-term prospects” (Agarwal & Helfat, 2009: 282). A substantial body of work has shown that strategic renewal substantially contributes to organizational growth (Agarwal & Helfat, 2009; Harrell, O'Reilly, & Tushman, 2007), but also causes conflicting trade-offs between continuity and change (Crossan & Berdrow, 2003; Williams et al., 2017).

Consistent with these findings, organizational scholars building on the core principles of upper echelons theory have provided strong empirical evidence that TMT experience plays an essential role in shaping strategic renewal and firm-level outcome (Bromiley & Rau, 2016; Carpenter, Geletkanycz, & Sanders, 2004; Hambrick & Mason, 1984; Lewis et al., 2014). Based on thoughts of the behavioural theory of the firm (Cyert & March, 1963), upper echelons theory asserts that TMT characteristics are significantly related to their cognitive bases and values, therefore influence strategic choices (Hambrick & Mason, 1984; Wiersema & Bantel, 1992; Zhang & Wiersema, 2009), and ultimately affect the firm's performance (Finkelstein et al., 2009b).

Since the seminal work of Hambrick and Mason (1984) on the firm's upper echelon, scholars have sparked a substantial stream of research, which can be distinguished into three different

approaches (Bromiley & Rau, 2016). The first approach investigates the direct or indirect effects of TMTs' observable demographic characteristics (e.g., age, origin, tenure, gender) on different firm-level outcomes (Crossland et al., 2014; Henderson, Miller, & Hambrick, 2006). The second approach examines the effects of TMTs psychological characteristics such as cognition, values and the underlying attitudes and expectations (Kashmiri, Nicol, & Arora, 2017). The third set of studies focusses on group characteristics, and examines the relevance of social relationships between TMT members (De Jong, Song, & Song, 2013). In this paper, we focus on directly observable TMT characteristics that are used as proxies for the more complex, non-observable psychological characteristics.

3.2 The role of TMTs for the Firm's Servitization Journey

Several scholars used theoretical reasoning based on market forces (Vandermerwe & Rada, 1988), resource-based perspective (Lütjen et al., 2017), ecology population (Finne et al., 2013), dynamic capabilities (Kindström et al., 2013), relational view (Mathieu, 2001a) and industry lifecycles (Cusumano et al., 2015) to explain the firm's servitization journey. However, servitization research still lacks coherent theoretical foundations to explain the role of TMTs (Kowalkowski et al., 2017). Thereby, the upper echelons view is consistent with empirical results examining the role of TMTs in the firm's servitization journey.

First, several scholars theorize that TMT characteristics and values affect servitization outcomes due to the inherent managerial cognitive bias. For example, some researchers found a lack of managerial belief on the economic potential of services (Gebauer et al., 2005; Luoto et al., 2017), the general overemphasis of tangible assets instead of intangible assets (Gebauer et al., 2005), and a strong managerial risk aversion (Fischer et al., 2010). In this respect, scholars suggest that top managers prefer the well-known product business to the uncertain service business (Gebauer et al., 2005; Oliva, Gebauer, & Brann, 2012).

In addition to the managerial cognitive bias, scholars have recently paid attention to the trade-offs of servitization by examining the benefits (e.g., stable revenues, lower imitation risks, higher flexibility) and challenges (e.g., higher coordination costs, uncertainty, cannibalization effects) of extending the service business (Baines et al., 2017; Benedettini et al., 2017). For example, Gebauer, Saul, Haldimann, and Gustafsson (2016) demonstrate that pay-per-use services sometimes pose a risk to the company profitability as they reduce the level of vertical integration. As vertical integration often plays a key role to secure the aftermarket, firms have to cope with a trade-off between securing revenue and managing costs. Rymaszewska, Helo,

and Gunasekaran (2017) present 10 strategic choices regarding Internet of Things (IoT) strategies. The scholars argue that building an IoT servitization strategy requires a comprehensive assessment of the benefits of the IoT service and the consequences of the integration with an enterprise business system (e.g., embedded software and tools).

As previously described, another important TMT issue relates to the greater complexity of service innovation compared to product innovation. Services often arise ad hoc from direct interaction with customers (Gebauer et al., 2005), and especially in the front end of innovation, success factors, challenges, and functional characteristics of a new service are fuzzy. Consequently, TMTs have to cope with an emergent, interactive, and dynamic service innovation process (Gallouj & Weinstein, 1997). In sum, the previous literature on servitization contributes to the overall understanding of the TMT role by demonstrating that the firm's servitization journey is as a double-edged sword. However, despite the previously mentioned cognitive bias, multiple trade-offs, and a greater service complexity compared to products, literature generally lacks on empirical evidence, how TMT experience affects strategic choices to implement servitization activities. In the following, we elaborate our hypotheses by theorizing how TMT experience affect the firm's servitization journey.

3.3 Hypothesis development

TMT outsider ratio

A wealth of previous TMT studies has examined how outside hires and internally promoted candidates affect strategic renewal (Karaevli, 2007; Kesner & Dalton, 1994; Williams et al., 2017; Zhang & Rajagopalan, 2004). Newly appointed TMTs can typically be divided into two categories: (1) TMT members who come from inside the company ("Insider"), and (2) TMT members who come from external organizations ("Outsider") (Zhang & Rajagopalan, 2010). However, despite more than six decades of research there is much controversy, on how the TMT origin affects strategic renewal (Bailey & Helfat, 2003; Georgakakis & Ruigrok, 2017; Karaevli, 2007).

While insiders are generally less costly (Bidwell, 2011; Williams et al., 2017), associated with firm familiarity (Zhang & Rajagopalan, 2004), and strong firm-specific skills (Bailey & Helfat, 2003), candidates from outside bring in more novel know-how, experiences and capabilities instead (Harris & Helfat, 1997; Zhang & Rajagopalan, 2004). In addition, while inside candidates are associated with incremental renewal in stable industries, outsiders often tend to initiate more radical change in dynamic environments (Kesner & Dalton, 1994).

Owing to the service development complexity, we argue that recruiting outside candidates increases the probability to bring in new perspectives and cognitive values that are essential for the firm's servitization journey. Service innovations frequently depart from the existing resource base and involve complementary innovation sources such as the customers as co-producers. Recruiting outside candidates promote the access to a much deeper understanding of customer needs and collective learning processes (Campbell, Coff, & Kryscynski, 2012; Williams et al., 2017), and enables firms to leverage their external network. In addition, consistent with organizational management studies arguing that outsiders break up path dependencies (Zhang & Rajagopalan, 2010), it is likely that internally promoted candidates are more challenged to develop new servitization strategies due to emotional connection with the traditional product-business (Wiengarten, Lo, & Lam, 2017).

In sum, we argue that innovative ideas and novel capabilities are essential for servitizing firms to challenge the status quo of a firm's product-business and to renew the resource base. In this respect, outsiders can help firms to reconfigure technological and organizational resources, processes and routines (Kowalkowski et al., 2017). Thus, we posit a positive relationship between TMT outsider ratio and the firm's degree of servitization.

Hypothesis 1. The higher the TMT outsider ratio, the greater is the firm's degree of servitization.

TMT cross-industry experience

While TMT outside hires refer to the gained knowledge from other firms, complementary know-how may originate beyond the focal industry as well. The question of how TMT cross-industry experience influences the strategic renewal is a long-standing issue in organizational studies (Crossland et al., 2014; Williams et al., 2017). Hambrick, Geletkanycz, and Fredrickson (1993) found that strong cross-industry experience has led CEOs to be less committed to the firm's status quo. George and Zhou (2001) argue that working in a new industry involves the acquisition of new skills and improves the development of creative solutions, and Crossland et al. (2014) argue that TMTs with experience from diverse institutional environments "have personal dispositions favoring experimentation and change" (p. 653). Consistent with studies examining the TMT career experiences (Crossland et al., 2014; Georgakakis & Ruigrok, 2017), we argue that TMTs with a variety of industry experience make a positive contribution to the firm's degree of servitization.

Across many industries, ideas for services are often not generated in the traditional industry, but arise from the interaction of different industries (Enkel & Gassmann, 2010). However, research has demonstrated that firms increasingly face challenges of coordinating activities across organizational boundaries (Zhang et al., 2016). Such network challenges include, for instance, the problems of cooperation with competitors (coopetition) and the problems of establishing and maintaining networks, as well as of terminating established partnerships (Ritter and Gemünden, 2003). Consequently, service innovations require the ability to orchestrate the service ecosystem efficiently (Adner & Kapoor, 2010; Kindström et al., 2013; Moore, 1993). In this context, servitizing firms need TMTs with access to diverse knowledge and networks beyond firm boundaries in order to adapt to new organizational settings (Georgakakis & Ruigrok, 2017).

Thus, we hypothesize that TMTs with a greater cross-industry experience will increase the degree of servitization, because they bring in a range of capabilities, openness to diverse ideas, and a broader network.

Hypothesis 2. The greater the TMT cross-industry experiences, the higher the firm's degree of servitization.

TMT tenure

Organizational tenure is a central variable in upper echelons research (Hambrick & Mason, 1984; Miller & Shamsie, 2001; Wu, Levitas, & Priem, 2005), and an essential indicator of TMT experience (Wang, Holmes, Oh, & Zhu, 2016a). Yet, like much of the research in the TMT experience domain, the field has not coalesced around a coherent set of findings. Some research finds positive effects of long-tenured top managers (Finkelstein & Hambrick, 1990; McClelland, Liang, & Barker III, 2010), other studies show negative instead (Nadkarni & Herrmann, 2010; Wang et al., 2016a) or more complex, often inverted u-shaped relationships (Miller & Shamsie, 2001; Wu et al., 2005).

The arguments for TMTs with a longer average tenure base on a better understanding of firm-specific routines, skills and procedures (Finkelstein, Hambrick, & Cannella, 2009a), a greater social cohesion (Michel & Hambrick, 1992) and enhanced communication effectiveness (Boone, Van Olfen, Van Witteloostuijn, & De Brabander, 2004). In contrast, long-tenured TMTs often develop a strong commitment towards the firm's status quo, and rely too much on proven paradigms that have secured the company's past success (Boeker, 1997a; Finkelstein et al., 2009b). Given these effects on strategic renewal in general, it is likely that the TMT tenure

affects the firm's servitization journey. However, neither conceptual nor empirical servitization studies have examined the relationship of TMT tenure and the firm's degree of servitization. As previously mentioned, service innovation is often less standardized and fuzzy, faced by trade-offs between strategic choices, and limited by managerial cognitive bias. Within this context, managers often tend to underestimate the value of services compared to products (Gebauer et al., 2005). This bias appears to be more relevant when managers have longer average tenure, as they become rigid over time and often more committed with the product-centric status quo. We argue that TMTs with a long-term focus on the current product-business are more likely to support product-oriented strategies and fail to recognize the economic potential of the new and risky service business. Consequently, they become more willing to secure the product-centric status quo over time and implement efficiency-oriented product-strategies instead of explorative servitization strategies.

Further, longer-tenured TMTs have developed a strong firm- and industry specific knowledge, which is more important in stable industries than in dynamic environments. Similarly, scholars have empirically demonstrated that firms located in dynamic environments, require a stronger and often riskier strategic renewal (Wu et al., 2005). Considering servitization as a risky strategic renewal, it is likely that short-tenured TMTs are more willing to take risks in a strategic renewal toward a service-centric business model.

Taken together, we argue that TMTs with shorter average tenure are less conservative and risk-averse (Barker & Mueller, 2002), more open-minded, have more pressure to prove their power and competences (Chen, Hsu, & Huang, 2010; Wang et al., 2016a), and are more often initiating product innovation and differentiation (Rajagopalan & Spreitzer, 1996). Thus, we hypothesize that TMTs with a longer average tenure have a negative effect on the firm's degree of servitization.

Hypothesis 3. The longer the TMT average tenure, the lower the firm's degree of servitization.

Figure 1 shows an overview of the research framework. In sum, we expect that TMT outsider ratio has a positive effect, TMT cross-industry experiences may have either a positive or a negative effect, and TMT tenure has a negative effect on the firm's degree of servitization.

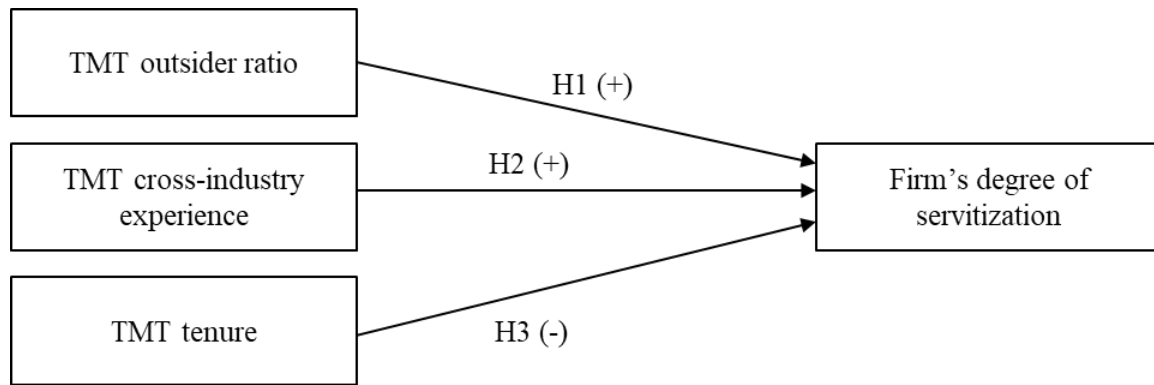


Figure 1. Research framework

4. Methodology

4.1 Empirical context

The German energy industry offers an attractive empirical context for studying the effect of TMT experience on the firm's degree of servitization, as its environment is characterized by a high degree of uncertainty and ambiguity. The energy transition from fossil fuels and nuclear energy to decentral deployment of renewable energy technologies and energy efficiency services has fundamentally changed the business model of German energy utilities. Traditionally, energy provision has been regarded as a commodity through which customers passively receive gas, water or electricity from energy utilities (Helms, 2016; Kehrel & Sick, 2014). Nowadays, several utilities attempt to innovate and change their commodity-oriented toward a service-centric business model. Service offerings range from simple consulting and energy saving services to extensive smart home and electro mobility services (Schultz et al., 2017). Although energy services play a key role for the energy transition (Kehrel & Sick, 2014; Müller et al., 2008; Richter, 2013), the utility sector generally shows a low innovation intensity, and only a few utilities have been successful in offering services in addition to their existing commodity base (Lütjen et al., 2017). Within this context, we argue that there is large room for TMTs, to choose between different strategic alternatives, especially for or against servitization activities.

4.2 Data collection

Germany's energy industry, with more than 1,000 energy utilities, is characterized by three firm types: (1) national utilities, (2) regional utilities, and (3) municipal utilities (Nikogosian & Veith, 2012). We focus on municipal and regional utilities, which cover the entire value chain from the generation of electric and thermal energy to the transmission, distribution, and delivery to end-customers. We identified the relevant group of energy utilities based on membership

lists of professional organizations (e.g., Bundesverband der Energie und Wasserwirtschaft, Verband kommunaler Unternehmen) and participant lists of specific industry conferences. We identified 211 energy utilities, which had at least a website and three annual reports that we could access from public registers. Consistent with recent TMT research, we dropped micro firms with fewer than 20 employees (García-Granero, Fernández-Mesa, Jansen, & Vega-Jurado, 2017), and we excluded firms with more than 1000 employees, because TMT members are more embedded in operational tasks in small and medium-sized firms (Kraiczy, Hack, & Kellermanns, 2015).

TMT information were manually collected from multiple secondary data sources, including www.moneyhouse.de, a comprehensive database for more than 8,500,000 managers in Germany, newspapers, internal firm documents, websites, annual reports, and other publicly available information. In case of uncertainties about the validity of data, we contacted executives via e-mail and telephone to validate the information. The data collection was conducted by four researchers and took nine months to complete (from April to December 2016). Excluding those with missing information or missing the above mentioned criteria, our sample included 212 TMT members in 139 energy utilities. 75 firms had one board member, 58 had two board members, and 7 had three board members included in the TMT.

4.3 Measures

Dependent variable

Given the critical stance of scholars concerning the measurement of the firm's degree of servitization, the dependent variable was measured using information from web sites, annual reports and press articles on the number and innovativeness of the implemented services. To identify of the number of services, we used qualitative content analysis. We relied on multiple sources of secondary data, which are usually publicly available and allow for replication (Calantone & Vickery, 2010). The sources of information on service activities were the last annual report, websites and press articles which typically represent a valid evidence of service activities (Benedettini et al., 2017; Bowman, 1982).

First, we defined the relevant services for our study and developed a list of the services that was based on prior energy and servitization research (Kindström & Ottosson, 2016; Müller et al., 2008). We focused our research on the commercial key businesses of the energy utilities, namely: electricity, gas, heat and telecommunications. We pilot tested the list of services with an innovation manager to ensure that we take into account all relevant services. Using the list of 61 distinct services, we analysed the sources of information (annual reports, websites and

press articles) between 2013 and 2016 for each firm. During the examination, the service categories were developed further, if we detected other service categories that differed sufficiently from the services in our list. The selection process led to a list of 71 different services. In order to minimize distortion effects, we included only services in the analysis, if they were demonstrably in the implementation phase, while services that were merely “planned” were eliminated.

Empirical innovation research shows that service innovativeness needs to be conceptualized by different facets (Atuahene-Gima & Evangelista, 2000; Schultz et al., 2013b). We followed this multifaceted view and used four dimensions to classify the innovativeness of each service: market, technology, firm-internal and environment (Schultz et al., 2013b). The market dimension refers to the offer of a new customer value, and the implementation of a new market or the reorganisation of the value chain in the industry. The technology dimension describes changes in technology components or principles of new services or products that require a new knowledge base. The firm-internal dimension relates to the change of a firm’s market strategy. This includes adaptations in technology strategy, organization structures or organizational culture due to the innovativeness of a new service. The environmental dimension refers to changes in infrastructures, industry norms or society values.

Consistent with research in this domain, we used the Consensus Assessment Technique (CAT) (Amabile, Conti, Coon, Lazenby, & Herron, 1996) to evaluate the service innovativeness. Three different energy experts evaluated the innovativeness of services to ensure a high validity of the results. We selected experts with a long-term energy industry experience and different professional backgrounds. Expert A works in the field of innovation management for a regional utility, expert B works as an energy consultant in the field of energy services and expert C works as sales manager in an energy utility firm. To assess the degree of innovativeness, each service was described as objectively as possible by using a prepared written document.

Then, we asked the expert to evaluate the innovativeness in four dimensions for each service category on a seven-point Likert scale (with the anchors ‘1 = low innovativeness ‘7 = high innovativeness’). To avoid group dynamics between the experts, each expert evaluated the service categories individually. To detect assessment differences between the experts, we used the intraclass correlation coefficient (ICC). The ICC value showed a value of 0.76 for all dimensions which is above the threshold of 0.7 to secure reliability and validity. Overall, the experts indicated significant agreement. In case a service showed ICC values below this threshold, we discussed the service categories with the experts.

