Managing customer satisfaction: digital applications for insurance companies

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Abstract

Customer satisfaction management is increasing in importance within the insurance industry. In particular, to define a customer-oriented strategy, installing digital applications based on technologies, e.g. including artificial intelligence or cloud computing, ranks among the major strategic challenges. Against this background, the aim of this paper is to take an integrated perspective on managing customer satisfaction and the digital transformation. Towards this end, we identify and assess a set of digital applications, as a result of a comprehensive review of 106 academic papers and publications of the industry and supervisory authorities. We illustrate the opportunities to increase customer satisfaction and emphasise their impact on insurers at four major customer touch points: contract conclusion, contract modifications, the event of damage and further contacts. Our results are strategic measures to strengthen the position for sales and marketing, to simplify standard processes and to increase efficiency and interaction with the customer.

Keywords Digital applications · Customer satisfaction · Insurance innovation

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Introduction

In the past, customer satisfaction in insurance has not been widely discussed as a key steering figure for insurance management, and academic research on customer satisfaction in the insurance industry is notably low compared with other sectors (e.g. Brutyan et al. 2019; Jahnert and Schmeiser 2021; Pooser and Browne 2018). Today, digitalization affects and transforms customer behaviour, customer expectations and customer requirements (Catlin et al. 2015; Cebulsky et al. 2018; Lyskawa et al. 2019). Private insurance customers experience highly transparent, fast service processes in other industries (e.g. firms such as Amazon setting the benchmark for best practices) and transfer their requirements to the quality of the insurance customer experience (e.g. Catlin et al. 2015; Hall 2017; Müller et al. 2015). Moreover, the insurance market observes the phenomenon of InsurTechs, which is beneficial for customers, as they operate flexibly and simplify innovation processes (e.g. Eling and Lehmann 2018; Grima et al. 2020). Hence, managing customer satisfaction has become more important and more challenging for incumbent insurance companies.

At the same time, digitalization also provides considerable benefits for insurance companies in this regard. By enhancing the customer experience (Eling and Lehmann 2018), bringing policyholders and insurance companies closer together (Kotalakidis et al. 2016) and widening the role of insurance companies to become the insured's risk manager, digitalization might help improve customer satisfaction (e.g. IAIS 2018), as insurance companies evolve from pure risk protectors to risk predictors and preventers (Kelley et al. 2018; Schmidt 2018).

Previous literature reveals that customer satisfaction drives customer loyalty and leads to fewer customer complaints (Fornell et al. 1996; Helgesen 2006; Heskett et al. 1994). Moreover, there is an abundance of literature investigating customer satisfaction in general (for an overview, see, e.g. Arora and Narula 2018). In particular, Oliver (1977, 1980) developed the expectation confirmation theory, which argues that customer satisfaction is mainly driven by customer expectations and perceived performance. Outperforming customer expectations with the product or service leads to higher customer satisfaction, while underperforming decreases customer satisfaction (Oliver 1977, 1980). In the context of insurance customer satisfaction, existing empirical evidence indicates that lower expenses and combined ratios in the presence of satisfied customers are due to an increasing number of renewed contracts (instead of new policies), with reduced costs for customer acquisition. Therefore, increasing customer satisfaction is discussed to enhance the profitability of insurance operations (Pooser and Browne 2018).[1] Jahnert and Schmeiser (2021) extend the investigations on the relation between customer satisfaction and profitability in the insurance industry by analysing data at the level of individual customers stemming from a Swiss non-life insurance

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[1] The related dataset of Pooser and Browne (2018) refers to automobile insurers in the US. The authors state the positive impact of customer satisfaction on the overall profitabiliy of automobile insurers. The investigations specifically refer to revenue, profitability and prices in terms of the financials of insurance companies. Due to better retention and recommendation rates of satisfied customers to friends and family, the authors identify the potential to lower customer acquisition costs (Pooser and Browne 2018).

company. Moreover, due to the widespread utilisation of information technology, the option to conduct comprehensive research from the perspective of customers in relation to the characteristics of insurance products, prior to purchasing them, becomes increasingly relevant (e.g. Mau et al. 2015): customers can easily compare products using comparison portals or conveniently buy products online, which is especially important for property and casualty insurance (e.g. Woo-Yeon et al. 2021). To further underpin the relevance of digitalization, recent empirical works discuss process improvements toward customer centricity (e.g. Kreuzer et al. 2020), customer engagement through value co-creation (e.g. Chen and Chen 2017), the trade-off between customisation and complexity (e.g. Grösch and Steul-Fischer 2017; Leischnig et al. 2018), the decisive function of intermediaries (e.g. Dominique Ferreira 2018) and the reliability and responsiveness of customer support (e.g. Ramamoorthy et al. 2018) as prerequisites for customer satisfaction in the insurance industry. As customer satisfaction builds trustful relationships, it thereby increases policyholders' willingness to disclose personal data, which in turn unlocks various benefits for insurers using digital technologies (Steiner and Maas 2018).

However, to the best of our knowledge, there is a lack of academic and practitioner-oriented research focusing on the benefits and opportunities of digital applications when *managing customer satisfaction* from the perspective of insurers, with a focus on the major customer touch points. By including them, we extend the investigations of Eckert and Osterrieder (2020), who take a more technical perspective on implementing digital technologies (e.g. big data, artificial intelligence, cloud computing, the Internet of Things and distributed ledger technology) and discuss the interdependencies between them. In particular, we contribute to previous work by identifying and analysing a set of digital applications. We distinguish between front-end and back-end functionalities and assess the opportunities of these applications at the major customer touch points of insurers, including contract conclusion, contract modifications, the event of damage and further contacts. Hence, our results provide insights and guidance for managing customer satisfaction in a targeted manner on the corresponding customer touch points (e.g. allow a focus on customer touch points, where customer satisfaction is currently low). For each incorporated digital application, we additionally provide a set of necessary requirements, so as to install these and comprehensively discuss their limitations due to concerns, e.g. related to data utilisation and customer attitudes regarding new technologies or regulatory hurdles.

The paper is structured as follows. The next section describes the theoretical background and addresses the terminology. We present the set of digital applications and focus on their benefits and opportunities at the four major customer touch points in the subsequent two sections. Then, we discuss the limitations and derive the related requirements for insurers. The final section summarises the results.

Theoretical background: methodology and analysis

The paper focuses on a comprehensive assessment of digital applications for insurers when managing customer satisfaction. To this end, we create, review and assess a comprehensive literature data sample, which consists of 106 articles in total and

incorporates academic research and the publications of industry experts and supervisory authorities.[2] The sample is based on the review approach of Eckert and Osterrieder (2020) and is a result of key word searches including 'insurance' AND 'artificial intelligence', 'insurance' AND 'big data', 'insurance' AND 'blockchain', insurance' AND 'cloud computing', 'insurance' AND 'digitalization', 'insurance' AND 'digital transformation', 'insurance' AND 'distributed ledger technology' as well as 'insurance' AND 'internet of things'. We thereby implement the searches in the selected journal databases (ABI/INFORM Collection, Business Source Complete, EconLit Full Text), and amend the focus of screening and selecting the resulting articles in relation to the effects on customer satisfaction. Besides, to get a reasonable understanding of the current state of research on customer satisfaction in the insurance industry, we search the Scopus database for scientific journals using the queries 'customer' AND 'satisfaction' in the field of business, management and accounting. Finally, to reduce the risk of omitting literature important to this work, we extend our scope to Google Scholar and Google, to incorporate recent discussions in the industry and additionally review and assess the cited references (see also Eckert and Osterrieder 2020; Gatzert and Osterrieder 2020).

Based on this, we have created a set of digital applications for insurers and explain why and how these applications support managing customer satisfaction, which "*evaluates whether the customer was satisfied with the insurance services, insurance transaction, and their relationship with the insurance company*" (Nguyen et al. 2018, p. 4).[3] To comprehensively assess the aforementioned set of digital applications for insurers, we consider versatile internal options of utilisation that affect different strategic levels within an insurance company. For this reason, we cluster the set of digital applications as a first step based on a categorisation of their main focus on automating or digitally enhancing back-office functionalities, front-office functionalities, or a combination of both (e.g. Günzel and Holm 2013; Marquez 2010; Osterwalder and Pigneur 2010):

- *Back-office functionalities* are related to enhancing the efficiency of insurers by affecting key resources, key activities, key partners or the cost structure.
- *Front-office functionalities* comprise the value-driven parts of insurers' business models by affecting the value proposition, channels, customer relationships or revenue streams.