A dichotomous scale (with “0 not offered” and “1” offered”) was used to measure the number of services. Then, for each implemented service, the four innovativeness dimensions of the experts were averaged, and summed up to produce the firm’s degree of servitization. This variable was natural log transformed to correct for skewness. In order to avoid method distortions and to improve causality, we assumed that TMTs require at least one year translating strategic decisions into new service initiatives. Thus, the degree of servitization as the dependent variable is lagged by 1 year (Hambrick, Humphrey, & Gupta, 2015).

Independent variables

We measured TMT characteristics following the criteria established in upper echelons research. Consistent with prior research in this domain, we focus on the two top-level managers within the firms (Williams et al., 2017). This embraces the chief executive officer (CEO), and (whenever they appeared in our empirical cases), commercial directors and technical directors.

Following prior studies (Williams et al., 2017), *TMT tenure* was calculated as the average number of years the TMT members have held the position on the TMT of firm *i* in year *t*. According to Zhang and Rajagopalan (2010), the *TMT outsider ratio* was coded 1, if the TMT member was hired from outside or had TMT experience of less than one year within the firm, and 0 otherwise. We calculate the TMT outsider ratio as the number of outside TMT members divided by the total number of TMT members. The *TMT cross-industry experience* was measured as the sum of the industry sectors that a TMT member had worked in, divided by the total number of TMT members.

Control variables

In our study, we controlled several factors that may affect the firm’s degree of servitization. First, we controlled for various TMT characteristics in prior studies on TMT experience. We added a control variable for *TMT age*, as upper echelons research has provided mixed results regarding the effects of TMT age on firm performance. While some studies have shown that senior executives are often risk-sensitive and develop less innovative strategies than younger leaders (Hambrick & Mason, 1984), other studies have indicated that older executives can be characterized with higher credibility (Cohen & Dean, 2005). We control for the *Top management team (TMT) size*, because research suggests that it affects the firm’s decision-making processes (Bantel & Jackson, 1989). *TMT size* was calculated by the total number of TMT members (Nakauchi & Wiersema, 2015). We added a control for the firm-contextual variable *prior firm performance*, which is suggested to be associated with organizational performance (Boeker,

1997b), and the degree of servitization (Böhm et al., 2017). We used average return on assets (ROA) over the previous three years, instead of ROA change, which may limit the effects of single-year outliers (Georgakakis & Ruigrok, 2017; Zhang & Rajagopalan, 2010). Further, we control for the educational background. We code 1 for TMT members without an apprenticeship, 2 for TMT members with at least an apprenticeship, 3 for TMT members with least a bachelor's or master's degree, and 4 for at least one doctoral degree or MBA (Wiengarten et al., 2017). The majority of TMT members obtained at least one master degree prior to their appointment.

We also used information about the number of employees as a proxy for *firm size*, as larger firms tend to have more slack resources and being more able to servitize than small firms (Benedettini et al., 2017; Neely, 2008). According to previous research, we measured *firm size* by taking the natural log of the number of employees (Lewis et al., 2014; Simsek, 2007). As public firms may operate different than privately held firms (Boeker, 1997b), we control for *ownership*. Firms with a private ownership of more than 50% are coded as 1, state and municipal ownership as 0. Scholars have found that the board of directors affect strategic renewal (Carpenter et al., 2004). To capture governance conditions and institutional influences, we measured the *number of shareholders* who own more than five percent of focal firm's stock (Wiengarten et al., 2017). Because energy utilities with an own *energy grid* have potentially greater possibilities to develop specific service types (e.g., telecommunication services), we coded 1 for firms with an own energy grid, and 0 otherwise.

5. Results

Table 1 reports the descriptive statistics and correlations for all variables. The firm's degree of servitization varied from 13.25 to 106.83. The TMT size ranged from 1 to 3 TMT members, with a mean of 1.5. The TMT age varied from 40 to 65 years, and the TMT tenures varied from 1 to 24 years. Table 1 indicates that there are significant correlations between the TMT outsider ratio, TMT tenure, firm size, TMT size and the firm's degree of servitization. TMT size is also related to firm size, as larger firms having larger top management teams. As can be seen in Table 1, neither the independent nor the control variables correlate strongly ($r \geq .50$). The results for the variance inflation factors (VIFs) show that the highest VIF score in our analysis is 1.4, which is below the traditional threshold value of 5. This imply that multicollinearity is not an issue (Cohen et al., 2003). The Kolmogorov-Smirnov test shows that the logarithmic dependent variable does not significantly differ from the normal distribution (Hair, Black, Babin, & Anderson, 2009a).

| Variables | M | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--|-------|------|--------|-------|-------|------|-------|------|-------|-------|-----|------|-----|----|
| 1 Firm's degree of servitization (LN) | 3.64 | .45 | 1 | | | | | | | | | | | |
| 2 TMT tenure ^o | 9.27 | 4.85 | -.25** | 1 | | | | | | | | | | |
| 3 TMT outsider ratio ^o | .71 | .41 | .24** | -.16 | 1 | | | | | | | | | |
| 4 TMT cross-industry experience ^o | .74 | .76 | .08 | -.01 | .213* | 1 | | | | | | | | |
| 5 TMT size ^o | 1.51 | .59 | .36** | -.12 | -.10 | .03 | 1 | | | | | | | |
| 6 TMT age ^o | 53.44 | 5.41 | .09 | .45** | -.18* | .01 | .06 | 1 | | | | | | |
| 7 Prior firm performance ^o | 6.53 | 5.74 | -.01 | .07 | -.05 | .01 | .20* | .04 | 1 | | | | | |
| 8 Public ownership ^o | .12 | .33 | .11 | -.15 | -.04 | .01 | .19* | -.04 | .26** | 1 | | | | |
| 9 Firm size ^o (LN) | 5.46 | .81 | .50** | -.11 | .09 | .04 | .39** | .12 | -.21* | .19* | 1 | | | |
| 10 Owner of the energy grid ^o | .94 | .23 | -.03 | .05 | -.02 | .04 | -.15 | .00 | -.20* | -.10 | .11 | 1 | | |
| 11 Number of shareholders ^o | 2.14 | 1.87 | .19* | -.02 | .03 | -.03 | .16 | .09 | .20* | .41** | .11 | -.11 | 1 | |
| 12 TMT education | 3.12 | .41 | .17* | -.09 | .19* | -.02 | -.01 | -.02 | -.20* | .05 | .16 | .03 | .06 | 1 |

^o = Lagged variables (t = - 1); M = mean; SD = standard deviation; * = p < .05; ** = p < .01; n = 139

Table 1. Descriptive Statistics and Correlations for All Variables

Our data were analysed using four stepwise OLS regression models with the firm's degree of servitization as the logarithmic dependent variable. Model 1 is the basic model and consists of

three individual control variables (TMT size, TMT age, TMT education) and five firm-level control variables (public ownership, prior firm performance, firm size, owner of the energy grid, and number of stakeholders). Model 2 considers the relationship of TMT outsider ratio and the firm's degree of servitization, and Model 3 examines the effect of TMT cross-industry experiences on the firm's degree of servitization. The full model (Model 4) additionally considers the effect of TMT tenure on the firm's degree of servitization. Table 2 presents tests of H1, H2a, H2b and H3, including all control variables.

As Model 1 in Table 2 indicates, the firm's degree of servitization increases with firm size ($b = .24$; $p < .0001$) and TMT size ($b = .13$; $p < .05$). The positive firm size indicates the effect of available resources on the ability to develop new services. Slack resources allow firms to invest in rather uncertain service development initiatives. The positive effect of TMT size reveals the relevance of a balanced power distribution, and different viewpoints for servitization activities (Haleblian & Finkelstein, 1993). Finally, TMT age, public ownership, TMT size, prior firm performance, ownership of the energy grid, number of shareholders and TMT education do not seem to have an effect on the firm's degree of servitization. In sum, Model 1 explains about 27 % of variance of the firm's degree of servitization.

Hypothesis 1 predicts that adding TMT members from outside the firm would be associated with a positive impact on the firm's degree of servitization. The results suggest a significantly positive effect of TMT outsider ratio on the firm's degree of servitization ($b = .24$; $p < .001$). Thus, we find evidence consistent with Hypothesis 1. Model 3 tests Hypothesis 2, which predicts a positive effect of TMT cross-industry experience on the firm's degree of servitization. The findings show that TMT cross-industry experience does not significantly increase the degree of servitization, thus we are failing to provide support for H2. Taken together, the positive effects of TMT cross-industry experience appear to compensate, but not to outweigh the disadvantageous effects.

Finally, Model 4 tests Hypothesis 3, which predicts that when current TMT members have longer average tenures, the effect on the firm's degree of servitization will be negative. The findings empirically demonstrate that the TMT tenure has a significant negative direct effect on the firm's degree of servitization. ($-.02^{***}$; $p < .001$). Thus, the results are consistent with H3. The overall variance explained is about 34 % and the independent variables for testing our hypotheses explain an additional variance of about 7 %.

| Variable | Model 1 (Controls) | Model 2 (Main effects) | Model 3 (Main effects) | Model 4 (Main effects) |
|--|-----------------------|---------------------------|---------------------------|---------------------------|
| <i>Intercept</i> | 1.69**** (.47) | 1.51**** (.46) | 1.51**** (.46) | 1.34** (.46) |
| TMT size ^o | .13** (.06) | .16** (.06) | .16** (.06) | .14** (.06) |
| TMT age ^o | -.00 (.01) | .01 (.01) | .00 (.01) | .01 (.01) |
| Prior firm performance ^o | .00 (.01) | .00 (.01) | .00 (.01) | .01 (.01) |
| Public ownership ^o | -.10 (.12) | -.08 (.11) | -.08 (.11) | -.11 (.11) |
| Firm size ^o (LN) | .24**** (.05) | .22**** (.05) | .22**** (.05) | .21**** (.05) |
| Owner of the energy grid ^o | -.07 (.15) | -.05 (.14) | -.05 (.14) | -.03 (.14) |
| Number of shareholders ^o | .03 (.02) | .03 (.02) | .03 (.02) | .03 (.02) |
| TMT education | .13 (.08) | .08 (.08) | .09 (.08) | .08 (.08) |
| <i>Independent variables</i> | | | | |
| TMT outsider ratio ^o | | .24**** (.08) | .24**** (.08) | .22** (.08) |
| TMT cross-industry experience ^o | | | .01 (.04) | .01 (.04) |
| TMT tenure ^o | | | | -.02*** (.01) |
| F | 7.387**** | 7.927**** | 7.096**** | 7.624**** |
| R ² | .31 | .35 | .36 | .40 |
| Adjusted R ² | .27 | .31 | .31 | .34 |

* p < 0.10; ** p < 0.05; *** p < 0.01; **** p < 0.001; N=139; Standard errors are indicated in brackets.

Table 2. Effects on Firm's degree of servitization

Robustness Checks

As with any empirical analysis, it is important to establish the robustness of the empirical results. Thus, we conducted a series of robustness tests to support our findings. First, we tested the firm's degree of servitization by only measuring the number of services without taken into consideration the service innovativeness. The results remained substantively similar. Then, we

ran supplementary analysis to test for moderating effects. Driven by empirical results demonstrating a past performance effect on TMT characteristics (Boeker, 1997b), we test for moderating effect of past performance on TMT tenure, TMT cross-industry experience and TMT outsider ratio. Neither of these effects appear to be significant. Consistent with empirical findings demonstrating an inverted u-shaped effect of CEO tenure on innovation (Miller & Shamsie, 2001; Wu et al., 2005), we additionally test for quadratic effects. However, we do not find support for curvilinear effect between the variables.

6. Discussion

In the last decades research on TMT influence on strategic renewal has developed into one of the most prominent areas in organizational management studies (Bromiley & Rau, 2016). While upper echelons research has led to a wealth of mixed and inconsistent results regarding the strategic renewal, research has largely neglected to examine the role of TMTs in firm's servitization journey. The lack of research on the specific role of TMTs is somewhat surprising, considering the empirically demonstrated impact of managerial behaviour on servitization (Gebauer, 2009; Gebauer & Friedli, 2005), and the calls for more critical research on TMTs behaviour (Luoto et al., 2017).

In this study, we hypothesized that firms with a specific TMT experience are likely to enhance a firm's servitization journey. In testing this idea, we focused on three aspects of TMT experience: TMT outsider ratio, TMT cross-industry experience and TMT tenure. Across multiple regression models, we find robust results: Hiring outside TMT members results in faster service growth relative to hiring inside counterparts. Thus, we argue that a greater TMT outside ratio is positively associated with the firm's servitization journey because outsiders bring in new external know-how and contribute to renewal and learning within organizations.

In contrast to prior TMT studies examining the effect on tenure on innovation (Wu et al., 2005), the results suggest that the firm's degree of servitization will decline over the length of a TMT average tenure. Finally, the results empirically challenge prior studies, which find a positive effect of TMT cross industry experience on firm-level strategic and social novelty (Crossland et al., 2014). The results suggest that TMT experience beyond the focal industry has neither a positive nor a negative effect per se on the firm's degree of servitization.

6.1 Theoretical contribution

We aimed at contributing to literature mainly in three ways. First, we extend existing work in upper echelons research by providing empirical evidence in the context of servitization. TMT

literature provides compelling arguments to argue that cross-industry experience positively affects the firm's degree of servitization (Crossland et al., 2014). However, our results contrast recent studies in strategic renewal research that have found positive effects of TMT cross-industry experience on strategic renewal.

Consistent with recent research on TMT experience (e.g., Williams et al., 2017), it is likely that rather TMTs with pronounced industry-specific skills can increase strategic renewal, and therefore the firm's degree of servitization (Boeker, 1997a; Kor, 2003). For example, Boeker (1997a) found that TMTs which had greater industry experience are more likely to enter new product development initiatives than TMTs with a lower industry experience. TMTs with long experience in the focal industry bring in in-depth knowledge about how that industry operates, and may possess a greater understanding of the industry's constraints (Eisenhardt & Schoonhoven, 1990). This might be important in the dynamic environment of many servitizing firms, as relationships with complementors, regulators and customers will require more industry-specific knowledge of the history of threats, competitors, processes, regulations and customers. In this respect, TMTs without an experience-based understanding of the specific industry conditions have to acquire industry-specific knowledge that help to implement successful servitization strategies and processes. Owing to our results, we argue that both, specific industry experience (e.g. knowledge about regulations, competition and technology development) and TMT experience beyond the focal industry (e.g., more novel knowledge) are important to identify and exploit new service opportunities, and to develop appropriate servitization strategies.

Second, owing to the discussion about stronger theoretical foundations in servitization research (Valtakoski, 2017), this study responds to calls for more servitization research on managerial attention and leadership issues (Kowalkowski et al. (2017b), and thus lay a foundation for future inquiry by applying the concepts of upper echelons to the servitization context. While most servitization studies are based on institutional theories (Hannan & Freeman, 1977), suggesting that servitization strategies are highly dependent on the organisational environment, this study is one of the first in servitization research to introduce and test the idea that TMT characteristics affect the firm's servitization journey.

This lack on leadership theories is somewhat surprising, as the institutional theory could potentially explain the shift towards servitization, when product-centric firms "adopt service strategies by simply imitating other successful firms" (Cusumano et al., 2015: 572). However, this does not offer an explanation for the reasons and conditions under which firms make the initial investment decisions into service innovation (Cusumano et al. (2015). Thus, we argue that the

institutional pressure might enhance the firm's servitization journey though, however, the TMT is particularly important to initiate and implement strategies for new servitization efforts. Finally, this study provides a more a fine-grained measurement of the underlying construct of the firm's degree of servitization. Prior studies measure the degree of servitization through dichotomous service items (Homburg et al., 2003), or service offering categories (Kohtamaki et al., 2013; Kowalkowski et al., 2015; Windahl & Lakemond, 2010). However, practical evidence has shown that the boundaries between products and services have been blurred (Vargo & Lusch, 2004), which leads to the fact that it can be hard to differentiate between what is a service and what is a product. Responding to the recent calls for new measurements, we use the number of offered concrete services and the innovativeness of these services to measure the firm's degree of servitization. As prior servitization studies have shown that service innovation requires substantial changes in strategies, processes and culture (Avlonitis et al., 2001; Schultz et al., 2013b), we argue that that service' degree of innovativeness reflects the progress in a servitization journey. Using the Consensus Assessment Technique (CAT), we based our innovativeness measurement on experts' assessments.

6.2 Managerial implications

The findings of this paper may aid firms to improve strategic renewal in the context of the firm's servitization journey. Although these results are tentative and based on the experiences of German energy utilities, we found robust results that TMT experience plays an important role to predict the firm's servitization journey. The findings indicate that it might be useful for boards of directors to have a greater awareness of a balanced TMT composition when planning and implementing servitization strategies. We show that TMTs early in their tenure pursuing greater servitization efforts than later in their tenure, thus service strategies may profit from hiring new TMT members.

In addition, boards need to be alert concerning the TMT outsider ratio as our results suggest that firms may benefit from explicitly considering outside candidates when making selection decisions. In other words, hiring an outsider might help to promote rapid, large-scale change towards a service-centric business approach. The above results suggest that outsiders often are more likely to break up with the status quo and are more endowed with a greater awareness on strategic renewal. Further, we empirically demonstrate that a greater TMT cross-industry experience has neither a positive nor a negative effect on the firm's degree of servitization. This is

not to say that cross-industry experience is generally unimportant for servitizing firms, but rather shows that board of directors should be vigilant that TMTs have cross-industry and industry specific competences.

Taken together, the results indicate that firms are more likely to increase the firm's degree of servitization performance through the selection of TMTs whose prior experience and background are consistent with the desired direction of the servitization journey. Consequently, the board of directors should pay close attention to the experience and background of TMT candidates, as these factors do matter in the context of servitization.

6.3 Limitations and future research suggestions

We acknowledge a number of limitations, which, in turn, open some avenues for further research in this domain. First, our secondary data study design is limited with regard to examine the causality of the proposed relationships. Owing to the lack of data availability, this study does limit the dynamic perspective of the servitization journey to a development over the period of one year. Future studies could apply a longitudinal research design over a longer time horizon to deepen our understanding of how, and under which conditions, TMTs affect the firm's degree of servitization. Second, our study focuses on the relationship of TMT experience and the firm's degree of servitization. However, it is possible that several complementary moderators and mediators reinforce, or mitigate, the TMT effect on the firm's degree of servitization. Relevant aspects may be leadership, team cohesion, and motivational issues.

Third, the analysis of directly observable characteristics is based on information retrieved from exclusively secondary data sources. Although most management studies rely on demographic proxies to measure executive behaviour, some studies have challenged the underlying assumption that TMT characteristics are indicators for cognitions and values. A fruitful avenue for further research would be using complementary methods to identify non-observable psychological characteristics including cognition and values and the underlying mental processes of the TMTs, instead of using demographic variables as proxies (Bromiley & Rau, 2016). As such, it would be possible to measure team dynamics and decision-making processes, which might influence the firm's degree of servitization. However, future studies have to take into account that TMT-surveys are traditionally poor in response rates and often raise self-assessment biases (Hambrick, 2007).

Fourth, we performed our study with firms for which we could find a minimum of service activities. However, it is unclear, whether and to which degree firms communicate the imple-

mentation of services in business reports, press and on their websites. For example, the measurement might be distorted for service activities that firms treated confidential to avoid competition. However, we expect that most relevant services should lead to a higher communication in websites, news articles and annual reports to gain new customers and market attraction (Benedettini et al., 2017). Additionally, we attempt to avoid subjective influences of the researchers, but additional research is needed to assess this measurement. A promising future research setting could use automated text-based content analysis. The automatic analysis is based on the assumption that the frequency of certain words or the composition of certain text modules demonstrates a significant indicator to identify hidden company activities (Breton, 2009).

Finally, we decided to limit our research to German energy utilities in order to improve the comparison of the analysed service activities and the validity of our results. We suggest that our results are transferable to other countries and industries, yet further validation represents a promising avenue for scientific research.

7. References

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Article IV: Use and Efficacy of Information Technology in Innovation processes: The Specific Role of Servitization

Julia Kroh, Heiner Lütjen, Carsten Schultz, Dietfried Globocnik

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1. Abstract

Innovation activities and, particularly, service innovations impose high demands on a firm's information processing capabilities, emphasizing the use of structural mechanisms to improve its capability. IT tools that support the internal and external information flows may be the means to achieve improvement and create a better understanding of the market. In this research, we develop a model to investigate empirically how IT use intensity affects innovation program performance, depending on the business focus. Given the current trend of former product-centric firms increasing their service efforts, this study specifically focuses on the degree of servitization. Since service innovation activities are associated with higher complexity and fuzziness, we investigate whether the actual use of IT tools and the benefits of a better market knowledge differ between firms characterized by their services' higher or lower relevance for their business. Using a cross-industry, multi-informant sample of the innovation programs of 116 firms collected from 887 informants, we provide empirical evidence that (i) intensive IT use to exchange information with internal and external stakeholders improves an organization's market knowledge, which in turn has a positive impact on its innovation program performance; (ii) the performance impact of market knowledge becomes stronger with increasing degrees of servitization; (iii) a higher degree of servitization reduces IT's use intensity. This research demonstrates the dilemma that servitized firms face due to their business focus hampering the use of IT tools, although the latter will allow them to benefit more from the improved market knowledge they create. We further discuss the implications for research and practice and how to cope with this dilemma.

2. Introduction

The importance of service innovations is increasing with more manufacturing and product-centric firms shifting their businesses to services instead of, or in addition to, their products – a trend referred to as servitization (e.g., Vandermerwe and Rada, 1988; Kowalkowski et al., 2017). Prior research has shown that in Western economies two third of all large manufacturers have engaged in servitization (Neely, 2008). More recently, the Annual Manufacturing Report 2017 underlines this trend: 83% of UK companies state that servitization helps them sell more products (Hennik Group, 2017). Service innovations may increase a firm's profitability (e.g., Fang et al., 2008) and help it differentiate itself from competitors (Gebauer et al., 2011). But research has also shown that, compared to product innovations, they are more challenging due to their complexity and fuzziness (e.g., Nijssen et al., 2006; Wieland et al., 2012; Storey et al., 2016). Service innovations require firms' customers and their service network partners to be more deeply involved, which demands strong information processing in order to generate, process, and distribute information from and to the external and the internal stakeholders.

In this context, information technology's (IT's) specific role has become a prominent theme in the service literature and the focus of this study. Empirical research has shown that IT-supported collaboration, coordination, and communication are becoming increasingly essential for innovation performance (Peng et al., 2014; Kawakami et al., 2015; Saldanha et al., 2017), because IT tools facilitate information flows within and beyond the firm's boundaries. Web-based innovation platforms, innovation process management software, and social media enable firms to process a large amount of information and support internal and external information flows (Marion et al., 2014; Moe and Schweidel, 2017). IT can thus help firms build a comprehensive and well diffused understanding of customer needs and their competitors' strategies, both of which are highly relevant for their success (Bharadwaj, 2000; Jayachandran et al., 2005). To date, previous empirical studies' findings do not consider these market knowledge aspects as influencing factors for the relationship between IT use intensity and innovation program performance. Hence, we develop a conceptual model to investigate empirically how IT use intensity affects innovation program performance, depending on the business focus through the theoretical lenses of organizational information processing theory (Galbraith, 1974; Tushman and Nadler, 1978) and service innovation.

Some empirical studies show that IT tools cannot influence innovation performance directly and identify mediators such as the IT use frequency (Barczak et al., 2007; Marion et al., 2016; Mauerhöfer et al., 2017). Current research mostly neglects underlying mechanisms that could explain how IT impacts performance, like the overall influence of IT use intensity on the firm-

wide market knowledge. Further empirical studies show that IT tool's efficacy is dependent on, for example, organizational complementary resources, like strategy and culture (e.g., Kawakami et al., 2015), and the innovation development phase (Durmusoglu and Barczak, 2011; Marion et al., 2014). Although several studies have shown that these organizational characteristics moderate the relationship of IT tools and innovation performance, the firm's specific business focus is often neglected as a potential contingency factor. Consequently, a better understanding of the immediate outcomes and contingencies of IT use intensity helps shed light on the IT-performance relationship in innovation.

Despite servitization's demonstrated relevance, the discussion on IT's effectiveness in innovation processes has not yet considered the firm's service focus. The service innovation literature shows that market knowledge is particularly important to cope with service innovation's high complexity and intangibility (Ordanini and Parasuraman, 2011; Storey and Larbig, 2017). Scholars have recently emphasized the importance of IT tools for service innovations (e.g., Plattfaut et al., 2015), but have also demonstrated the difficulties that the internal and external service network partners' heterogeneity causes (Jaakkola et al., 2017). In this respect, we investigate whether the use of IT tools is more challenging for firms with higher degrees of servitization. Further, we analyze whether servitized firms benefit either more or less from a better market knowledge than their rather product-centric peers.

Most of the studies that investigate the relationship between IT and innovation performance focus on product innovations' project level. We therefore know little about the relevance of IT use intensity on the firm's overall innovation activities. Since investments in IT are usually directed at the innovation system and not at specific projects, IT's impact on the overall innovation performance is the relevant decision criterion. We address these issues by proposing that the IT use intensity is positively related to the firm's innovation program performance, because it increases the organization's market knowledge.

We test our developed hypotheses with a cross-industry, multi-informant sample of innovation programs of 116 firms collected from 887 informants. Our subsequent contribution to the literature is threefold: First, our results confirm that, in respect of internal and external information flows, IT use intensity has a significant positive effect on innovation program performance by improving a firm's market knowledge. Second, we find that the degree of servitization strengthens market knowledge's positive effect on innovation program performance, but, simultaneously, the degree of servitization leads to a lower IT use intensity. Consequently, servitized firms hardly use IT to support their information flows, but benefit more from market knowledge

by achieving superior innovation program performance. This finding reveals the current dilemma of servitized firms: There is a gap between the required level of IT support and its current use intensity in practice. Third, we provide a more fine-grained measurement of the degree of servitization that goes beyond traditional industry classifications and accounts for the blurring boundaries between the product and the service businesses.

3. Conceptual Framework and Hypotheses

3.1 Information Processing Capability for Innovations

Organizational information processing theory states that firms have to develop an information processing capability to enable them to fulfil their information needs and cope with the uncertainty in their environment (Galbraith, 1974). Organizational tasks are split into many subtasks and assigned to different interdependent roles, which requires high internal coordination and information exchange (e.g., Premkumar et al., 2005; Zhou and Benton, 2007). The theory particularly emphasizes structural mechanisms that gather, process, and distribute information throughout the organization to allow it to fulfil its tasks (Tushman and Nadler, 1978; Daft and Lengel, 1986).

Organizational information processing theory fits the context of a firm's innovation tasks well. Innovation activities require different functional areas within a firm to interact. Furthermore, innovation activities bear risks and are inherently uncertain, especially when the development of products or services differs from a firm's existing experiences (Carbonell et al., 2009; Schultz et al., 2013). Consequently, innovation activities require much market knowledge, which means to absorb and act on relevant information about customers' and competitors' needs, activities, and behaviors (De Luca and Atuahene-Gima, 2007). Information processing capabilities enable a firm to gather the required external input and translate it into usable information that improves the knowledge of the market that it and its employees require to deliver superior new products and services (von Hippel, 1994; Veldhuizen et al., 2006).

The innovation literature has recently highlighted the role of IT as an enabler, or structural mechanism, to process large amounts of information easily, i.e. to increase a firm's information processing capability by extending the existing information systems' technical level (Bensaou and Venkatraman, 1996; Ben-Arieh and Pollatscheck, 2002). Moreover, IT supports the coordination and knowledge sharing activities within a firm and its ecosystem (Zahay et al., 2011). However, prior research has not investigated the role of IT tools in increasing a firm's overall innovation performance by improving its market knowledge. Several studies confirm that IT tools improve the general information flows between innovation project members (e.g., Song

and Song, 2010, Marion et al., 2014) and increase the innovation process's flexibility (e.g., Durmusoglu et al., 2006; Bhatt et al., 2010). Others report that the actual use frequency rather than the mere existence of IT tools drives performance (e.g., Marion et al., 2016; Reid et al., 2016). In this respect, clear responsibilities for IT tools and regular employee training to use these tools promote IT use, which is associated with higher innovation project success (Mauerhöfer et al., 2017).

Some studies dealing with the market-related aspects of IT tools in the innovation process's later stages demonstrate that they facilitate innovations' fit with the initial requirements (Durmusoglu and Barczak, 2011) and increase the market performance after market entry (Barczak et al., 2007). Interestingly, most of the mentioned studies investigate the impact of IT tools on project performance, thus failing to explain how IT affects the organizational-level outcomes. This is surprising, because information processing is conceptualized as an organizational capability. The relevance of better market knowledge and reduced uncertainty due to superior information processing capabilities is likely to go beyond individual projects and can be assumed to impact all the strategic and operational decisions within a firm. Consequently, this research draws on organizational information processing theory's view and investigates the impact that IT use intensity has on the innovation program performance, thereby facilitating information processing capabilities in the form of market knowledge.

To the best of our knowledge, prior research neglected the differentiation between IT tools directed at external stakeholders (e.g., customers, suppliers) and internal stakeholders (e.g., employees of different departments). This differentiation seems relevant, because, in order for IT tools to manage external information flows, they need to focus on gathering market information (Li and Calantalone, 1998). Conversely, for IT tools to manage internal information flows, they need to focus on processing and distributing information within the firm to where it is needed for decision-making (Cooper and Zmud, 1990). Accordingly, we explicitly distinguish between IT that facilitates either internal or external information flows in order to tap into the full conceptual domain of organizational information processing capability.

3.2 Influence of IT Use Intensity on Innovation Program Performance

IT tools that improve external information flows facilitate the interaction with customers to learn more about their needs, problems, and ideas, which are required to create new products and services (Gordon et al., 2008). Collecting and analyzing data from users' activities in online communities and their operating machine data help a firm better understand their customers' current behaviors, their issues and needs, as well as their opinions about competitors' offerings

(e.g., Füller et al., 2008). Web-based toolkits, through which customers can configure, or design, their own solutions, provide information about customers' specifically desired solutions (e.g., Franke and Piller, 2004). Furthermore, with the help of crowdsourcing platforms, ideas for new products and services can be both collected from customers and prioritized (e.g., Pötzt and Schreier, 2012). Together, these IT tools help firms gather in-depth knowledge about the market, which will subsequently lead to better informed decisions regarding which innovation activities to pursue and to the building of a superior portfolio of innovation projects. These well-informed innovation activities subsequently result in higher performance (e.g., Baker and Sinkula, 2007). Drawing on the presented arguments, we propose that firms whose IT tools have a higher use intensity, which stimulates external information flows, will have better market knowledge, which has a positive impact on their overall innovation performance.

H.1a: IT use intensity to stimulate external information flows has a positive impact on innovation program performance, mediated by market knowledge.

IT tools that improve internal information flows allow information required to innovate, such as that on customer needs, technical solution knowledge, and competitive intelligence, to be accessible in a timely manner to all relevant employee groups within the firm. This function of the IT's structural mechanism is especially relevant due to innovation activities' cross-functional nature and the growing number of geographically dispersed R&D departments (Blindenbach-Driessen and Van den Ende, 2014; Chen and Lin, 2016). If innovation activities and the knowledge required for innovation are widely dispersed across several departments, this reduces personal information exchange and increases transaction costs (Boutellier et al., 1998). IT tools for internal information exchange help overcome this information challenge by helping different functional groups and departments share information, knowledge, and ideas on the innovation process. IT enables employees to work in virtual network organizations, where they can access and exchange required information on competitors and customers regardless of their location (Montoya et al., 2009). In other words, IT helps overcome departmental boundaries (Song and Song, 2010) by improving internal communication and the speed with which information is exchanged. In turn these benefits could facilitate the development of better market knowledge within the firm (Jiménez-Castillo and Sánchez-Pérez, 2013) and thus help firms achieve a better overall innovation performance.

H.1b: IT use intensity to stimulate internal information flows has a positive impact on innovation program performance, mediated by market knowledge.

3.3 The Moderating Role of the Degree of Servitization

Manufacturing firms increasingly servitize their product-centric business models to provide services instead of, or in addition to, products (Vandermerwe and Rada, 1988; Lightfoot et al., 2013). These servitization strategies may include the offering of integrated product and service solutions, which Rolls-Royce Aerospace did with its product-service system of “power by the hour,” which allows customers to purchase aero engines’ capability (Neely, 2008). Since new services often arise ad hoc from direct interaction with customers (Gebauer et al., 2005), servitized firms have to cope with an emergent, interactive, and dynamic innovation process (Gallouj and Weinstein, 1997; Miles, 2008). This implies that information processing and, thus, achieving a high degree of overall market knowledge at the firm level become more challenging in the servitization context. We can develop this perspective further by drawing on the IHIP service characteristics: intangibility, heterogeneity, inseparability, and perishability (Fitzsimmons and Fitzsimmons, 2008).

Despite criticism (Lovelock and Gummesson, 2004; Vargo and Lusch, 2004), these characteristics provide a theoretical foundation for explaining why information processing is more challenging for services. Service innovation relies on sticky and tacit information (Leiponen, 2006), and frequently lacks knowledge about customer preferences, due to customer needs’ heterogeneity and service delivery’s inseparability from its consumption (Carbonell et al., 2009; den Hertog et al., 2010). To overcome this issue, customers need to be integrated into the service development processes to increase their efficiency and success (Jiménez-Zarco et al., 2011), thus building a complex service ecosystem (Spohrer et al., 2007; Wieland et al., 2012).

Further, since services are intangible and perishable, competitors’ service activities in adjacent ecosystems are difficult to assess. Consequently, it is difficult for servitized firms to deduce market standards and to differentiate themselves from their competitors. Owing to this inseparability, service innovation is also associated with the risk of critical information gaps between those employees in a firm’s department without direct customer interaction and the front line employees who deliver a service to customers and have the relevant customer knowledge (Dörner et al., 2011). This problem becomes even more severe when one takes into consideration that service innovation often happens ad hoc, that most firms do not have a department dedicated to service development, and that service employees develop a service for specific customers without a link to the firm’s overall strategy regarding innovation activities (e.g., Johnes and Storey, 1998; Ettlie and Rosenthal, 2011; Blindenbach-Driessen and Van den Ende, 2014).

Finally, information processing becomes more difficult due to the trend to develop and provide services in service ecosystems, which increases the amount of information and the efforts required

to coordinate the information flows and activities between the partners (de Vries, 2006; Zhang et al., 2016).

Owing to these above service innovation characteristics, servitized firms face more challenges regarding gathering, processing, and distributing market-related information, although service innovations need as much external information as possible (Kang and Kang, 2013) to achieve a high service innovation performance (Jaw et al., 2010). If market knowledge is more difficult to build in firms which are intensely engaged in servitization, the relevance of market knowledge for performance might even be higher for servitized firms than for more product-centric firms due to the former's competitive advantage and higher success rates as a result of being better informed about the market. Consequently, firms with a higher degree of servitization and which achieve a high level of market knowledge throughout their structure might benefit more from their superior market knowledge than their less servitized peers. We thus suggest that firms' degree of servitization strengthens the market knowledge's positive effect on innovation program performance.

Hypothesis 2: The positive impact of market knowledge on innovation program performance is stronger (weaker) when the degree of servitization increases (decreases).

3.4 Degree of Servitization's Impact on IT Use Intensity

The degree of servitization may also have an impact on IT tools' use intensity. Previous research reported that servitized firm's performance profits from implementing IT tools (e.g., Nakata et al., 2008; Behera et al., 2015), although service innovation research has not provided empirical evidence of this. The characteristics of services and service innovation explain servitized firms' lower IT use intensity. Services are developed and provided in close direct interaction with customers and service partners, which means that communication channels have often already been established, which allow employees to interact directly, without additional IT support, with these customers and service ecosystem partners (Chen and Tsou, 2012; Liu et al., 2015). Furthermore, customers' and service ecosystem partners' heterogeneity inhibits the broad use of IT tools (Barrett et al., 2015), because the partners in the firm's ecosystem may differ regarding their infrastructure, work procedures, and IT experience levels and, thus, reject the adoption of such tools. Consequently, a firm's stronger servitization focus may result in IT tools for external information flows having a lower use intensity.

Service innovation processes within a firm are usually less structured and developed than product innovation processes (Johne and Storey, 1998; Biemans et al., 2016). Service innovation activities are often delegated to operational business units, although many firms have no service development department to coordinate and undertake service innovation (Sundbo, 1997; Blindenbach-

Driessen and Van den Ende, 2014). Consequently, no unit is responsible for developing, buying, and diffusing IT tools to connect the firm's dispersed employees who provide services and service innovations. However, even if IT tools are available, the sticky and tacit information associated with service innovations (Dotzel et al., 2013) complicates the codification of information (Jin et al., 2012). These arguments suggest that firms with a higher degree of servitization also use IT tools for internal information flows at a lower intensity.

Hypothesis 3a: The IT use intensity for external information flows decreases with a higher degree of servitization.

Hypothesis 3b: The IT use intensity for internal information flows decreases with a higher degree of servitization.