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[2] The literature data sample consists of 83 academic articles that are relevant to the subject of the research questions. These 83 articles (mainly peer-reviewed, as, for instance, relevant working papers are included) represent the foundation from which we draw conclusions for the paper. However, we consider 23 web-references as a supplement to capture recent discussions of the topical strategic issue of managing customer satisfaction in insurance companies. Even if the content of the web-references incorporates non-peer-reviewed documents, such as reports or studies of industry representatives (e.g. consultancy companies), that are not representative of scientific knowledge, considering the articles allows us to draw further implications from current developments in practice.

[3] See Giese and Cote (2000) for a detailed literature review and discussion concerning the definition of customer satisfaction.

Figure 1 illustrates the integrated perspective on the digital transformation and customer satisfaction in the insurance industry. Moreover, it provides an overview of the analysis along with definitions of the relevant terminology and substantiates the derivation of the relevant research questions. In general, the relevance of the illustrated research questions is underpinned by the importance of managing customer satisfaction in the insurance industry: academic work connects customer satisfaction in the insurance industry to customer loyalty (e.g. Abu-Salim et al. 2017; Lee 2019; Nguyen et al. 2018; Ruefenacht 2018), which is important due to its potential impact on the (current and future) economic results of insurance companies (e.g. Eskildsen and Kristensen 2008; Trautinger 2015). In addition to that, Jahnert and Schmeiser (2021), for instance, emphasise the vast amount of non-insurance literature that highlights customer satisfaction as an important factor for a firm's profitability, and state the necessity of differentiated considerations of the effects for the insurance industry. Extending the focus to academic work from outside the insurance industry, empirical findings state the positive impact of customer satisfaction on organisational performance (Ittner and Larcker 1998), such as stock prices (e.g. Aksoy et al. 2008; Fornell et al. 2006, 2016), cash flows (e.g. Gruca and Rego 2005), or Tobin's Q (e.g. Anderson et al. 2004). Moreover, customer satisfaction increases the market share of firms and creates barriers to customer defection (e.g. Fornell 1992; Matzler and Hinterhuber 1998). Thus, firms benefit from cost savings as retaining already existing customers is typically less expensive than acquiring and nurturing relationships of new customers (e.g. Mittal and Kamakura, 2001; Reichheld and Sasser 1990).

Regarding the drivers of customer satisfaction, previous research additionally points to the customers' perceived value of a product or service (e.g. Dodds et al. 1991; Parasuraman 1997). According to existing research (e.g. Anjum et al. 2016; Dodds et al. 1991; Fornell et al. 1996; Johnston 1995; Parasuraman et al. 1988; Zeithaml et al. 1990), the perceived value itself is driven by corporate image, service quality and price (see, e.g. Nguyen et al. 2018 for an overview in the context of the insurance industry).

When managing customer satisfaction, it is of great relevance to focus on the customer *touch points* during the customer journey, as these generate customer perceptions. These customer touch points are commonly used when measuring customer satisfaction (e.g. AssCompact 2020). For this reason, we cluster the illustrated digital applications in terms of applicability for each of those touch points*: contract conclusion, policy modifications*, *event of damage* and *further contacts*. The latter includes points of contact, which are related to providing additional services, offering information on general features or placing general advertisements (e.g. provided by insurance brokers or agents). By integrating the categorisation into our analysis, we are able to derive a set of strategic measures for insurers, aimed at specific areas of the customer journey (e.g. by focusing customer satisfaction management on the touch points, which are characterised by a low customer satisfaction level).
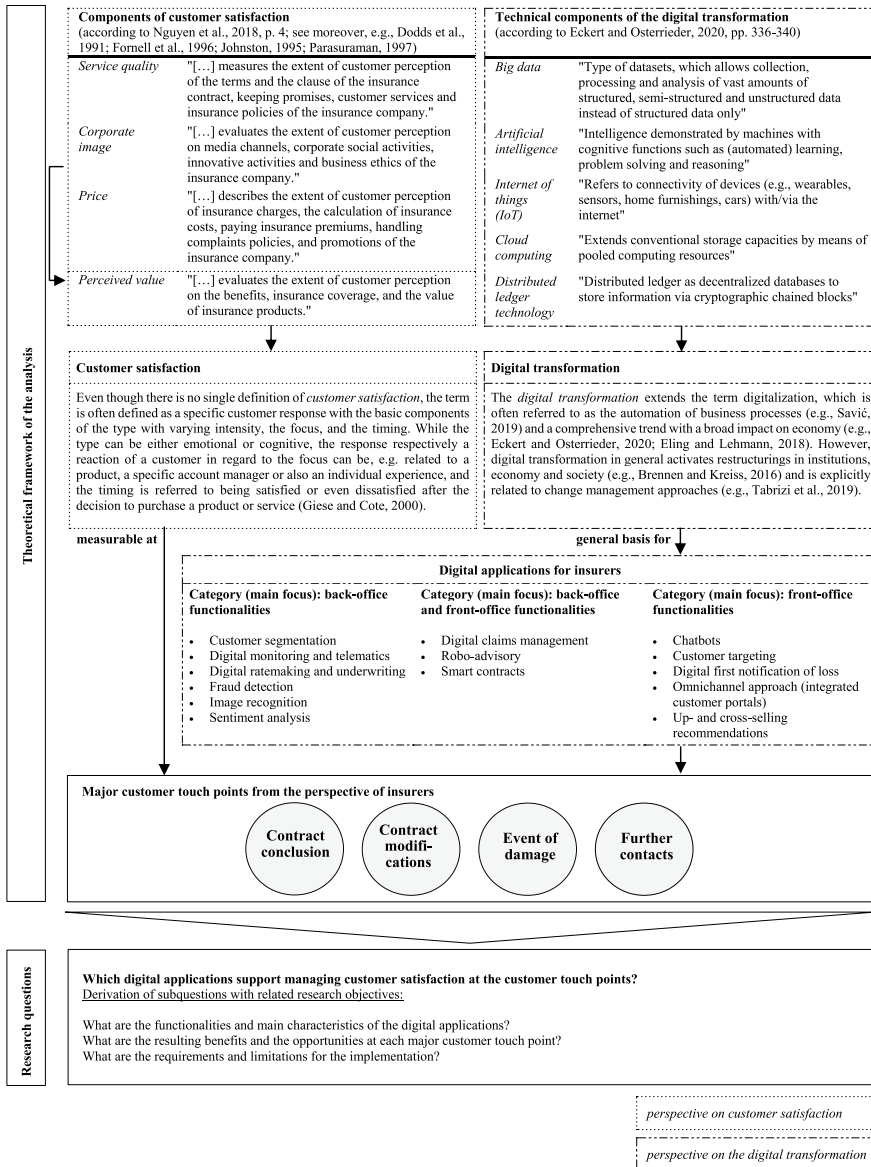
Theoretical framework of the analysis

Components of customer satisfaction
(according to Nguyen et al., 2018, p. 4; see moreover, e.g., Dodds et al., 1991; Fornell et al., 1996; Johnston, 1995; Parasuraman, 1997)

Service quality "[…] measures the extent of customer perception of the terms and the clause of the insurance contract, keeping promises, customer services and insurance policies of the insurance company."

Corporate image "[…] evaluates the extent of customer perception on media channels, corporate social activities, innovative activities and business ethics of the insurance company."

Price "[…] describes the extent of customer perception of insurance charges, the calculation of insurance costs, paying insurance premiums, handling complaints policies, and promotions of the insurance company."

Perceived value "[…] evaluates the extent of customer perception on the benefits, insurance coverage, and the value of insurance products."

Technical components of the digital transformation
(according to Eckert and Osterrieder, 2020, pp. 336-340)

Big data "Type of datasets, which allows collection, processing and analysis of vast amounts of structured, semi-structured and unstructured data instead of structured data only"

Artificial intelligence "Intelligence demonstrated by machines with cognitive functions such as (automated) learning, problem solving and reasoning"

Internet of things (IoT) "Refers to connectivity of devices (e.g., wearables, sensors, home furnishings, cars) with/via the internet"

Cloud computing "Extends conventional storage capacities by means of pooled computing resources"

Distributed ledger technology "Distributed ledger as decentralized databases to store information via cryptographic chained blocks"

Customer satisfaction

Even though there is no single definition of *customer satisfaction*, the term is often defined as a specific customer response with the basic components of the type with varying intensity, the focus, and the timing. While the type can be either emotional or cognitive, the response respectively a reaction of a customer in regard to the focus can be, e.g. related to a product, a specific account manager or also an individual experience, and the timing is referred to being satisfied or even dissatisfied after the decision to purchase a product or service (Giese and Cote, 2000).