4. Methods

4.1 Data Collection and Sample

We test the hypotheses with data from a cross-sectional industry sample of German and Austrian firms. We contacted senior firm managers and informed them of the study's purpose, which covers various aspects of innovation management. Those willing to participate nominated a set of employees who work with innovation tasks daily. Each of the employees was the best informant on the evaluation of the firm's practices and processes, as they evaluate these regularly. Subsequently, they received a link to an online survey, which includes the items to be assessed. A different survey was sent to one senior executive of each business unit to capture the overall innovation program performance and the degree of servitization, since these require a good overview of the organization's activities and outcomes. By using different informants, this multiple respondent design reduced the likelihood of common method bias. In total, this research draws on a sample of 887 informants from 116 firms (an average of 7.65 participants per firm) and their responses. Nine firms are located outside the study's geographical region, but have their headquarters in Austria. Table 1 summarizes other details about the sample characteristics.

| Industry | Number | Percent | Size (revenue; Mio. EUR) | Number | Percent |
|---|---------------|----------------|---------------------------------|---------------|----------------|
| Manufacturing goods (chemicals, food, plastics, glass, etc.) | 46 | 39.7% | <10 Mio. | 9 | 7.8% |
| Industrial engineering (machine construction, plant engineering, etc.) | 16 | 13.8% | 10-50 | 19 | 16.4% |
| Utilities (energy, water, recycling) | 40 | 34.5% | 51-250 | 36 | 31.0% |
| Others (information technology, industrial research) | 14 | 12.1% | 251-500 | 11 | 9.5% |
| | | | 501-1000 | 7 | 6.0% |
| | | | >1000 | 17 | 14.7% |
| | | | n.a. | 17 | 14.7% |
| Number of informants | | | Size (FTE) | Number | Percent |
| 2-3 informants | 18 | 15.5% | <50 FTE | 11 | 9.5% |
| 4-5 informants | 22 | 19.0% | 50-250 | 47 | 40.5% |
| 6-7 informants | 35 | 30.2% | 251-500 | 21 | 18.1% |
| 8-9 informants | 15 | 12.9% | 501-1000 | 13 | 11.2% |
| 10-20 informants | 20 | 17.2% | >1000 | 24 | 20.7% |
| >20 informants | 6 | 5.2% | | | |
| | | | Country | | |
| | | | Austria | 63 | 54.3% |
| | | | Germany | 44 | 37.9% |
| | | | other | 9 | 7.8% |
| <i>Total number of informants</i> | 887 | | | | |
| <i>Average no. of informants by business unit</i> | 7.65 | | | | |

n=116.

Table 1. Sample Characteristics

Measures

We used reflective multi-item measures and five-point Likert-type scales for all of this study's multivariate constructs, which are reported in the appendix. Where possible, we used established indicators from prior research, while the development of new scales followed the corresponding literature closely. We assessed the developed measures's content validity via a pre-test in two workshops with practitioners from 20 organizations. Minor adaptations, based on the feedback we received, were undertaken to the items' wording to remove the remaining ambiguities.

Innovation program performance was assessed at the portfolio level with six items from previous research (Griffin and Page, 1993; Manion and Cherion, 2009) that captured the innovation activities' performance impact over the previous three years. According to the for-profit focus of the industrial organizations investigated, the items measured the impact of the products' and the services' on the profitability, revenues, and market share, and on the quality and functionality, as well as the customer satisfaction. The senior management acted as the information source of the innovation program performance. Innovation team members — not including the senior manager who rated the performance — provided information on the IT use intensity and market knowledge.

Market knowledge was captured with nine items about the availability of meaningful and up-to-date market information for employees regarding the customer needs and demands, the market size and growth, the relevant competitors and their strengths, weaknesses, and business models, as well as the current market developments. The development of the items closely fol-

lowed previous literature on market orientation that emphasized the acquisition and dissemination of market knowledge to enable the organization to respond appropriately to changes in the customer needs and in the competitive situation (Jaworski and Kohli, 1993; Zhou et al., 2005). *IT use intensity for external information flows* focused on IT tools' use intensity regarding the management of information flows to and from external partners in the innovation process. Drawing on related open innovation research (e.g., Kozinets, 2002; Franke et al., 2008; Piller and Walcher, 2006; Füller et al., 2008; von Hippel, 2001), we developed nine items that probed whether the organization applied digital approaches, like netnography, used data mining, hosted online-communities, provided toolkits, and used crowdsourcing.

IT use intensity for internal information flows was assessed with four items that probed the intensity of the organizational IT use for employees when executing their innovation activities. This included, for instance, questions about the use of innovation process management software, internal web-based innovation platforms, and internal knowledge management tools. We used scales from previous research (Kawakami et al., 2015, Barczak et al., 2007). Our items reflected the availability of IT infrastructure that support the generation and distribution of innovation-related information and knowledge to stimulate the internal information flow and to facilitate internal communication and collaboration.

To assess the *degree of servitization*, the senior managers rated the importance of 12 industrial services (e.g., maintenance and repair, consulting and operating optimization, remote services, contracting, etc.) for their organization. The degree of servitization was then calculated as an index by using the average score across all the services. These overall service intensity scores of all the organizations were then mean-centered to calculate the relative intensity of each organization's industrial servitization. Consequently, we contribute to research by providing a more fine-grained measurement of the degree of servitization that goes beyond traditional industry classifications and accounts for the blurring boundaries between the product and service business.

More covariates were included in the model to control for the effects of organizational, industry sector, and environmental factors. Since the relevance of market information and performance levels may vary according to the uncertainty and dynamics of the organization's environment, *market and technology turbulence* were each captured with four items adapted from previous research (Calantone and Garcia, 2003; Venkatraman, 1989). In larger organizations, it may also be more difficult to diffuse market knowledge; therefore, the number of employees was used as a proxy for the *organization's size*.

To avoid biases caused by extreme outliers, we recoded the absolute variable into six categories. In addition, we controlled for the performance impact of the firms' operational and strategic proficiency on their innovation activities by adding two covariates. At the operational level, the *innovation process formality*, captured by means of four items from Schultz et al. (2013), indicates whether the firm has clearly defined stages and decision points for realizing innovation projects.

The *strategic proficiency* was captured with 11 items adapted from Cooper, Edgett, and Kleinschmidt (2004), as well as Bart and Pujari (2007), to assess whether the firm has a formal innovation strategy that defines the innovation domains, which its employees know well, and which determines all the innovation activities, roles, and resource allocation decisions. Although all the organizations in the sample operated in the industrial context, further *industry differences* were controlled for by building dummy variables for four industry sectors: manufacturing goods, industrial engineering, utilities, and others. A dummy variable was entered in the model to control for country differences. The variables that were assessed by several respondents within an organization were aggregated to a firm-level score by calculating the mean values across their individual responses.

4.2 Properties of the Scales

The applied measures were tested for validity and reliability. To assess the internal consistency, Cronbach's alpha coefficients were calculated, which ranged at satisfactory levels between .78 and .96. Principal component analyses (varimax rotation), which were conducted separately for each construct's items, only extracted one factor with eigenvalues greater than one, demonstrating these items' unidimensionality (Hair et al., 2006). Furthermore, we used partial least squares (PLS) path modeling's latest version in the software package SmartPLS 3 to assess the proposed model. We chose this method, because the application of PLS is appropriate for research situations in which not all paths have previously been tested and the used measurement instruments are partly new. Furthermore, PLS outperforms complementary covariance-based path modeling techniques when a model is complex and the sample size is limited (Chin and Newsted, 1999; Henseler et al. 2009).

To assess the significance of the loadings and paths, we applied the resampling procedure, bootstrapping (Efron and Tibshirani, 1993), thus following the recent recommendations of 4,999 subsamples (Henseler et al., 2016). The PLS analysis supported the measurement model's indicator reliability, with all factor loadings being $>.50$ and significant ($p <.05$) (Hulland, 1999). Convergent validity was demonstrated by an average variance extracted of $>.50$ for all constructs (Chin, 1998). Discriminant validity was assessed at the indicator and the construct level.

The correlation of each item with its corresponding latent construct was bigger than its correlation with any other construct, and cross-correlations were clearly below .40. Discriminant validity at the construct level was supported by the results that the average variance extracted of each latent variable was greater than the highest squared correlation with all the other latent variables (Fornell and Larcker, 1981), and that, as an estimate of the upper boundary of the factor correlations, the HTMT were significantly smaller than one (Henseler et al., 2015).

The appropriateness of the individual responses' aggregation of several of the variables of firm-level scores was tested further by calculating the intra-class correlation coefficients (ICC) (1,k), which inform the inter-rater reliability and inter-rater agreement (Shrout and Fleiss, 1979). With the ICC (1,k) values between .67 and .89, the agreement on IT use intensities to stimulate external and internal information flows, as well as on market and technology turbulence, was considered moderate to strong (LeBreton and Senter, 2008) and, thus, appropriate for aggregation. The ICC (1,k) was only lower for market knowledge (.34), which is intuitively conclusive, as the informants were from different functional areas and departments, not all of which deal with market-related issues. From this perspective, the aggregation is also valid, because the score represents the organization's overall market understanding. The means, standard deviations, correlations, and alpha coefficients are reported in Table 2, while further details on the loadings, t-values, average variance abstracted, and ICC(1,k) are listed in the appendix.

| Construct | Mean | S.D. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|--|------|------|---------|--------|---------|-------|--------|--------|-------|--------|--------|--------|-------|
| 1. Country | .54 | .50 | (-) | | | | | | | | | | |
| 2. Firm size | 3.91 | 1.36 | .01 | (-) | | | | | | | | | |
| 3. Market turbulence | 3.07 | .53 | -.55*** | -.14 | (.82) | | | | | | | | |
| 4. Technology turbulence | 2.71 | .53 | -.10 | .04 | .33*** | (.87) | | | | | | | |
| 5. Innovation process formality | 2.71 | 1.27 | .52*** | .35*** | -.55*** | -.12 | (.98) | | | | | | |
| 6. Innovation strategy | 2.46 | .71 | .35*** | .32*** | -.39*** | -.04 | .70*** | (.96) | | | | | |
| 7. Degree of servitization | 1.99 | .80 | -.09 | -.11 | .07 | .24 * | -.19* | -.19* | (-) | | | | |
| 8. IT use intensity for internal inform. flows | 2.23 | .76 | .28** | .21* | -.28** | .02 | .56*** | .59*** | -.18* | (.78) | | | |
| 9. IT use intensity for external inform. flows | 1.84 | .55 | .06 | .01 | .13 | .14 | .17 | .27** | -.16 | .51*** | (.88) | | |
| 10. Market knowledge | 3.53 | .44 | .18* | .07 | -.03 | -.08 | .29** | .38*** | -.19* | .36*** | .44*** | (.93) | |
| 11. Innovation program performance | 3.37 | .67 | .26** | .02 | -.21* | .17 | .32*** | .43*** | .03 | .26** | .18* | .38*** | (.80) |

^a S.D., standard deviation. Cronbach's alpha reported along the diagonal.

* p < .05, ** p < .01, *** p < .001 (two-tailed).

n=116.

Table 2. Mean, Standard Deviations, and Correlation Matrix^a

5. Results

5.1 Main Effect Model

The size, sign, and significance of the path coefficients inform the strengths of the relationships to test the proposed hypotheses. Furthermore, R^2 indicates the percentage of variance explained by the predictors of a dependent variable (Chin, 1998). We report the adjusted R^2 values, which also takes the model's complexity and the sample size into account.

The effect size f^2 quantifies whether the significant effects are weak ($f^2 >.02$), moderate ($f^2 >.15$), or strong ($f^2 >.35$) (Cohen, 1988). Owing to the multiple mediations in the model, we also calculated the indirect and total effects (Zhao et al., 2010). We followed the approach proposed by Henseler et al. (2016) to integrate the categorical control variable industry on four levels. A dummy variable was generated for each industry. Thereafter, a composite model was formed for the industry sectors manufacturing, industrial engineering, and utilities from the dummy variables. The remaining dummy variable to capture all other industries characterized the reference level. Table 3 presents the results of the main effects.

| Hypothesis | Independent | Dependent | β | p | Adj. R^2 | f^2 | Indirect effect | Total effect |
|------------|---|---|---------|------|------------|-------|-----------------|--------------|
| H.3.a | Degree of servitization | → IT use intensity for external information flows | -.17 * | .045 | .02 | .03 | (-) | -.17 |
| H.3.b | Degree of servitization | → IT use intensity for internal information flows | -.23 ** | .008 | .04 | .05 | (-) | -.23 |
| H.1.a | IT use intensity for external information flows | → Market knowledge | .32 ** | .006 | .23 | .09 | (-) | .32 |
| H.1.b | IT use intensity for internal information flows | → | .20 ** | .040 | | .03 | (-) | .20 |
| | Degree of servitization | → | -.06 | .270 | | .00 | -.10 | -.16 |
| | Market turbulence | → | .10 | .321 | | .01 | (-) | .10 |
| | Technology turbulence | → | -.07 | .360 | | .01 | (-) | -.07 |
| | Firm size | → | .02 | .421 | | .00 | (-) | .02 |
| | Industry | → | .10 | .289 | | .01 | (-) | .10 |
| | Country | → | .11 | .165 | | .01 | (-) | .11 |
| | Market knowledge | → Innovation program performance | .33 ** | .005 | .32 | .12 | (-) | .33 |
| | IT use intensity for external information flows | → | -.04 | .347 | | .00 | .11 | .07 |
| | IT use intensity for internal information flows | → | -.03 | .410 | | .00 | .07 | .04 |
| | Degree of servitization | → | .07 | .178 | | .01 | -.04 | .03 |
| | Market turbulence | → | -.10 | .197 | | .01 | .03 | -.07 |
| | Technology turbulence | → | .28 *** | .002 | | .11 | -.02 | .26 |
| | Firm size | → | -.12 | .080 | | .02 | .01 | -.11 |
| | Innovation process formality | → | -.09 | .274 | | .00 | (-) | -.09 |
| | Innovation strategy | → | .27 * | .022 | | .05 | (-) | .27 |
| | Industry | → | .22 | .111 | | .03 | .03 | .25 |
| | Country | → | -.03 | .398 | | .00 | .04 | .01 |

^a β , path coefficient; p, level of significance; Adj. R^2 , adjusted explained variance; f^2 , effect size
 * $p < .05$; ** $p < .01$; *** $p < .001$ (one-tailed).
 n=116.

Table 3. Main Model Results^a

The results support hypotheses H.3a and H.3b, which proposed that the degree of servitization has a negative effect on IT use intensity for external information flows ($\beta = -.17$; $p = .045$) and

on IT use intensity for internal information flows ($\beta = -.23$; $p = .008$). The effect sizes are weak to moderate ($f^2 = .03$, and $.05$).

As expected, IT use intensity for external information flows increases market knowledge ($\beta = .32$; $p = .006$). Furthermore, IT use intensity for internal information flows has a positive effect on market knowledge ($\beta = .20$; $p = .040$). Both exert a weak to moderate effect on market knowledge ($f^2 = .09$ and $.03$). The effect of market knowledge on innovation program performance is positive and significant ($\beta = .33$; $p = .005$; $f^2 = .12$). IT use intensity for external information flows ($\beta = -.04$; $p = .347$) and IT use intensity for internal information flows ($\beta = -.03$; $p = .410$) have no direct performance impacts. Together, these results support Hypotheses H.1a and H.1b. The indirect effect of IT use intensity for external information flows on innovation program performance through market knowledge is $.11$, while that for internal information flows is $.07$. Their total effects, which also consider the direct effects on performance, are $.07$ and $.04$ for the IT use intensity for external and internal information flows. The degree of servitization does not impact market knowledge directly ($\beta = -.06$; $p = .270$), but has an indirect effect ($-.10$) through its impact on IT use intensity for internal and external information flows. The total effect, which considers both the direct and the indirect relations of servitization with market knowledge, is $-.16$. None of effects of the control variables market and technology turbulence, size, country, and industry sector is significant. In total, the variables explain 23% of the market knowledge variance. As control variables, both the technology turbulence ($\beta = .28$; $p = .002$; $f^2 = .11$) and the innovation strategy proficiency ($\beta = .27$; $p = .022$; $f^2 = .05$) have a significant positive effect on innovation program performance. In total, the predictors explain 32% of innovation program performance's variance.

5.2 Moderation analysis

To test hypothesis H.2, which proposes that the strength of the relationship between market knowledge and innovation program performance depends on the degree of servitization, we extended the main model by integrating a moderation effect. In addition, we controlled whether the impacts of IT use intensity for internal and external information flows on the market knowledge are also contingent upon the degree of servitization. To test the moderation effects, we applied the two-stage approach, which draws on the latent variable scores estimated in the main model to calculate the interaction term. This approach is recommended if not both variables are measured with reflective indicators as for our moderator, the degree of servitization. (Henseler and Chin, 2010; Chin et al. 2003). The results are summarized in Table 4.

| Hypothesis | Independent | Dependent | β | p | Adj. R ² | f ² | Indirect effect | Total effect |
|------------|---|---|----------|------|---------------------|----------------|-----------------|--------------|
| H.3.a | Degree of servitization | → IT use intensity for external information flows | -0.17 * | .045 | .02 | .03 | (-) | -0.17 |
| H.3.b | Degree of servitization | → IT use intensity for internal information flows | -0.23 ** | .008 | .04 | .05 | (-) | -0.23 |
| H.1.a | IT use intensity for external information flows | → Market knowledge | .32 ** | .006 | .23 | .09 | (-) | .32 |
| H.1.b | IT use intensity for internal information flows | → | .20 ** | .040 | | .03 | (-) | .20 |
| | Degree of servitization | → | -.06 | .270 | | .00 | -.10 | -.16 |
| | Market turbulence | → | .10 | .321 | | .01 | (-) | .10 |
| | Technology turbulence | → | -.07 | .360 | | .01 | (-) | -.07 |
| | Firm size | → | .02 | .421 | | .00 | (-) | .02 |
| | Industry | → | .10 | .289 | | .01 | (-) | .10 |
| | Country | → | .11 | .165 | | .01 | | .11 |
| | Market knowledge | → Innovation program performance | .33 ** | .005 | .32 | .12 | (-) | .33 |
| | IT use intensity for external information flows | → | -.04 | .347 | | .00 | .11 | .07 |
| | IT use intensity for internal information flows | → | -.03 | .410 | | .00 | .07 | .04 |
| | Degree of servitization | → | .07 | .178 | | .01 | -.04 | .03 |
| | Market turbulence | → | -.10 | .197 | | .01 | .03 | -.07 |
| | Technology turbulence | → | .28 *** | .002 | | .11 | -.02 | .26 |
| | Firm size | → | -.12 | .080 | | .02 | .01 | -.11 |
| | Innovation process formality | → | -.09 | .274 | | .00 | (-) | -.09 |
| | Innovation strategy | → | .27 * | .022 | | .05 | (-) | .27 |
| | Industry | → | .22 | .111 | | .03 | .03 | .25 |
| | Country | → | -.03 | .398 | | .00 | .04 | .01 |

^a β , path coefficient; p, level of significance; Adj. R², adjusted explained variance; f², effect size
 * p < .05; ** p < .01; *** p < .001 (one-tailed).
 n=116.