Digital transformation

The *digital transformation* extends the term digitalization, which is often referred to as the automation of business processes (e.g., Savić, 2019) and a comprehensive trend with a broad impact on economy (e.g., Eckert and Osterrieder, 2020; Eling and Lehmann, 2018). However, digital transformation in general activates restructurings in institutions, economy and society (e.g., Brennen and Kreiss, 2016) and is explicitly related to change management approaches (e.g., Tabrizi et al., 2019).

measurable at   general basis for

Digital applications for insurers

Category (main focus): back-office functionalities
- Customer segmentation
- Digital monitoring and telematics
- Digital ratemaking and underwriting
- Fraud detection
- Image recognition
- Sentiment analysis

Category (main focus): back-office and front-office functionalities
- Digital claims management
- Robo-advisory
- Smart contracts

Category (main focus): front-office functionalities
- Chatbots
- Customer targeting
- Digital first notification of loss
- Omnichannel approach (integrated customer portals)
- Up- and cross-selling recommendations

Major customer touch points from the perspective of insurers

(Contract conclusion) (Contract modifications) (Event of damage) (Further contacts)

Research questions

Which digital applications support managing customer satisfaction at the customer touch points?
Derivation of subquestions with related research objectives:

What are the functionalities and main characteristics of the digital applications?
What are the resulting benefits and the opportunities at each major customer touch point?
What are the requirements and limitations for the implementation?

perspective on customer satisfaction

perspective on the digital transformation

Fig. 1 Derivation of the research questions based on the theoretical background of customer satisfaction and digital transformation

The set of digital insurance applications: overview and characteristics

As previously explained, the set of digital applications for insurers was created based on the literature data sample. By reviewing and analysing the incorporated articles, we further develop the investigation of Eckert and Osterrieder (2020) and consider

the following fields of applications: *customer segmentation* (e.g. Heo and Grable 2017; Owadally et al. 2019), *customer targeting* (e.g. Venkatesh 2019), *up- and cross-selling opportunities* (e.g. Owadally et al. 2019), the *omnichannel approach* with integrated customer portals (e.g. Cebulsky et al. 2018; Matouschek and von Hülsen 2015), *digital monitoring and telematics* (e.g. EIOPA 2019; Hall 2017; Lehrer et al. 2018; Spender et al. 2019), and enhanced *fraud detection* in respect of efficiency, speed advantages and the potential to lower claims costs (e.g. Deloitte 2017; EIOPA 2019; Garde, 2017). We moreover focus on *sentiment analysis* along with *image recognition* (e.g. Deloitte 2017; EIOPA 2019; Eling and Lehmann 2018), *digital claims management* (e.g. EIOPA 2019; Hall 2017; Lehrer et al. 2018) and the *digital first notification of loss* (e.g. EIOPA 2019), *digital and automated underwriting and ratemaking* (e.g. EIOPA 2019; Helfand 2017; Xu and Hoesch 2018; Venkatesh 2019), *smart contracts* (e.g. Baron and Chaudey 2019; Gatteschi et al. 2018), *robo-advisory* (e.g. OECD 2017) and *chatbots* (e.g. Gruhn, 2018; Riikkinen et al. 2018). Table 1 provides a comprehensive overview of the incorporated set of digital applications categorised by their main focus on back-office functionalities, front-office functionalities, or both, including a description and the major characteristics.

Note that some of the digital applications can be seen on different hierarchical levels. For instance, *image recognition* can be also used to improve *fraud detection*. Practical literature (e.g. Bitkom 2018) often refers to a 'periodic table of AI' that consists of elementary applications of artificial intelligence such as *image recognition* or *predictive inference*, while applications in practice, e.g. *fraud detection*, are frequently a combination of these elementary applications of artificial intelligence. In this paper, we focus on the most important digital applications for insurance companies, which often consist of more than one elementary artificial intelligence/digital application and do not aim to go to the level of the elementary applications. However, the areas of applying *image recognition* in insurance companies go way beyond *fraud detection*, as explained in Table 1. For this reason, in this case the elementary application itself is important enough to be considered as a separate digital application. Moreover, *fraud detection* is not only improved by means of *image recognition*, which is why we investigate *fraud detection* also as a separate digital application, leading to dependencies between some digital applications in Table 1.

Four major customer touch points: benefits and opportunities of digital applications

In what follows, we discuss and assess the benefits as well as the opportunities of the presented set of digital applications, in terms of managing customer satisfaction from the perspective of insurers. Table 2 states the relevance of the applications within the displayed 'opportunity landscape' and emphasises the potential to enhance, e.g. the customer experience, but also the customer journey, based on the literature. Moreover, the specific benefits and opportunities are clustered for each of the four customer touch points (contract conclusion, contract modifications, the event of damage, further contacts). These provide the basis for the strategic decisions of insurers when evaluating applications in regard to deriving measures to

Table 1 A description of digital insurance applications and their characteristics based on the literature

Category (main focus)	Digital application	Description and characteristics
Back-office functionalities	Customer segmentation	• Subdivides the market into customer groups (e.g. depending on their needs or past behaviour)[g,m,w,ai] • Provides the basis for granular and more precise segments, e.g. for risk assessments, based on an increasing number of data sources and prioritises customers, e.g. depending on profit potential and ability to serve them[m,n]
	Digital monitoring and telematics	• Record, track and evaluate individual information regarding policyholders[l,m] as a result of the increasing integration of new data sources (e.g. due to the internet of things with the adoption of sensors and wearables)[c,m,aa,ac] • Affect internal processes (e.g. insurers gain further data that can be used to improve risk assessment but also product design)[j,l,m,ab] • *Practical examples* in regard to data availability: driving behaviour (measured by variables such as speed, braking, distance driven),[b,m,at] activities to maintain a healthy lifestyle (e.g. fitness activities),[m,ar] but also 'smart home' data[e]
	Digital ratemaking and underwriting	• Describes automated and/or digital underwriting and ratemaking processes: while cloud computing or blockchain enable the capture of large amounts of data, blockchain can also automate the underwriting process,[n] which is due to artificial intelligence no longer being limited to historical data but extended to real-time information[t] • Increases accuracy with regard to risk selection, insurance rating classification and thus insurance rating factors[m,n,t,v,at] • Automates and secures the process of underwriting by evaluating, e.g. unstructured customer data with artificial intelligence[s]
	Fraud detection	• Allows the precise analysis of fraudulent patterns to *more effectively* detect (e.g. false claims or manipulated claim size) and prevent them[h,i,m–o,r,v,al,as] • *Practical examples* for applying enhanced fraud detection: natural language processing and text analytics or speech recognition (e.g. considers contract applications or phone conversations)[k]
	Image recognition	• Allows the automation of internal processes by translating images as unstructured data into explanatory information, based on machine learning techniques[k,m,u] • *Practical examples* refer to applying image recognition for digital fraud detection (thus interdependent applications), the validation of signatures/handwritings, video surveillance, customising services (e.g. VIP identification) or tailored marketing activities (e.g. based on customer's social media content)[am]
	Sentiment analysis	• Automatically recognises emotions, e.g. based on analysing the voice during a call, specific text messages (e.g. mails and social media content) or videos of customers[k,m] • *Practical examples*: sentiment analysis is suitable for enhancing fraud detection, due to its integration in claims management[k,m]

Table 1 (continued)

Category (main focus)	Digital application	Description and characteristics
Back-office and front-office functionalities	Digital claims management	• Enhances digital support for the customer with regard to claims handling, processing and reporting[h,m,n]: digital applications refer to the automation of specific milestones during the claims process, e.g. claims estimations, invoice processing or payment processing (can incorporate, e.g. image recognition or speech recognition)[m] • Includes (semi-)automated document management in regard to reporting claims and settling them, but can also refer to the automated calculation of damages[m,n]
	Robo-advisory	• Supports asset management within the insurance value chain, by providing automated asset managers[y,aj]: by delimiting an own risk appetite and by aligning it with solvency requirements, insurers can engage robo-advisory to harmonise their portfolios[n] • Automates customer interaction and support, e.g. with the assessment of individual needs, policy recommendations, steering and monitoring of policy performance with adjustments (if needed)[ad,ah,aq]
	Smart contracts	• A specific type of contract that executes without intermediaries: automates contract handling and execution of the policy stored in a blockchain, incorporating comprehensive contract information, e.g. payment conditions or coverage components[d,p,q,ao,ap] • *Practical example*: in the case of the death of a life insurance policyholder, the smart contract initiates the payout to the descendants[q]
Front-office functionalities	Chatbots	• Generate text output, based on individual customer requests: simulation of human customer support,[an] e.g. for straight-forward standard inquiries[r] • Describe dialog systems employing natural language processing to process text input, as well as text output, which ensure a basic service, especially in peak hours (e.g. after a hurricane)[a,f,x,ak]
	Customer targeting	• Tailors (online) product offerings and aligns these to a customer's personal life stage (e.g. marriage)[m,v,ab,as] • *Practical example*: customers receive real-time insurance offerings (e.g. a pop-up message on their smartphone) with certain trigger events (e.g. acquisition of a defined product)[as]
	Digital first notification of loss	• Incorporates functionalities, such as an automated signal to involved parties regarding a defined trigger event, such as a car accident in the context of property and casualty insurance[m] • Can potentially report additional information on the course of the trigger event: can be accompanied by additional information for the policyholder (e.g. including the application of chatbots, which are described in more detail above), but also for insurers (e.g. predictions on required reserves)[m]