Table 4. Moderation Model Results^a

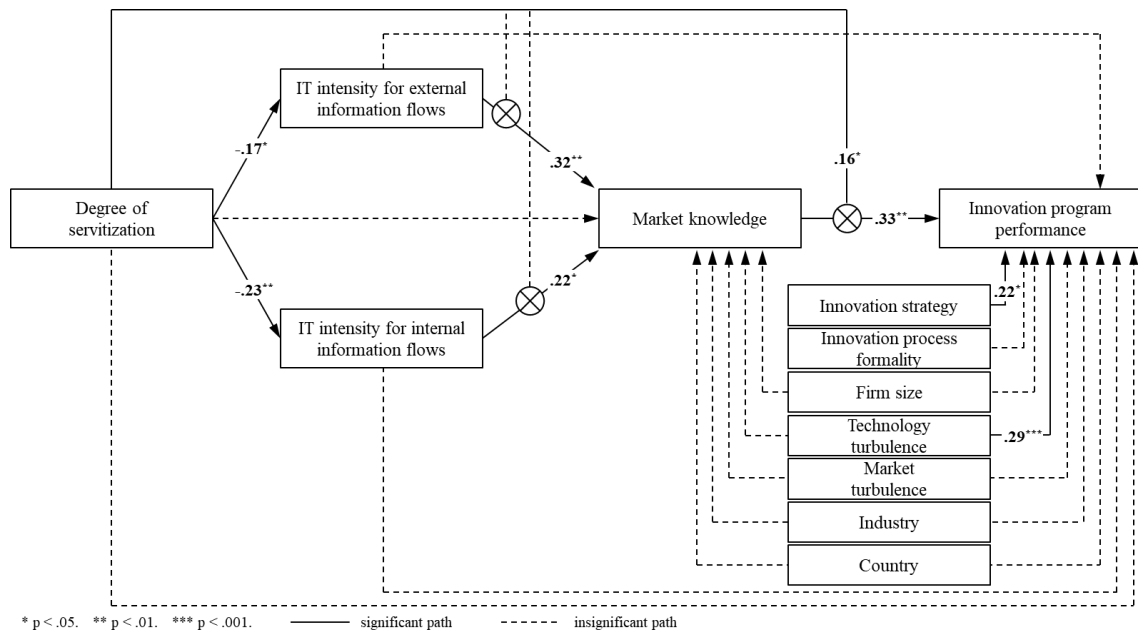


Figure 1. Model and Path Coefficients

While the effects of the main model remained the same, the interaction term testing whether the market knowledge-performance relationship is contingent upon the degree of servitization

is positive and significant ($\beta = .16$; $p = .044$). Thus, the empirical data support hypothesis H.2. In addition, we tested whether the relationship between IT use intensity for internal and external information flows and market knowledge depends on the degree of servitization, but the data does not reveal a significant effect. The presented results are summarized in Figure 1.

The plots of the simple slope analyses — depicted in Figure 2 — graphically illustrate the strength of the independent variable’s effect on the dependent variable regarding the low (mean minus one standard deviation) and high (mean plus one standard deviation) moderator levels of all three moderation effects. The first two plots show that the positive relationships between the IT use intensity for internal and external information flows and market knowledge are almost identical for both levels of servitization, which the parallel lines with similar slopes for low and high servitization levels illustrate. The third plot for the significant moderation effect of the relationship between market knowledge and innovation program performance illustrates this effect with the higher slope of the line for a high level of servitization than for a low level of servitization.

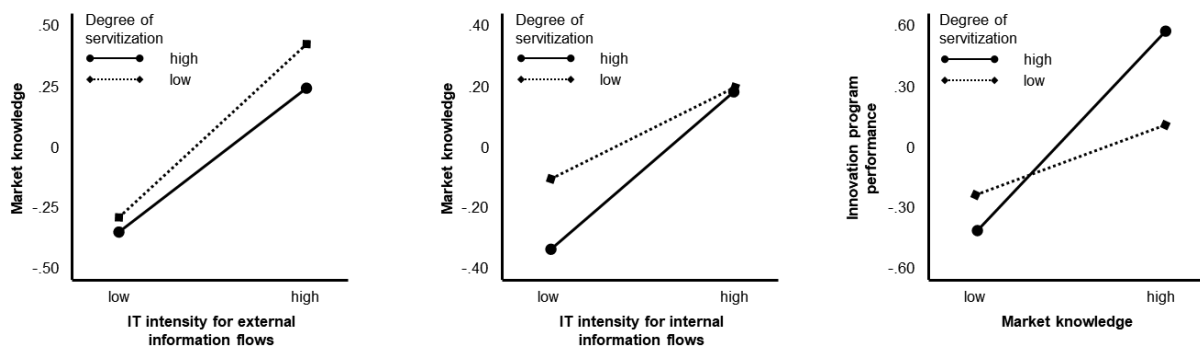


Figure 2. Plots of Moderation Effects

6. Discussion and Implications

Based on the information processing theory’s arguments, this study aimed at detailing our understanding of how IT use intensity affects innovation program performance, depending on the business focus. We show that intensive use of IT tools to exchange information with internal and external stakeholders influences innovation program performance by increasing a firm’s market knowledge. In addition, we provide empirical evidence that the degree of servitization strengthens the relationship between market knowledge and innovation program performance. We show that firms with a higher degree of servitization use IT tools less intensively than their less-servitized peers. Our empirical results reveal that the adoption of IT tools fails more often

when firms achieve a higher degree of servitization, although these firms profit more from market knowledge than their product-centric counter-parts. This implies a dilemma for servitized firms, as it reveals a gap between the required level of IT use intensity and firms' current use. Finally, we respond to the call for an improved measurement of firms' service focus (e.g., Hipp and Grund, 2005) by providing a fine-grained measurement of the degree of servitization. Unlike previous studies that distinguish between service and manufacturing firms in terms of industry codes and sector classifications, we focus on the relevance of specific services for the firm.

Influence of IT Use Intensity on Innovation Program Performance

Prior research has shown that IT tools support collaboration, coordination, and communication in the innovation context, but their influence on innovation performance is subject to possible mediators (e.g., Barczak et al., 2007; Marion et al., 2016; Mauerhöfer et al., 2017). Internally directed IT tools improve the information flows in cross-functional innovation teams (e.g., Song and Song, 2010, Marion et al., 2014), while externally directed IT tools support market entry (Barczak et al., 2007). Accordingly, we introduced market knowledge as an immediate outcome of IT use intensity. Our findings show that IT use intensity affects market knowledge positively, thereby increasing the innovation program performance. The effect of IT use intensity on performance is fully mediated by market knowledge. This is consistent with recent research: Market knowledge, the firm's knowledge about its competitors and its customers results from efficient information processing (Kohli and Jaworski 1990; De Luca und Atuahene-Gima, 2007), and increases its ability to meet its customers' various needs and increase its innovation activities' efficiency (Narver and Slater, 1990; Atuahene-Gima, 1995; Henard and Szymanski, 2001). However, our study is one of the first to demonstrate that market knowledge is the result of an intense use of IT tools. We thus reveal the relevance of market knowledge as a central outcome of IT application. Further, we show that the IT tools' relevance goes beyond single innovation projects and affects the overall innovation system. Consequently, we extend current research, which investigates the impact of IT use on the project performance only (e.g., Durmusoglu et al., 2011).

The Moderating Role of the Degree of Servitization

Existing studies on IT and service innovation largely ignore the role of servitization as a key contingency (e.g., Zhang et al., 2016), despite the high uncertainty and ambiguity of service innovation due to its intangibility and the relevance of tacit knowledge (Chae, 2012; Kang and Kang, 2013). We contribute to the existing IT and service innovation research by taking into account that the degree of servitization influences a firm's IT use intensity and its market knowledge's importance. We therefore integrate IT and service innovation research by investigating how the degree of servitization influences the IT use intensity and the importance of market knowledge for innovation program performance. Our findings show that this importance increases with higher degrees of servitization, which corresponds to the discussion on the relevant moderators of the relationship between market knowledge and innovation performance (e.g., De Luca und Atuahene-Gima, 2007). Our results emphasize the key role that external know-how plays in highly servitized firms by increasing innovation performance, which is even more important than in product-centric firms. Using an information processing lens, we provide empirical support for service innovations being more complex and relying on sticky and tacit market knowledge; they therefore require high information processing capabilities, i.e. a high IT use intensity.

In addition, we show that an increasing degree of servitization leads to a weaker rate of IT use intensity, which hampers the required internal and external information sharing. To the best of our knowledge, no research has so far provided detailed evidence of this the limited use of IT tools in servitized firms. We argue that IT tools show potential incompatibilities with the requirements and prevailing organizational structures of highly servitized firms. Service innovation processes tend to be less standardized than product development processes (Gallouj and Weinstein, 1997), require specific skills, capabilities, and routines (Atuahene-Gima, 1996), lack dedicated organizational responsibilities (Nijssen et al., 2006), and involve interactive and dynamic communication with customers (Miles, 2008). Standardized IT tools may therefore be unable to cope with these complex and fuzzy service innovation processes, thus reducing their perceived usefulness and ease of use.

6.1 Limitations and Future Research

Despite its contributions, this study has certain limitations that need to be taken into account. First, our model specifies that market knowledge fully mediates the impact of internal and external IT use intensity on innovation program performance. However, with respect to this complex relationship (e.g., De Luca und Atuahene-Gima, 2007), other mediators (e.g., collaboration

quality) may exist which could shed light on the existing black box regarding the relationship between IT use intensity and market knowledge. Additionally, it is possible that several complementary assets reinforce, or mitigate, the IT effect on market knowledge. Relevant aspects may be leadership, team cohesion, and motivational issues.

Second, our study focuses on the degree of servitization as relevant for the relationship between market knowledge and innovation program performance. Again, other issues may contribute to a better understanding of the market knowledge-performance relationship. For instance, future studies might investigate the availability of resources, or cultural aspects, which may impact how market knowledge actually translates into portfolio performance. A lack of R&D resources, or a strong technological orientation, might inhibit a superior understanding of customer needs being used in innovation projects, which maintains the misfit between the market needs and the firm's offerings.

Our results indicate the dilemma of the current and desired level of IT use for firms with a strong service focus; further research should therefore investigate further barriers that prevent firms from using information technology. For example, scholars might examine whether the use of IT tools differs for different types of services, as they might be easier to use in the context of standardized services than of customized services. The use of IT tools might also differ depending on the innovation program's desired degree of innovativeness. Radical service innovations might require different information (e.g., latent needs) than incremental innovation (e.g., machine data from already used machines), which might also impact the IT tools that are used more or less intensely.

Finally, our survey study design is limited with regard to examine the causality of the proposed relationships. Future studies could apply a longitudinal research design to deepen our understanding of how, and under which conditions, IT instruments affect innovation program performance. This would also allow researchers to focus on the reinforcing effects of market knowledge on the degree of servitization, as the latter should benefit from market needs' greater transparency. Furthermore, our empirical analysis draws on data from multiple respondents (7.73 participants per firm) to limit common method bias; but future research could employ secondary data to assess the firm's innovation program performance.

Despite these limitations, this study provides valuable insights into the effects of internal and external IT use intensity on innovation program performance, and improves our understanding of service innovation management.

6.2 Managerial implications

Our results suggest that firms should, in the following ways, take advantage of IT tools for internal and external information flows: First, the results show that intensive IT use fosters market knowledge (i.e. the firm's knowledge about its customers and competitors), which increases innovation program performance. Practitioners therefore need to pay more attention to IT tools to broaden their market knowledge and gain better insights into customer needs, and offerings, as well as into competitors' strategies.

Second, managers aiming to improve the innovation program performance need to take their firms' service focus – the degree of servitization – into account. The results show that firms with a higher service business focus have increased information processing needs, with their market knowledge therefore having a higher impact on innovation program performance. These information requirements need to be supported with proper information technologies and systems to enhance the internal and external collaboration, which will increase the firms' market knowledge.

Third, our results show that the IT use intensity decreases with a higher degree of servitization. A potential explanation refers to the existing product-specific IT infrastructures, which are not aligned to the service development's requirements and may not fit the specific needs of complex service innovation processes. This dilemma increases the relevance of managers paying attention to the selection of IT tools aligned to service innovation's organizational requirements and needing technical competences to adapt their existing IT tools to their service specific needs. Managers in highly servitized firms specifically need to provide service teams with human and financial resources to face the increasing requirements for service innovation.

7. References

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8. Appendix

Measures, Corresponding Factor Loadings, and Psychometric Properties^a

| Construct/Respondent | Items | Factor loading | t-value |
|---|--|----------------|------------|
| Market turbulence | ($\alpha=.82$, AVE=.63, ICC(1,k)=.70) | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | |
| | Many new competitors are active in the market. | .92 | 4.70 *** |
| | The competitive conditions in the market are unpredictable. | .65 | 2.95 ** |
| | Many new value chain partners (suppliers, service partners) are active in the market. | .85 | 4.20 *** |
| | Business models often change in the market. | .73 | 3.80 *** |
| Technology turbulence | ($\alpha=.87$, AVE=.68, ICC(1,k)=.71) | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | |
| | Our industry often experiences technological breakthroughs. | .89 | 6.70 *** |
| | The technologies applied in our industry are constantly changing. | .86 | 7.47 *** |
| | Technologies from different technological fields are often combined in our industry. | .91 | 6.90 *** |
| | New technologies in our industry often trigger business model changes. | .60 | 3.07 *** |
| Innovation process formality | ($\alpha=.98$, AVE=.96, ICC(1,k)=.89) | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | |
| | Our company uses a formal innovation process, e.g. a standardized set of stages and go/no-go decisions that guide all innovation activities from the idea through to market launch. | .97 | 104.69 *** |
| | Our standardized innovation process lists and defines specific activities for each phase of the process (e.g. the validation stage contains activities such as prototype tests and customer tests). | .98 | 229.23 *** |
| | Our standardized innovation process includes clearly defined go/no-go decision points for each stage of the process. | .98 | 237.70 *** |
| | Our standardized innovation process defines 'gate keepers,' whose task it is, e.g. to review the activities at each stage of the process, as well as decide on whether to continue or abort the project. | .97 | 126.96 *** |
| Innovation strategy | ($\alpha=.96$, AVE=.73, ICC(1,k)=.71) | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | |
| | We have an innovation vision documented in writing. | .76 | 10.74 *** |
| | We have an innovation strategy documented in writing. | .89 | 41.26 *** |
| | The innovation strategy is widely known in the organization and understood by everyone. | .89 | 39.98 *** |
| | The innovation strategy is defined with the involvement of a broad employee base. | .75 | 14.25 *** |
| | Our innovation strategy specifies who is responsible for its implementation. | .89 | 41.11 *** |
| | We have clearly defined what we consider to be innovation and what is deemed daily business. | .85 | 27.55 *** |
| | The strategic areas our innovation activities are focused on are clearly defined, e.g. markets, product areas, industries, technologies. | .90 | 40.98 *** |
| | All innovation activities are determined by the innovation strategy. | .87 | 41.93 *** |
| | Resources for innovation activities are allocated in accordance with the defined strategic areas. | .82 | 22.79 *** |
| | There is a clear link between our corporate strategy and the set innovation strategy. | .91 | 44.06 *** |
| | The innovation strategy contributes to the achievement of the strategic corporate objectives. | .87 | 36.86 *** |
| Innovation program performance | ($\alpha=.80$, AVE=.51) | | |
| Respondents: CEO | (1=strongly disagree, 5=strongly agree) | | |
| | Our innovation activities have contributed to the success of our firm within the last three years with respect to ... profitability | .70 | 11.48 *** |
| | ... revenue | .79 | 16.27 *** |
| | ... market share | .78 | 12.24 *** |
| | ... product/service quality | .70 | 13.11 *** |
| | ... product/service functionality | .61 | 7.49 *** |
| | ... customer satisfaction | .66 | 10.72 *** |

Appendix 1. (Continued)^a

| Construct/Respondent | Items | Factor loading | t-value |
|----------------------|-------|----------------|---------|
|----------------------|-------|----------------|---------|

Essays on the Management of Servitization

| | | | | |
|---|---|-------|-----|--|
| Market knowledge | ($\alpha=.93$, AVE=.63, ICC(1,k)=.34) | | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | | |
| We have access to meaningful and up-to-date information about... | | | | |
| ...the problems and needs of our customers. | .87 | 28.75 | *** | |
| ...customer segments. | .89 | 31.68 | *** | |
| ...the size and growth of our target markets. | .86 | 24.84 | *** | |
| ...the price sensitivity of our target customers. | .85 | 20.42 | *** | |
| ...the expected sales and turnover of our new products/services. | .76 | 14.53 | *** | |
| We know our competitors' business models. | .66 | 8.90 | *** | |
| ...the competitive situation, e.g. relevant strengths and weaknesses of competitors, product/service differences and positioning. | .84 | 16.07 | *** | |
| ...the environmental conditions in the target market, e.g. legal framework conditions, social and political conditions. | .81 | 14.09 | *** | |
| We know our customers and understand how the work of each employee can help create benefits to customers. | .54 | 4.65 | *** | |
| IT use intensity for external information flows | ($\alpha=.88$, AVE=.58, ICC(1,k)=.67) | | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | | |
| We systematically analyze online forums and social networks (netnography). | .75 | 11.26 | *** | |
| We perform systematic data mining, e.g. recording and analyzing the operating data of our sold products/services. | .68 | 10.13 | *** | |
| We host our own online community that supports us in the development of products/services. | .83 | 16.73 | *** | |
| We provide our customers various means of having discussions with one another and observe their communication, e.g. through peer assistance via a web platform. | .69 | 6.60 | *** | |
| We use web-based toolkits for the development of products/services. | .65 | 6.68 | *** | |
| We use crowdsourcing to generate ideas when developing products/services. | .83 | 17.45 | *** | |
| We use crowdsourcing to assess ideas when developing products/services. | .88 | 24.29 | *** | |
| IT use intensity for internal information flows | ($\alpha=.78$, AVE=.59, ICC(1,k)=.82) | | | |
| Respondents: mean of innovation team member's responses | (1=strongly disagree, 5=strongly agree) | | | |
| We use specific software to support our innovation process. | .87 | 18.67 | *** | |
| We use IT solutions to analyze the data collected. | .80 | 17.69 | *** | |
| We use web-based tools to generate, gather, and assess ideas, e.g. idea competitions, virtual idea platforms, and innovation games. | .82 | 11.99 | *** | |
| Knowledge sharing is supported by an IT tool in our company, e.g. knowledge database and wikis. | .54 | 4.26 | *** | |
| Degree of servitization | (Average over all services and mean centered) | | | |
| Respondents: CEO | (1=not important at all, 5=very important) | | | |
| How important are the following product-supporting services offered by your company or strategic business unit for the success of your company? | | | | |
| ... maintenance, repairs, and servicing | | | | |
| ... commissioning, transport, and assembly | | | | |
| ... planning and offering multi-provider solutions | | | | |
| ... instructing and training customers | | | | |
| ... consulting and operating optimization | | | | |
| ... spare parts management | | | | |
| ... hotline and telephone support | | | | |
| ... analysis of operating data | | | | |
| ... teleservice and remote service (condition monitoring) | | | | |
| ... preventative maintenance | | | | |
| ... contracting (complete assumption of product operation) | | | | |
| ... sharing (use of the product by multiple customers) | | | | |

^a α , cronbach alpha. AVE, average variance extracted. ICC(1,k) intra-class correlation coefficient.

** p < .01; *** p < .001 (two-tailed).

n=116.