Table 1 (continued)

Category (main focus)	Digital application	Description and characteristics
	Omni-channel approach (integrated customer portals)	• Focuses on adding further online/mobile channels (e.g. 'direct-to-consumer') to the common offline customer interface[s,z,ag] • Offers information and products via several channels, adjusted to the requirements of digital customers (focus: convenience),[ae] with further relevance for advanced assistance services[ag]
	Up- and cross-selling recommendations	• Provide more granular up- and cross-selling probabilities for specific products for individual customers[m,af,ai] e.g. by taking into account the customer lifetime value[n] • Provide support to flag the most attractive customer, based on precise up- and cross-selling probabilities, e.g. as a result of trained machine learning models[m,n]

[a]Abdul-Kader and Woods (2015); [b]Baecke and Bocca (2017); [c]Banafa (2016); [d]Baron and Chaudey (2019); [e]Behm et al. (2019); [f]Belanche et al. (2019); [g]Brenner (2019); [h]Brüggemann et al. (2018); [i]Catlin et al. (2015); [j]Catlin et al. (2018); [k]Deloitte (2017); [l]Derikx et al. (2016); [m]EIOPA (2019); [n]Eling and Lehmann (2018); [o]Garde (2017); [p]Gatteschi et al. (2018); [q]Grima et al. (2020); [r]Gruhn (2018); [s]Gupta and Tham (2018); [t]Hall (2017); [u]Hall et al. (2016); [v]Helfand (2017); [w]Heo and Grable (2017); [x]Hill et al. (2015); [y]Kelley et al. (2018); [z]Kotalakidis et al. (2016); [aa]Lang et al. (2019); [ab]Lehrer et al. (2018); [ac]Maas et al. (2019); [ad]Maedche et al. (2016); [ae]Matouschek and von Hülsen (2015); [af]Miehé and Lingens (2019); [ag]Müller et al. (2015); [ah]OECD (2017); [ai]Owadally et al. (2019); [aj]Phoon and Koh (2017); [ak]Riikkinen et al. (2018); [al]SCOR (2018); [am]Shang (2018); [an]Sharma (2019); [ao]Sheth and Subramanian (2019); [ap]Singer (2019); [aq]Sironi (2016); [ar]Spender et al. (2019); [as]Venkatesh (2019); [at]Verbelen et al. (2018)

Table 2 Benefits and opportunities of the digital applications from the perspective of insurers, considering the major customer touch points of contract conclusion, contract modification, the event of damage and further contacts

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
Back-office functionalities	Customer segmentation	• Supports better understanding of customers and offers more tailored products to more specifically meet individual needs[c,i,q]	-	-	• Helps identify hidden patterns[c] which can be further examined to predict and steer customer demands[q] • Enables the creation of a large number of small, explicitly addressable customer groups, instead of several general groups[c] • Includes automated updating of segments in changing markets, with an unlimited number of segments to better address individual customers[g,i,q,y] • Contributes to decreasing cost levels (*relevant with regard to the price*): low degree of human maintenance[c]
	Digital monitoring and telematics	• Enable a behaviour-based product design, e.g. usage-based insurance for automobile, home, health and life insurance[h,ae,ag] • Enhance actuarial models, which can result in reduced claims costs, along with more precise risk assessment: potential to reduce the combined ratio by attracting lower-risk clients and loss prevention,[e,h,aa] which might especially impact the perception of price, but also service quality/perceived value	-	• Provide the basis for advanced (and secured) loss prediction, but also extend available measures for prevention as well as loss mitigation[b,h] • Process claims digitally, thus increasing transparency with regard to customer interactions (with side effects: reducing fraudulent claims and decreasing adverse selection and moral dilemmas)[h,aa] • Provide new business opportunities for additional services, which are beneficial for the customer[b,h,s,t]	• Increase the customer interaction density,[ae] e.g. extension of regular communication via an app; insurers thus relate to the behaviour of their policyholders[h] • Support/reward positive behavioural patterns of the customers, based on comprehensible principles (predefined by the insurer) and thus help increase interaction beyond the damage event, which might be associated with positive experiences from the perspective of the customers[h]