Article V: Managing networks and ecosystems for servitization: A dynamic capability approach

Heiner Lütjen, Carsten Schultz, Florian Urmetzer, Frank Tietze

1. Abstract

Adopting a dynamic capability approach, this study examines necessary sensing, seizing and reconfiguration capabilities for successful servitization from both, the network and ecosystem perspective. Based on a mixed-method research design, we present results from three interconnected studies: (1) a secondary data analysis of 181 firms to determine the degree of servitization as the addressed performance indicator; (2) a quantitative survey of 133 managers from 28 firms to identify network-related capabilities; and (3) a qualitative multiple-case study to explore complex and context-bound ecosystem-related capabilities. The findings make three primary contributions to the body of knowledge. First, we contribute to servitization research by identifying relevant capabilities that product-centric firms need to possess for a successful servitization journey. Second, we extend existing research in the relatively young field of ecosystems by providing empirical evidence in the context of servitization. Third, we propose a novel and more fine-grained measurement for the degree of servitization adopting an innovation management perspective.

2. Introduction

Across industrial sectors, we are currently witnessing firms shifting from a product-centric business model towards a service-centric approach, often defined as servitization (Baines et al., 2009; Gebauer, Fischer, & Fleisch, 2010; Kowalkowski et al., 2017a; Lightfoot et al., 2013). Although a service-centric approach is often considered a powerful engine for organizational growth, previous research identifies barriers and provides rather mixed results regarding servitization performance effects (Benedettini et al., 2017; Fang et al., 2008; Gebauer et al., 2011; Gebauer, Ren, Valtakoski, & Reynoso, 2012; Visnjic et al., 2016). Among other barriers, an important but largely unexplored one relates to the exploitation of external resources through networks and ecosystems, in which firms are likely to be operating if they successfully servitize (Eloranta & Turunen, 2015; Kohtamäki & Rajala, 2016; Martinez, Neely, Velu, Leinster-Evans, & Bisessar, 2016; Opresnik & Taisch, 2015). In an effort to advance the understanding of inconsistent performance effects, this paper adopts a network and ecosystem perspective to explore key micro-foundations that may help firms and other actors to build the necessary dynamic capabilities for successful servitization.

The network approach has become pervasive in the examination of business relationships (e.g., Gulati, 1998; Ritter & Gemünden, 2003; Walter, Auer, & Ritter, 2006). Unlike the network approach, the ecosystem concept has just recently gained attention in strategic management (e.g., Adner, 2017), value co-creation (e.g., Kohtamäki & Rajala, 2016) and platform management (e.g., Gawer & Cusumano, 2014). Although the ecosystem literature has proliferated, the definition, theoretical backbone and the value added to innovation management research appears mainly conceptual, lacking empirical evidence (Adner & Kapoor, 2010; Tsujimoto, Kajikawa, Tomita, & Matsumoto, 2017). Hence, we aim to provide meaningful insights of necessary capabilities for successful servitization by complementing the network approach with an ecosystem perspective.

We argue that networks research in the context of value-co creation and servitization has largely focused on value-adding relationships of the focal firm in business-to-business (B2B) or business-to-consumer settings (B2C) (Ford & Gadde, 2003; Frow, McColl-Kennedy, & Payne, 2016; Kohtamäki & Partanen, 2016; Sjödin, Parida, & Wincent, 2016). However, in terms of value creation this is often an incomplete approach, as it largely neglects a diverse set of ecosystem actors (e.g. institutions, laws, regulation, communities), which are not directly connected to the focal firm through value-adding relationships (Akaka, Vargo, & Lusch, 2013) but increasingly shape the evolutionary fitness of the focal firm (Teece, 2007). Based on this view, an ecosystem approach focuses on the evolutionary dynamics and ties of exchange

processes between a diverse set of ecosystem actors and influencers (Akaka et al., 2013; Lusch & Vargo, 2014). In this paper, we show that both the network and a complementary ecosystem perspective are needed to explain the mixed performance effects of servitization. To investigate the complex and context-bound micro-foundations, this paper follows a mixed-method research approach. We conduct a secondary data analysis to determine the degree of servitization, and a quantitative survey to examine the network-related micro-foundations. To gain an in-depth understanding of the context-bound and complex ecosystem-related micro-foundations, we investigate multiple case studies. By extending the servitization discussion into industries where it is difficult to maintain competitive product differentiation, we focus on energy utilities that are regarded as having large growth opportunities through service initiatives (Kowalkowski et al., 2017b).

This study makes three contributions to the current literature. (1) Drawing on the dynamic capability concept (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece et al., 2009; Teece, 2007), we introduce a structured approach for examining network-and ecosystem-related dynamic capabilities and the underpinning micro-foundations in the context of servitization. Adopting a network and ecosystem perspective, we offer a more fine-grained view of servitization by not only focusing on essential internal capabilities but also integrating essential ecosystem-related capabilities, which concern the relationships with a broader set of actors and influencers in the ecosystem. (2) The ecosystem literature reflects the diversity of scholars' research traditions and theoretical backgrounds, but is still vague and lacks empirical evidence in practice. This paper extends existing research on the relatively young research field of ecosystems by specifically providing empirical evidence in the context of servitization. (3) Responding to the call for an improved measurement of service strategies (Kohtamaki et al., 2013), we provide a novel measurement of the underlying construct of the degree of servitization from an innovation management point of view. We argue that an innovation perspective can help to assess the degree of servitization by considering the number of service offerings and the service innovativeness.

The remainder of this paper is structured as follows. We begin by reviewing the ecosystem and network literature to identify the central assumptions of both concepts. A brief discussion of the dynamic capability framework follows to identify network- and ecosystem-related micro-foundations. Section 4 describes the methodology, and Section 5 displays the results for the specific context of energy utilities in Germany. In Section 6, we synthesize the results and discuss the implications of our research. Finally, we provide managerial implications, limitations and avenues for further research.

3. Background and theory building

3.1 Business ecosystems

Although scholars are unanimous that ecosystems are increasingly relevant to explain organizational outcome, the review and search of the literature demonstrated a vast variety of definitions and conceptualizations for the terms ecosystem and network. Prior research has demonstrated two key distinguishing features between the network and ecosystem concept. (1) Network scholars have contributed to a comprehensive understanding of exchange relationships and ties between network actors from an individual perspective (social networks) or firm perspective (networks of alliances) (Adner, 2017). This is often an incomplete approach, as it does not address the dynamic and evolutionary flows within such a network (Frow et al., 2016; Vargo & Lusch, 2010). Hence, the ecosystem concept extends the “somewhat static network approach” (Lusch & Vargo, 2014:161), as it conveys the entire dynamic exchange processes of activity flows within networks by focusing on the value proposition of the focal firm (Adner, 2017). (2) Network research has focused mainly on actors with direct ties to the focal firm (Akaka et al., 2013; Ford & Gadde, 2003; Mele, Pels, & Storbacka, 2015). The ecosystem concept goes beyond the traditional network approach by integrating a diverse set of ecosystem actors to which “the focal firm have no control, and with whom they have no direct contact” (Adner, 2017:44). This broad range of ecosystem actors (e.g. communities, city governments, regulators, standard setting bodies) often have no direct value-added ties to the focal firm, but indirectly affect the innovation behaviour of the focal firm (Teece, 2007). In this sense, and consistent with Frow et al. (2016), we argue that the network is considered to be a component of a broader ecosystem.

The literature on ecosystems offers various conceptualizations and reflects the diversity of scholars' research traditions and theoretical backgrounds (Lusch & Vargo, 2014; Teece, 2016). To summarize the review results, we adopted the view of Tsujimoto et al. (2017) and disaggregated the ecosystem literature into four major research streams. First, there is the industrial ecology perspective, which refers to the transformation of the industrial system using the analogy of the biological ecosystems. This perspective focuses on the breakdown of industry boundaries, the increasing relevance of interdependencies and questions of network openness and density (Adner, 2017; Moore, 1993). The second literature stream relates to the platform approach, focusing on platform evolutionary dynamics and the investigation of how platforms can leverage the value of technologies and achieve flexibility through modularity (Cenamor, Sjödin, & Parida, 2017; Gawer & Cusumano, 2014). Third, the business ecosystem perspective reflects research on ecosystem dynamics and its influence on organizational behaviour. The

focus lies on the relationships between suppliers, complementors, customers and the focal firm (Adner & Kapoor, 2010). The fourth approach expands the business ecosystem perspective towards a multi-actor network perspective, which stems from the assumption that relationships among a diverse range of actors and intermediaries can indirectly affect the innovation behaviour of a focal firm (Hienerth, Lettl, & Keinz, 2014). It reflects the contributions of all entities in the context of innovation, for example, local states, national governments, communities, policy-makers and actors that control public resources.

The multi-actor view is consistent with the “*ecosystem-as structure*” view of Adner (2017), which suggests focusing more on the role of regulators, influencers and institutions in order to understand firms’ actions. We adopted the view of Adner (2017:40) and defined the ecosystem as the “*alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*”. We selected this view because it offers a complementary perspective to the network approach. It starts with the firm’s value proposition, examines the relevant capabilities for the materialization, and ends with the alignment of a diverse set of ecosystem actors. Hence, it does not constrain the analyses to direct-related actors and activities of the focal firm, but expands the boundaries of the analyses to the complex network of a broad range of ecosystem actors and influencers.

Building on this definition of networks and ecosystems, our analysis of dynamic capabilities for servitization is based on two perspectives. First, the network perspective focuses on the direct value-adding ties of the focal firms. Second, the ecosystem perspective provides a complementary lens for the evolutionary and dynamic relationships among the focal firm and diverse set of ecosystem actors, which only indirectly affect the focal firm.

3.2 Dynamic capabilities in the context of networks and ecosystems

The dynamic capability approach focuses on how certain firms cope with situations of rapidly changing environments to sustain competitive advantage (Eisenhardt & Martin, 2000; Helfat et al., 2009; Teece, 2007). Following the generic model of Teece (2007), we distinguish dynamic capabilities into three distinct categories that are most critical for sustaining competitive advantage: the capacity to sense and shape opportunities and threats; to seize those opportunities; and to maintain competitiveness through enhancing and reconfiguring intangible and tangible resources. The organizational foundations of these generic dynamic capabilities are described as micro-foundations, which are defined as “the distinct skills, processes, procedures, organizational structures, decision rules, and disciplines – which undergo

enterprise-level sensing, seizing, and reconfiguring capacities, are difficult to develop and deploy” (p.1319).

Sensing opportunities and threats

In general, the sensing of dynamic capabilities refers to the identification and calibration of opportunities by continuously scanning, filtering and exploring technologies and markets (Teece, 2007). Research on network-related micro-foundations provides a vast variety of conceptualizations for the capability to sense and gather technological, market and competitive information (Ritter & Gemünden, 2003; Ritter, Wilkinson, & Johnston, 2004; Walter et al., 2006). To summarize the review results, we found two important constructs arising from the reviewed articles. (1) *The selection of cooperation partners*, which refers to the identification, selection and gaining of cooperation partners in the network (e.g. the mutual benefits, compatibility of the strategic goals and cultural compatibility) (Ritter et al., 2004; Walter et al., 2006). (2) *Network initiation*, which includes the firm’s analysis of its own strengths and weaknesses in advance, for example, the competitive situation and possible consequences of outsourcing innovation activities (Walter et al., 2006).

The search and review of ecosystem-related micro-foundations reveal that a major aspect in the sensing of opportunities relates to the understanding of regulations, law and institutions. For instance, firms are exposed to actors (e.g. local or national governments) that control or allocate public resources, which often constrain the ability to adapt new strategies and business models (Akaka et al., 2013; Teece, 2007). Especially in the early phase of a service lifecycle, firms face a high level of uncertainty regarding a diverse set of stakeholders that potentially affect the innovation behaviour of the focal firm (Cusumano et al., 2015). Hence, by filtering technological, market and competitive information, the influence of various stakeholders on its own innovation behaviour needs to be analysed by the focal firm.

Seizing opportunities and threats

In addition to the sensing of external stakeholders and discontinuities in the business environment, firms also have to address and exploit a broad range of opportunities to enhance their value propositions (Teece, 2007). Based on our review, we identify two essential network-related constructs: (1) *network promotion*, which refers to the maintenance of relations with external actors, for example, sufficient internal resources and specific incentive schemes for employees to maintain relations with external contacts (Ritter & Gemünden, 2003); and (2) *network configuration*, which emphasizes the legal, time, resource and formalization aspects of

the network (Ritter & Gemünden, 2003). This concerns, for example, whether cooperation between partners is always clearly regulated, the temporal scope of the cooperation is always appropriate for the content of the innovation activity, and the systems of project management and reporting are clearly regulated.

Using a broader ecosystem lens, the search and review of the literature reveal that service implementation is often influenced by complementors and complementary assets. This means that a specific service innovation is often a component of a larger solution, which are influenced by a diverse set of complementors that had to develop their own innovations or standards (Adner & Kapoor, 2010). This dependency on other complementors or complementary assets needs to be assessed in order to determine the critical bottlenecks of an innovation (Adner, 2017). In this sense, firms need to integrate various ecosystem actors into decision-making processes, which potentially affect the innovation behaviour of the firm. Additionally, it may be helpful to clarify certain roles and responsibilities of all the ecosystem actors and to evaluate make-or-buy decisions that potentially affect the position in the ecosystem.

Reconfiguration capabilities

The identification and calibration of opportunities may result in firm growth, but also often lead to path dependencies (Teece, 2007). In order to sustain profitable growth, firms have to secure a “continuous alignment and realignment of specific tangible and intangible assets” (p.1340). The review of network-related micro-foundations shows that a major aspect relates to the re-evaluation and management of the strategic fit of all cooperation activities. Based on past research, we identify the construct “*network reconfiguration*”, which relates to the reassessment of actual contributions of the cooperation partners with the agreed contributions and the coordination and management of the network (Ritter & Gemünden, 2003; Walter et al., 2006). Based on a broader ecosystem lens, the literature shows that the strategic fit between the focal firm and ecosystem actors needs to be continuously realigned. The orchestration of the whole ecosystem embraces the management of co-specialization and complementarities and development of the ability to utilize co-specialized assets (Teece, 2007).

In summary, to implement new services in an increasingly dynamic environment, firms need network-related capabilities in order to manage value-adding relationships in B2B or B2C settings. However, we argue that this is not sufficient to explain the mixed performance effects of servitization. Additionally, firms need to consider ecosystem actors, which are not directly related to the focal firm through value-adding relationships (e.g. communities). While the network perspective is increasingly applied to servitization research, a broader ecosystem

perspective still lacks empirical evidence. We are offering a refined understanding of the mixed performance effects of servitization and use both perspectives to explore the essential micro-foundations in the empirical setting of energy utilities.

4. Methods

4.1 Research context

The energy utility sector represents a suitable setting to investigate dynamic capabilities from a network and ecosystem perspective. Traditionally, the utility sector has shown low innovation intensity and weak customer orientation (Zentrum für Europäische Wirtschaftsforschung GmbH 2015), as energy provision has mainly been regarded as a commodity through which customers passively receive gas, water or electricity from energy utilities (Helms, 2016). When operating those traditional commodity-centric business models, utilities merely collaborate with suppliers (e.g. plant manufacturers, energy traders, electrical engineering firms), who supply components or produce complementary products to those of the energy utility. However, utilities are being forced to develop new services, in which relationships with a broad range of ecosystem actors become important, for instance, being able to continuously develop and comprehend smart energy services (e.g. e-mobility or smart home services). This not only embraces relationships with charging providers, battery manufacturers, grid integration firms, but also involves ecosystem actors such as legislators, communities and standard-setting bodies that potentially affect the innovation behaviour of the focal utility. Hence, accomplishing the required combination of technologies, capabilities and infrastructure necessary to deliver smart services requires intensive interaction with a large bandwidth of actors that go beyond value-adding B2B or B2C relationships.

4.2 Research design

The purpose of this paper is to explore the underpinning ecosystem-related micro-foundations that enhance the delivery of service innovation. The complexities of this topic led us to adopt a three-step mixed-method approach, involving quantitative data (secondary data and survey data) and qualitative data (semi-structured interviews) to increase the validity and reliability of our research. Such an approach combines strengths from both research methods and is appropriate when the research questions are deep and complex and a more complete understanding is necessary (Creswell & Clark, 2007). First, in order to determine the degree of servitization for each energy utility, we conduct a secondary data study. We use qualitative content analysis and a critical assessment technique (CAT) to capture the degree of servitization

by measuring service offerings and service innovativeness. Application of the measurement results in a ranking for the degree of servitization for each utility. This ranking is then used to test the network-related micro-foundations in our survey and the selection of case firms to examine ecosystem-related micro-foundations. Second, we conduct a quantitative survey of 28 firms to identify network-related micro-foundations. Third, we perform eleven interviews with eight highly servitized firms to provide in-depth insights into the ecosystem-related micro-foundations.

4.3 Secondary data analysis to determine the degree of servitization

We began our data-collection process by identifying a list of German energy utilities based on professional utility organizations and participant lists of specific industry conferences. In selecting the companies to include in the study, we focused on regional suppliers and municipal utilities (we refer to them here as energy utilities). Three criteria were applied to the selection of appropriate cases: (1) the core business is heating and electricity production and sales; 2) the firm should have a minimum of 50 employees and a maximum of 2,000 employees; and 3) the firm should offer a minimum of two service offerings. Application of the selection criteria resulted in the sample of 211 energy utilities. We dropped 30 firms based on the lack of data availability (e.g. website and annual reports). After eliminating firms that did not meet the sampling criteria, or relevant reports were unavailable, a sample of 181 energy utilities remained.

To determine how the 181 firms ventured into service activities, we based our study on qualitative content analysis. We relied on multiple sources of secondary data, which are usually publicly available and allow replication (Calantone & Vickery, 2010). The sources of information on service activities are the last annual report, websites and press articles, which typically represent valid evidence of service activities. We decided upon data collection in two phases: (1) identification of the number of innovative services using different secondary data sources; and (2) evaluation of the service innovativeness using the critical assessment technique (CAT) (Amabile et al., 1996). The data collection was conducted by four researchers and took nine months to complete (April to December 2016).

To identify the number of services, we defined the relevant services for our study and developed a list of the services that the firms have integrated into their service offerings. We based the list on prior servitization literature and energy-specific research (Helms, 2016; Kindström & Ottosson, 2016). The selection process led to a list of 89 different service categories (see example in Table 1). To evaluate the innovativeness of the service offerings, we followed

current innovation research, which suggests conceptualization by different dimensions (Atuahene-Gima & Evangelista, 2000; Schultz et al., 2013b). We used four dimensions to classify the innovativeness of each service offering: market, technology, firm-internal and environment (Schultz et al., 2013b). The market dimension refers to the offering of a new customer value in comparison with current products, the creation of a new market or the reorganization of the value chain in the industry. The technology dimension describes changes in technology components or principles of new services or products that require a new knowledge base. The firm-internal dimension relates to adaptations in technology strategy, organization structures or organizational culture due to the innovativeness of a new service. The environmental dimension refers to changes in infrastructure, industry norms or society values (see Table 1).

To evaluate the service innovativeness dimension, we used the consensus assessment technique (CAT) proposed by Amabile et al. (1996). The CAT was originally developed for the measurement of creative behaviour, but was also successfully applied to determine the innovativeness of product and service portfolios (Piller & Walcher, 2006). Following the rules of the consensual assessment technique (CAT), the service innovativeness dimension offerings were evaluated by three energy experts with long-term energy experience and different professional backgrounds (Amabile et al., 1996). To assess the degree of innovativeness, each service category was described as objectively as possible. We asked each expert independently to evaluate the innovativeness in four dimensions for each service category on a seven-point Likert scale (with the anchors “1 = low innovativeness” and “7 = high innovativeness”). To detect assessment differences between the experts, we used the intra-class correlation coefficient (ICC), which informs about inter-rater reliability and inter-rater agreement (McGraw & Wong, 1996). The ICC value showed an overall value of 0.76 for all dimensions, which is above the threshold of 0.7 to secure reliability and validity.

To measure the degree of servitization, a dichotomous scale (with “0 not offered” and “1 offered”) was used by the researchers to indicate whether or not a service was offered (see column 3, Table 1). If the service was offered, the firm received a score based on the average of the three expert judges in each dimension (see columns 4–8, Table 1). Finally, the service innovativeness (total) scores were added up and the accumulated degree of servitization calculated (see columns 8–9).

| Service category | Service offering | Service category offered | Service innovativeness dimensions* | | | | Service innovativeness (total) | Accumulated degree of servitization |
|------------------|------------------------|--------------------------|------------------------------------|------------|---------------|---------------|--------------------------------|-------------------------------------|
| | | | Market | Technology | Firm-internal | Environmental | | |
| 1 | Smart home services | yes | 6.33 | 5.67 | 6 | 6.33 | 24.33 | 24.33 |
| 2 | Online customer portal | yes | 2.33 | 1.67 | 2 | 1.67 | 7.67 | 32.00 |
| 3 | E-carsharing | yes | 5.67 | 5.34 | 5.67 | 6 | 22.67 | 54.67 |
| 89 | ... | ... | ... | ... | ... | ... | ... | ... |
| Total | | | | | | | 126.67 | |

*Average of three expert judges.

Table 1. Measurement of the degree of servitization

4.4 Survey

Data collection and sample

To examine the network-related micro-foundations, we performed a survey with 133 managers from 28 energy utilities in Germany. Senior managers of firms were contacted via a direct mailing and telephone campaign explaining the objectives and procedures of the study. Those willing to participate nominated a set of employees involved in innovation tasks in their daily work. Each employee received an individual link to an online survey, including the items for the assessment. This multiple respondent design also reduced the likelihood of a common-method bias. Our respondents were CEOs, marketing managers, business development managers and other persons responsible for innovation development.

Measures and properties of the scales

All indicators of constructs were measured using five-point Likert-type scales. Based on our literature review (see 2.2), we examined a selection of cooperation partners and network initiation (sensing), network promotion and network configuration (seizing) and network reconfiguration (reconfiguration). The empirical models include other factors that may affect the degree of servitization; for example, larger firms typically have greater resources. Therefore, we controlled for firm size, measured by the log-transformed number of employees per company. To measure these constructs of interest, existing and already validated scales were applied where possible. We assessed the content validity of the developed measures via a pre-test in two workshops with practitioners from 20 organizations. The variables that were

assessed from several respondents within an organization were aggregated to a firm-level score by calculating the mean values over their individual responses.

The applied measures were tested for validity and reliability. To assess internal consistency, Cronbach's alpha coefficients were calculated, which ranged between .96 and .64 at satisfying levels. Principal component analyses (varimax rotation) conducted separately for the items of each construct only extracted one factor with eigenvalues of greater than one, demonstrating their unidimensionality (Hair et al., 2009b). A complete listing of the scales and coefficients used in the study is provided in Appendix A. Convergent validity was checked through exploratory factor analyses and demonstrated by an average variance extracted of $>.50$ for all constructs (Chin, 1998). Discriminant validity at the construct level was supported by the results that the average variance extracted of each latent variable was greater than the highest squared correlation with all other latent variables (Fornell & Larcker, 1981). The largest correlation coefficient among the variables is .71, which is below the .80 threshold that would give rise for concern for multicollinearity.

To analyse the network-related micro-foundations, we conducted a correlation analyses and a t-test to examine whether network-related capabilities were more pronounced in servitized firms than in less servitized firms. In order to validate our results, we used the ranking of the degree of servitization determined by the secondary data analyses as an indicator to divide our sample into two sub-samples: highly servitized firms (top 25% of the sample, $n = 10$) and less servitized firms ($n = 18$).

4.5 In-depth interviews

Data collection and sample

To gain an in-depth understanding of the ecosystem-related micro-foundations, we conducted 11 semi-structured interviews with eight highly servitized firms. We used the ranking of the degree of servitization determined by secondary data analyses as the basis for the selection of our case firms (see Table 2). The in-depth interviews were guided by a case study protocol based on input from servitization literature, the business ecosystem and the dynamic capability framework. Hence, the interviews covered (1) service offerings, (2) ecosystem configuration, (3) drivers and challenges and (4) dynamic capabilities (for the interview guidelines, see Appendix B). We recorded and transcribed the interviews, which ranged from 45 to 90 minutes (Yin, 2009). As a result of data confidentiality, the participating company names are not revealed. Our selected respondents were innovation managers (6), key-account managers in energy services (3), marketing managers (1) and CEOs (1) (see Table 2).

| Firm | Degree of servitization (rank) | Employees (approx.) | Turnover in millions (approx.) | Recent service development | Interview duration | Position of interviewee |
|-------------|---------------------------------------|----------------------------|---------------------------------------|---|---------------------------|---|
| Firm 1 | 226 (35) | 100 | 58 | Smart meter services | 1:10 h | Innovation manager |
| Firm 2 | 437.7 (1) | 1864 | 509 | Tenant's (sub-metered) electricity supply | 0:50 h 0:58 h | Innovation manager Key-account manager |
| Firm 3 | 303.2 (11) | 695 | 481 | Photovoltaic contracting | 0:49 h | Innovation manager |
| Firm 4 | 323.7 (9) | 336 | 230 | E-mobility service | 0:58 h | Innovation manager |
| Firm 5 | 291.7 (15) | 1108 | 1.580 | E-mobility service | 0:55 h 1:21 h | Key-account manager Innovation manager |
| Firm 6 | 297.3 (13) | 1200 | 868 | Heat and power plants | 0:47 h | Innovation manager |
| Firm 7 | 282.3 (22) | 1069 | 270 | Smart home services | 1:10 h | CEO |
| Firm 8 | 337.3 (6) | 523 | 273 | Assisted ambient living service | 0:53 h 0:57 h | Marketing manager Key-account manager |

Table 2. Case firms and the degree of servitization

Data analysis

For the data analysis of the case interviews we followed the procedure proposed by Eisenhardt (1989) and Zimmermann et al. (2015) in order to maximize internal and external validity. In our analysis, we examined the empirical data through three distinct stages. In the first phase of analysis, we started with a deductive approach, reviewing the servitization and ecosystem literature to obtain a basic understanding of the theoretical assumptions. We developed an initial framework for the key micro-foundations to categorize the prevailing patterns in our empirical cases. Second, we followed inductive reasoning and built the first-order codes from the interviews. In order to ensure the reliability of our results, two researchers independently analysed the interview transcripts with the aid of the NVivo software tool. In the case of different interpretations of the data, we returned to the interview data, discussed the deviations and built a consensus, which finally led to a list of first-order categories (Miles & Huberman, 1994). Then, we grouped our first-order categories into second-order categories, which created the basis for the ecosystem-related micro-foundations. Finally, we categorized these 12 second-order clusters into our aggregate dynamic capabilities of sensing, seizing and reconfiguration (Figure 1).

5. Findings

5.1 Network-related micro-foundations

Table 3 describes the mean values from the survey conducted, standard deviations, correlations and univariate tests of the underlying variables coming from the survey data collected in 28 energy utility firms. To test the relationship between the network-related micro-foundations and

the degree of servitization, we used the ordinal variable “ranking of the degree of servitization” determined by the secondary data analyses. To validate our results, we additionally used the metric variable “degree of servitization”, which is the basis for the determination of the ranking. Hence, a high degree of servitization is related to a better position in the ranking.

Regarding the sensing of opportunities, the results indicate that there is a significant negative correlation between the ranking of the degree of servitization and the selection of cooperation partners (-0.39 ; $p < 0.05$). The results of the t-test confirmed that there is a significant difference between the two coefficients ($t = -3.56$; $p < 0.01$). The results also suggest that the ranking of the degree of servitization is negatively correlated to the network initiation (-0.41 ; $p < 0.05$), which is additionally supported by the t-test ($t = -2.22$; $p < 0.05$). These results reveal the positive effect of the identification and selection of appropriate partners for the servitization journey, the importance of the definition of clear goals for each cooperation activity (e.g. innovation result) and the relevance of a thorough analysis of the company environment (e.g. the competitive situation).

With respect to the seizing of opportunities, the findings suggest that the ranking of the degree of servitization is also negatively correlated to the network configuration (-0.39 ; $p < 0.05$), which is supported by the t-test ($t = -2.74$; $p < 0.05$). These findings show the positive effect of clear regulated cooperation in terms of the legal (e.g. scope of information exchange), duration (e.g. temporarily limited cooperation) and resource (e.g. type and amount) aspects on the degree of servitization. We additionally tested the relationship between network promotion and the degree of servitization. The findings reveal a negative correlation between network promotion and the ranking of the degree of servitization (-0.55 ; $p < 0.01$), which is supported by the t-test (-3.09 ; $p < 0.01$). This result suggests the positive effect of clearly defined contact persons, which are responsible for maintaining external relations.

| Variables | Overall correlations, means, standard deviations | | | | | | | | T-test for equality of means | | | |
|--|--|--------|--------|-------|-------|-------|-------|------|------------------------------|---|------|-------------------------------|
| | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | Highly servitized (N=10) Mean |
| 1 Ranking degree of servitization ^o | | | 1 | | | | | | | | | |
| 2 Degree of servitization | 183.60 | 107.21 | -.96** | 1 | | | | | | | | |
| 3 Selection of cooperation partners (Sensing) | 3.30 | .68 | -.39* | .35† | 1 | | | | | | 3.80 | 3.02 |
| 4 Network initiation (Sensing) | 2.95 | .79 | -.41* | .35† | .71** | 1 | | | | | 3.37 | 2.71 |
| 5 Network configuration (Seizing) | 2.92 | .58 | -.39* | .45* | .55** | .73** | 1 | | | | 3.27 | 2.71 |
| 6 Network promotion (Seizing) | 2.40 | .60 | -.55** | .55** | .72** | .59** | .48* | 1 | | | 2.85 | 2.19 |
| 7 Network reconfiguration (Reconfiguration) | 3.13 | .57 | -.25 | .25 | .55** | .68** | .72** | .36 | 1 | | 3.44 | 2.95 |
| 8 Firm size (LN) | 5.33 | 1.21 | -.72** | .75** | .00 | .03 | .28 | .40* | -.03 | 1 | 6.20 | 4.84 |

^o = Spearman correlation; M = mean; SD = standard deviation; ** = p < .01; * = p < .05; † = p < .10; n = 28

Table 3. Descriptive statistics and univariate tests

Regarding the reconfiguration of opportunities, the relationship between the ranking of degree of servitization and network reconfiguration seems to have no effect. In contrast, the t-test indicates a significant difference between highly servitized and less servitized firms, which assumes that highly servitized firms have more pronounced capabilities in terms of modifying

and evaluating the contribution of the cooperation, and the coordination activities. The control variable firm size has a significant positive effect on the ranking of the degree of servitization ($-.72$; $p < .01$). The results of the t-test confirmed that there is a significant difference between the two coefficients ($t = -3.96$; $p < 0,01$). Overall, the results show that servitized firms have more pronounced network-related micro-foundations than less servitized firms. To examine the micro-foundations for ecosystem-related micro-foundations, in the next section we provide in-depth insights from eight highly servitized firms.

5.2 Ecosystem-related micro-foundations

Based on 11 interviews with highly servitized firms (Table 2), we present and describe the identified ecosystem-related dynamic capabilities of sensing, seizing and reconfiguration and the underpinning micro-foundations.

Sensing the ecosystem-related capabilities

Creating an internal open mindset for ecosystem-related activities

As a result of the increasing embeddedness of firms in networks and ecosystems, the results show the importance of creating an internal open mindset for collaboration with ecosystem actors. The interviewed firms stated that they gather in meetings to discuss trends and external actors, like interest communities. This also includes voicing visionary or disruptive concepts such as offering power free of cost in 10 years and how this could potentially work with external partners. A key account manager of firm 8 said: *“In the beginning of our service journey, we were completely overwhelmed with the new processes and the different actors. And the problems are increasing, if you attempt to promote these services internally. You need to take these people with you.”* In summary, in order to develop services within a broader range of ecosystem actors, firms need to allow employees to sense and think. One option would be internal recognition of the relevance of projects with ecosystem partners.

Calibrating opportunities through initial investments in common R&D projects

The results show that highly servitized firms seize their chances through learning, interpretation and probing of customer needs and technological opportunities. For instance, an innovation manager from firm 4 said about a cross-firm R&D project: *“During our smart meter service development, it was not clear what the standards of the smart meter would look like. However, we wanted to gain first insights and to establish a foundation for the decision a few years later. This extended our experiences and prepared us for the final decision to invest.”* In short, firms

with a high degree of servitization often use initial investment in common R&D projects with other ecosystem actors to probe customer needs and to assess and filter target markets, technology and customer segments.

Screening markets and technologies with research institutes and universities for relevant actors

Our results indicate that firms often sense opportunities through scanning and screening markets and technologies with research institutes and universities. Universities are mentioned as an aggregator and organizer of knowledge or as a channelling partner to organize relationship platforms. The latter are described as interest alliances, which include diverse partners on a topic. An innovation manager from firm 6 said: “*We have implemented an advisory board for service innovation, which includes universities and employer associations. The reason behind [this] is to gather feedback, opinions and recommendations from leading academics.*” In summary, projects with universities can be seen as an investment in research and development activities, which may lead to a deeper internal understanding and knowledge of the firm.

Gathering information from institutions, regulators and influencers

The firms here have specifically been mentioning their need to understand what politicians and the government are requesting from them, as well as the influences of NGOs looking at green energy production. The following statements from a marketing manager (firm 8) underline that micro-foundations for service innovation go beyond intra-organizational boundaries and increasingly relate to the broader environment of the focal firm: “*The greatest chaos concerns politics. If they nowadays pass a law to support a certain technology or service, all firms jump onto this train. But if they revise the law a few years later, we frequently cannot leave this train.*” In short, in order to identify and shape opportunities, firms must constantly explore and screen the broader ecosystem, which involves local (e.g. municipal communities) and distant stakeholders (e.g. national governments).

Seizing ecosystem-related capabilities

Top-management support of external collaboration

The descriptions from the interviews vary here. In many organizations gaining management support was seen as trivial, which may have been biased by the fact that we had only highly innovative firms in the sample. However, there was a mention of aligning culture and single people internally, but also towards external partner firms. For instance, an innovation manager from firm 3 pointed out: “*At the end of the day, the CEO has to take care of the relations with*

other ecosystem actors. He needs the willingness to actively deal with the relevant stakeholders, associations and institutions to manage external collaborations.” In short, engaged individuals and a highly supportive top management towards a diverse set of ecosystem actors are crucial for seizing service opportunities.

Integration of ecosystem actors in decision-making processes

The findings reveal that highly servitized firms integrate ecosystem actors in decision-making processes during the implementation of new services. The interviewees describe that they have taken into account external actors such as local institutions, environmental associations, advisory boards and local communities, or used them for their own purpose internally to drive decisions. One example was to integrate environmental NGOs in the development of eco-friendly power products and services. The expertise and collaboration added by the specialist partners offer significant advantages through the direct input and idea exchange. Another example relates to the interview with a key account manager from firm 5, who said: “*We have an energy-related community in our city, which is negatively related to some of our energy projects. You have to take this community on board with you. Then they are always positive for new service activities.*” In short, there is an obvious role for the top management to create an environment in which the ecosystem actors are involved in making the decision for services.

Pursuing a keystone position in the ecosystem

The results show that highly servitized firms are increasingly embedded within ecosystems, and additionally develop a more holistic strategy that goes beyond organizational boundaries. This micro-foundation is consistent with research from Iansiti and Levien (2004), who stated: “Strategy is becoming, to an increasing extent, the art of managing assets that one does not own” (p.1). Similarly, the CEO of company 5 pointed out: “*I would consider us a leader for new service in our ecosystem, sometimes additionally as an incubator to increase the maturity of the service.*” In summary, the highly servitized firms expressed an urge to be the driver and to be seen as the innovator within their ecosystem. They therefore stated that they are driving innovation discussions and aiming to be as active as possible. It was also stated that it was positive to be seen as an innovator by other actors in the industry, as they would choose to approach them for innovation collaborations.

Controlling the bottleneck of the ecosystem

The results show that firms seek information and drive change in the area of bottlenecks, which are seen as hindering large innovations and changes. This is consistent with the research of Adner and Kapoor (2015), which stresses that the success of innovation often depends on the challenges that other complementors face in its environment. For instance, a key account manager from firm 3 stated: *“We have implemented a technology from our supplier Siemens, but we are dependent on this company, [so] what should we do if Siemens is planning to change its technology standards? This would be a mess for our firm.”* The innovation manager from firm 3 similarly said: *“The oil price is currently weak, and the national government indirectly promotes oil condensing boilers. Under this condition, you will not find a customer who wants to invest in a new heat pump. That destroys our new service business.”* In short, firms have to track and, if possible, control different ecosystem influencers, regulators and standard-setting bodies that potentially affect innovation behaviour.

Reconfiguration of ecosystem-related capabilities

Orchestration of the service system

Consistent with previous studies (e.g. Agarwal and Selen 2009; Kindström et al. 2013), our results show that innovative firms re-evaluate and re-orchestrate the whole ecosystem of suppliers, customers and other actors. The orchestration is stated to start internally, where the firm rearranges and organizes itself and then looks externally for ideal optimization of the managerial exchange points, also considering whether the external actor (e.g. supplier) still fits and delivers value. This is not considered trivial as a task and culture within a firm. For instance, the CEO from firm 7 said: *“The biggest difficulty is to adapt the process-oriented system infrastructure of our firm towards a project-oriented system infrastructure. These systems need to be realigned with know-how from outside.”* Overall, several interviewees reported the relevance of including different ecosystem actors in the service system and stressed the requirement to orchestrate the process, internally but also externally.

Realignment knowledge-transfer to adapt cross-industry innovation

The case firms have shown that they are prepared to seek innovations beyond its traditional industry. Additionally, firms coordinate knowledge transfer with specialized and co-specialized newcomers and partners outside the traditional value chain. The innovation manager from firm 5 said: *“To successfully implement service systems, we separated the new service business from our daily business. That was vitally important that we realigned our corporate structure by*

establishing a start-up company in our own firm.” In short, to engage in other industries would first aid the ideation processes and act as inspiration, but also then allow engagement in potential innovation opportunities through new connections.

Coordinating the role of governance structures, newly built institutions and their regulation

The results show that highly servitized firms have to realign organizational structures on institutions and influencers and revamp internal routines. There may be a legal form or a tax choice that will make or break the new venture structure. Firms need to understand and evaluate local investments and governmental support mechanisms for new ventures. An innovation manager from firm 1 pointed out the need to “*create internal responsibilities to cope with new regulation and laws*”. Another manager pointed out: “*The legal framework in Germany is quite difficult as there are different restrictions. We need to establish clever units so that we can react to this.*” In summary, a key to sustained service innovation seems to be the ability to coordinate and realign governance structures, newly built institutions and their regulation.

Developing and extending the ecosystem

Extending, as well as developing, the ecosystem is an active task from highly servitized firms, which is described step by step. There is a certain marketing and communication task at hand, thereby informing and communicating with potential new partners and increasing the partnership’s market ability, reach and, foremost, turnover. Hence, a revisiting of ability and change is required on a regular basis. The innovation manager from firm 3 said: “*It was a strategy to present our new service in the network and broader ecosystem. We have seen relatively quickly that there was a great demand and the idea was to create new networks in order to continue to roll out, even beyond our traditional customers.*” In conclusion, there was a reoccurrence of the view that an ecosystem has to adapt to changes constantly, be it internally or externally. Figure 1 summarizes the empirical findings of the qualitative interviews and connects the identified categories with the overarching concept of dynamic capabilities.

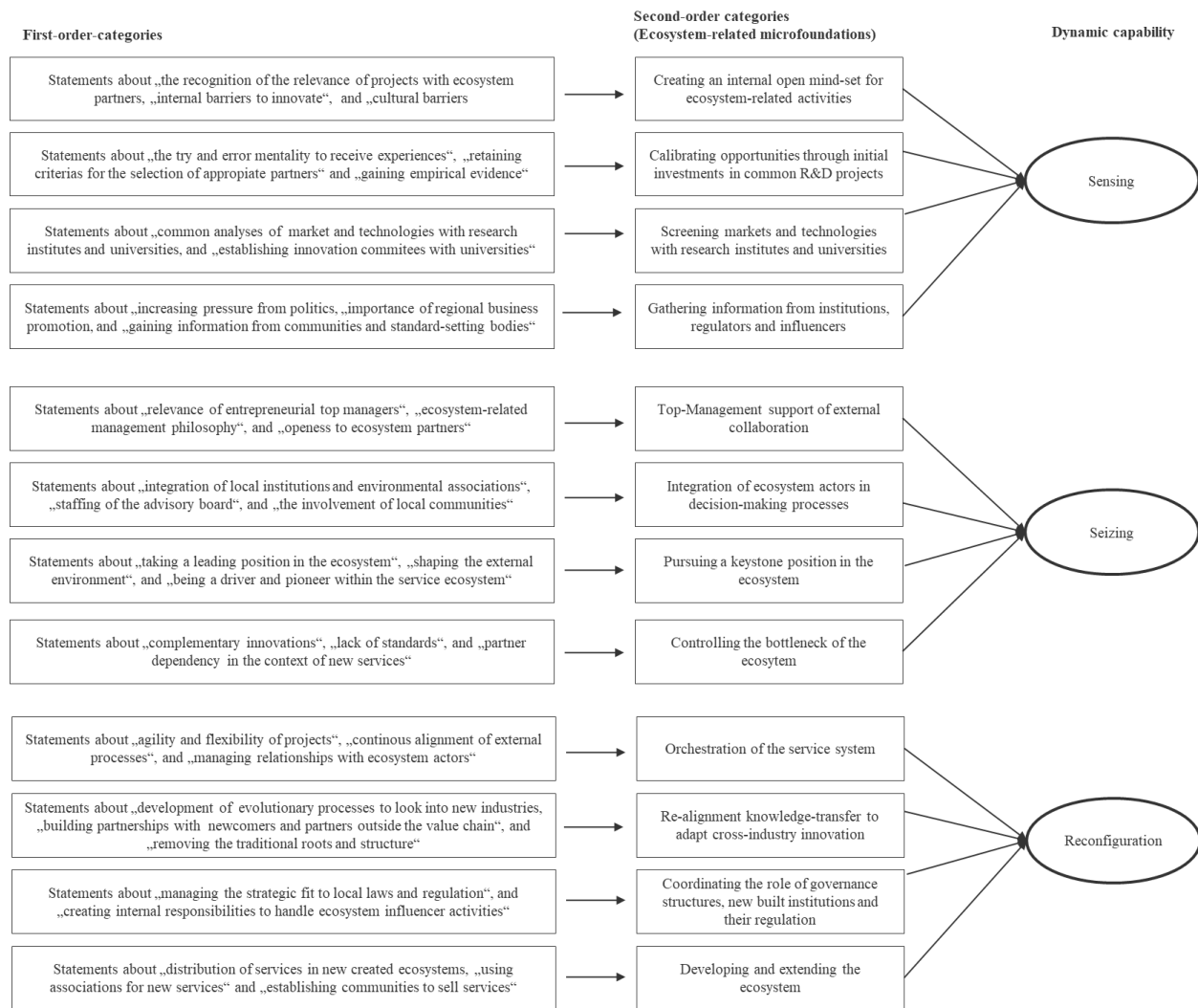


Figure 1: Identified ecosystem-related dynamic capabilities

6. Conclusion

6.1 Theoretical contribution

The existing research highlights the largely inconsistent performance effects of servitization. We argue that the relationship between service offerings and performance is affected by network- and ecosystem-related micro-foundations, which facilitate the servitization journey of product-centric firms. In this sense, the purpose of the study was to uncover this black box of mixed performance effects by exploring network- and ecosystem-related capabilities in the context of servitization. To achieve this purpose, this study applied a mixed-method approach by using quantitative analysis of the secondary information of 181 firms, allowing an innovation ranking and a survey of 28 firms to identify relevant capabilities and qualitative data (in-depth interviews with eight highly innovative firms).

The results show that servitized firms have more pronounced network-related micro-foundations than less servitized firms. This is consistent with servitization research, which

emphasizes the network management capability to coordinate a diverse set of B2B relationships in order to co-create value for the customer (Parida et al., 2014; Sjödin et al., 2016). In addition, we show that additional ecosystem-related capabilities (e.g. pursuing a keystone position and integration of ecosystem actors into decision-making processes) are needed to enhance the degree of servitization. This is new to servitization research and contributes to the understanding of which essential capabilities are required to successfully servitize. In detail, the paper contributes to the literature in three ways.

First, this study extends the discussion on dynamic capabilities in the context of servitization (Fischer et al., 2010; Kindström et al., 2013). While Kindström et al. (2013) and Fischer et al. (2010) have investigated the dynamic capabilities of service innovation and contributed to an understanding of the underpinning micro-foundations, we extend this research by using a specific network and ecosystem perspective to explore essential dynamic capabilities. While the network perspective has expanded significantly in the field of servitization and value co-creation (Kohtamäki et al., 2013; Story et al., 2017), empirical studies based on an ecosystem perspective are rarely applied. Hence, this work responds to the remarks of Kohtamäki and Rajala (2016), who emphasize that ecosystem perspectives are valuable for service research, as the literature in this context is still conceptual and lacks empirical evidence. Indeed, this study confirms that ecosystems play an important role for service innovation in the context of energy utilities. We believe that this empirical setting is particularly suitable to exploring the underpinning micro-foundations, because utilities increasingly shift from commodity providers towards complex service providers (Helms, 2016; Kindström & Ottosson, 2016). The results show that network-related and ecosystem-related capabilities have a positive relationship with the degree of servitization. In particular, the results demonstrate that servitized firms not only have more pronounced capabilities in the context of network-related B2B and B2C value-adding partnerships, but have also implemented evolutionary exchange processes with a diverse set of ecosystem actors (e.g. regulators, standard setting bodies and communities), which may only indirectly affect the degree of servitization.

Second, this study contributes to the research on ecosystems (Adner, 2017; Adner & Kapoor, 2010; Tsujimoto et al., 2017) by providing empirical evidence within the unique context of servitization. We confirm the underlying propositions of conceptual studies in the ecosystem literature by demonstrating that highly servitized firms, at least in our setting, generally have more pronounced ecosystem-related capabilities than less servitized firms. In particular, we provide a novel insight regarding the differentiation between the network and the ecosystem concept. Existing research on networks largely focuses on value-adding partnerships in B2B or

B2C settings (e.g., Kohtamäki & Partanen, 2016; Sjödin et al., 2016). The ecosystem concept goes beyond these boundaries and additionally analyses the evolutionary relationships with a diverse set of ecosystem actors and influencers (e.g. institutions, laws and regulation), which does not directly affect the focal firm through value-adding relationships.

Third, the study provides a more refined conceptualization and a finer-grained measurement of the underlying construct of the degree of servitization. This novel approach responds to scholars calling for a new and improved measurement of service strategies (Kohtamaki et al., 2013). We provide a novel measurement of the underlying construct of the degree of servitization from an innovation management point of view. Prior studies have mainly measured the degree of servitization by using dichotomous service items (e.g. Homburg et al. 2003), or service offering categories (Kohtamaki et al., 2013; Kowalkowski et al., 2015; Windahl & Lakemond, 2010) as proxies for the degree of servitization. Although we acknowledge the measurement of previous approaches, we argue that employing an innovation management perspective could further improve the measurement of the degree of servitization, because it not only measures the number of services but also takes into account the innovativeness of those services. We argue that the implementation of innovative services requires a change in firms' organizational structures, processes and strategies (Avlonitis et al., 2001; Schultz et al., 2013b). In this sense, the newness and complexity of services increases in relation to the progress of servitization and may better reflect the degree of servitization. Although we believe that our approach reflects the degree of servitization better than prior approaches, further validation of our measurement should be undertaken.

6.2 Managerial implications

This study has important practical implications for managers of product-centric firms who aim to create value by offering advanced services. In this paper, we explored dynamic capabilities from a network and ecosystem perspective, which helps managers to address and build some of the main external capabilities associated with the servitization journey. By using the generic dynamic capability framework of Teece (2007), we disaggregated capabilities in sensing, seizing and reconfiguration. In doing so, we developed a generic framework for managers that addresses the exploitation and building of ecosystems for service innovation (Figure 1).

Our results imply that managers need not just a network perspective to address and organize value-adding B2B or B2C relationships, but also a broader ecosystem perspective to orchestrate the whole ecosystem, which additionally includes non-directly value-adding relationships with institutions, communities and regulators. In terms of value-adding B2B or B2C relationships,

managerial attention should develop network management capabilities, which relate to the network initiation, network configuration, partner selection, network promotion and network reconfiguration. For instance, network promotion means the definition of contact persons for external relations, detailed job descriptions for employees regarding the maintenance of external relations, sufficient internal resources and specific incentive schemes to motivate employees to maintain relations with external contacts. However, building on the results of this study, we argue that these network competencies are not sufficient to explain mixed servitization performance effects. Hence, managers should additionally establish ecosystem-related dynamic capabilities, which concern, for example, the pursuit of a keystone position in the ecosystem or the integration of ecosystem actors into decision-making processes. These capabilities emphasize the orchestration of the entire ecosystem's actors (e.g. institutions, influencers and regulators) and activities. In sum, our results show that this broader perspective is important for managers, as not only does a successful servitization journey involve value-adding partnerships, but it also becomes obvious in dynamic environments that the whole ecosystem's activities need to be continuously realigned for service innovation.

6.3 Limitations and suggestions for further research

Despite its contributions, our study has limitations that need to be taken into account when interpreting the results. First, this study was an initial attempt to explore the network- and ecosystem-related micro-foundations of capabilities in the context of servitization. To test the effect on the degree of servitization, we used independent secondary data, which enhanced the validity of the results. However, descriptive evidence does not address the causal mechanism factors behind this suggested relationship. Consistent with Helfat (2007), we argue that the relationship between capabilities and firm performance is complex, as financial measures could not be applied as a proxy for the firm outcome. The resulting question is: What comes first: the degree of servitization or the network- and ecosystem-related capabilities?

Second, as practical evidence has shown that the boundaries between products and services have been blurred (Vargo and Lusch 2004), this study conceptualizes the degree of servitization through an innovation perspective, which is a valuable complementary view to the current literature. We measured the degree of servitization by using the number of services and the innovativeness. Consistent with innovation research (Schultz et al. 2013), we argue that services with a high degree of innovativeness positively affect innovation performance and, in turn, the overall corporate performance. However, based on our data, we are not able to explicitly

measure the performance effect of each service offering. In this sense, additional research is needed to analyse the overall performance effects of service offerings.

A third limitation relates to the measurement of the degree of servitization. It is unclear whether, and to what degree, firms communicate the implementation of services in business reports, the press and on their websites. For example, the measurement might be distorted for service activities that firms treated confidentially to avoid competition. Nevertheless, we expect that most relevant services should lead to a higher degree of communication in websites, news articles and annual reports to gain new customers and market attraction (Benedettini et al., 2017). Fourth, we examined dynamic capabilities in the context of a single industry, and we expect that other market environments would reveal similar results. However, the results are based on cases from the specific commodity-oriented energy industry, where even greater challenges in the context of servitization can be expected, and which may be different to more innovative industries. Hence, a replication in other industry contexts would extend its generalizability and represent a promising avenue for scientific research.

7. References

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Appendix

A. Measures and corresponding factor loadings

| Construct | Items | Factor loading |
|---|--|----------------|
| Sensing Selection of Cooperation Partners (Sources: Walter et al., 2006; Ritter and Gemünden, 2003; Ritter et al., 2004) | ($\alpha = .88$; AVE = .74) (1 = strongly disagree, 5 = strongly agree) Before we decide to select a network partner ... | |
| | ...we systematically identify potential cooperation partners. | .94 |
| | ...we search for potential cooperation partners, even outside the existing network. | .86 |
| | ...we systematically evaluate potential cooperation partners, e.g. the mutual benefits of cooperation, compatibility of our respective strategic goals and cultural compatibility. When communicating with potential cooperation partners for the first time, we fully disclose our own goals for the cooperation. | .87 .78 |
| Sensing Network Initiation (Sources: Walter et al., 2006; Ritter and Gemünden, 2003; Ritter et al., 2004) | ($\alpha = .92$; AVE = .81) (1 = strongly disagree, 5 = strongly agree) Before we cooperate with external partners on innovation activities ... | |
| | ...we analyse our own strengths and weaknesses with regard to the relevant project. | .97 |
| | ...we analyse the company environment, e.g. the competitive situation, infrastructure and funding possibilities. | .93 |
| | ...we analyse the possible consequences of (partially) outsourcing innovation activities, e.g. consequences to our core competencies, image and internal barriers. We define clear goals for each cooperation activity, e.g. innovation result, contribution to the competitive situation, temporal goals and use of resources. | .86 .85 |
| Seizing Network Configuration (Sources: Walter et al., 2006; Ritter and Gemünden, 2003; Ritter et al., 2004) | ($\alpha = .84$; AVE = .57) (1 = strongly disagree, 5 = strongly agree) The legal aspects of cooperation between the cooperation partners are always clearly regulated, e.g. joint patent utilization, scope of information exchange and the contractual form of cooperation. | .74 |
| | Sanctions for conduct that is contrary to agreement form a component of our cooperation contracts. | .78 |
| | The duration of cooperation is clearly regulated for each innovation activity, e.g. temporally limited project cooperation and long-term cooperation in a business area. | .75 |
| | The temporal scope of cooperation is always appropriate for the content of the innovation activity, e.g. limited project cooperation for incremental further development. | .78 |
| | The type and amount of resources each cooperation partner is expected to provide is always clearly regulated. | .79 |
| | The systems of project management and reporting are clearly regulated for all cooperation. | .67 |
| Seizing Network Promotion (Sources: Walter et al., 2006; Ritter and Gemünden, 2003; Ritter et al., 2004) | ($\alpha = .82$; AVE = .59) (1 = strongly disagree, 5 = strongly agree) We have defined contact persons responsible for maintaining external relations. | .78 |
| | The role of maintaining external contacts (such as the systematic collection of information and internal dissemination) is regulated by detailed job descriptions. | .86 |
| | The employees of our company responsible for external contacts have sufficient resources for carrying out this activity. | .84 |
| | Specific incentive schemes motivate employees to maintain relations with external contacts. We encourage all employees to be open to external input sources. | .67 .65 |
| Reconfiguration Network Reconfiguration (Sources: Ritter et al., 2004; Walter et al., 2006; Ritter and Gemünden, 2003; Ritter et al., 2004) | ($\alpha = .88$; AVE = .69) (1 = strongly disagree, 5 = strongly agree) The project objectives, project progress and the project decisions are known and accessible to all the team members of a cooperation project. | .90 |
| | The actual contributions of the cooperation partners are regularly compared with the agreed contributions. partners. | .75 |
| | The cooperation partners regularly come to agreements, e.g. in joint meetings, progress and result reports. | .70 |
| | Employees who carry out cooperation activities know exactly which information may be passed on to cooperation partners and which information may not. | .85 |
| | We regularly evaluate all cooperation activities. | .92 |

Appendix B. Questionnaire

1. Service offerings

- What service types does your firm develop?
- How strong is the relevance of service offerings in your organization?

2. Ecosystem configuration

- Who are the participants of your ecosystem? What is your role? What is the ultimate goal that unites all the players?
- Who brings resources, solves the problem, manages the process?
- What are the rules of the game? Where does the power lie?
- How does the money flow?
- Are there differences between regional, national and international ecosystems?

3. Drivers and challenges

- What are the drivers for developing services in a digital ecosystem?
- Are there dependencies from other ecosystem actors?
- What are the key challenges for your firm in developing, configuring and delivering advanced services within an ecosystem?
- Are all the challenges solved optimally? Are there cultural challenges?
- What is the challenge/need of the ultimate customer(s) of the ecosystem?
- What is your value-added share?

4. Dynamic capabilities

- Describe how you are dealing with these challenges and what activities are needed to be able to offer more advanced services within ecosystems?
- Is the complex solution that the ecosystem provides optimal? Which capabilities do you need to solve the ecosystem problem?
- Can you think of a better way to solve the problem?
- Could you provide a better solution to another part of the challenge that is currently served poorly?
- Can you provide a better service to your part of the challenge?

Erklärung zum selbstständigen Verfassen der Arbeit

Ich erkläre hiermit, dass ich meine Doktorarbeit „Essays on the Management of Servitization“ selbstständig und ohne fremde Hilfe angefertigt habe und dass ich als Koautor maßgeblich zu den weiteren Fachartikeln beigetragen habe. Alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehrenden Ausführungen der aufgeführten Beiträge wurden besonders gekennzeichnet und die Quellen nach den mir angegebenen Richtlinien zitiert.

Ort, Datum

Unterschrift