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
	Digital ratemaking and underwriting	• Shorten the process to provide appropriate coverage to the customer with transparent and individual premiums,[n] enhancing customer experience with regard to the application process	• Reduce manually executed core processes, which are personnel intensive[h]	-	-
	Fraud detection	• At contract conclusion, this allows an improved risk selection, which relies on the results of cognitive algorithms (e.g. employing speech recognition or natural language processing) or machine learning (e.g. by employing predictive analytics to consider forecasts relating to expected customer behaviour)[aa] • *General link to customer satisfaction:* improved fraud detection leads to lower claims payments along with increasing efficiency (due to the decrease of bound capacities) allowing lower premiums (thus relevant with regard to the price); moreover: component of accelerating turnaround times and processes	-	• Secures claims settlement processes due to the precise probabilities of fraud, enabling the investigation of only selected cases in more detail (flagged/early warning claims); these investigations include the derivation of fraud scorecards for claims[b,j,p]	-

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
	Image recognition	• Apart from managing claims, image recognition verifies signatures or handwritten documents and offers customised services (e.g. VIP/customer identification), which improve service quality and are thus an important interface in terms of customer satisfaction[i,o,ab]	• Secures and simplifies standard processes, such as authentication (e.g. during sales or customer services processes)[ab]	• Automates and digitize the claims management process (e.g. by integrating the analysis of optical patterns) with positive time effects for the customers and potential fraud detection[h,ab] • With regard to the automation of processes in property and casualty insurance, the resulting data can be further processed to estimate claim size, e.g. referring to a damaged car,[h] thus allowing fast reactions to reduce incurred losses[ab]	• Gathered information provides the basis for enhanced customer targeting, customer segmentation and behaviour-based up- and cross-selling[ab]
	Sentiment analysis	• Supports the detection and investigation of the specific reactions of a customer, e.g. voice material of a conversation, which complement written customer information[f] • Comprehensively analyses e.g. social media content to evaluate customer services[f,h]	-	• Extracts emotions, e.g. from conversations (spoken or written)[f] and can thus be embedded in digital fraud detection or claims management	• Analyses social media sentiment, but also sentiment with regard to customer feedback,[h] thus fostering understanding of the needs and requirements of a customer, as well as steering the brand value[af] • Incorporates fluent data management (based on big data analytics), which results in a central customer profile database (usable across the entire insurance company), which provides the basis for further customer interaction[af]

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
Back-office and front-office functionalities	Digital claims management	• Provides the general basis for less personnel-intensive processes: positive impact on expenses[h,aa] along with lower costs of software and hardware computing,[af] which might have an impact on the price, thus supporting contract conclusion	• Improves customer interaction with regard to document management, leading to transparent and standardised processes,[af] which can improve the customer experience	• Eases the process of precisely reporting a claim (e.g. by submitting details of damage via an app/mobile platform, with the opportunity to add further information, such as visual material/police reports)[af] • Digital and automated claims management helps to design intuitive claims processes for the customer[d,p] • Increases the quality of managing claims: automation reduces manually-executed core processes, which are less error prone[ac] • Utilises economies of time from a customer's perspective: quick and simple claims settlement[ac]	-
	Robo-advisory	• Supports the customer with automated and intelligent advice, e.g. by suggesting individual policy recommendations, even at peak times[u,ad]	-	-	• Fast, objective, consistent and transparent advice: automated individual financial planning considering various determinants (retirement, need for protection, property planning),[x] which is less personnel intensive and also fosters operational excellence

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
	Smart contracts	• Technology engagement as an enabler for automated contracts: cost reduction potential due to decreasing transaction costs and elimination of intermediaries[i,k]	• Support operations due to the attribute of being highly unsusceptible to errors[k] • Create transparent and objective processes for customers[k]	• Positively affect the organisation of policies by decreasing the duration of average claims settlements and reducing the probability of fraudulent behaviour/claims due to 'trusted' transactions[g,k]	• From the insurers' perspective, smart contracts can be implemented within highly standardised divisions to reduce information asymmetries, transaction costs and to create a high level of transparency with respect to customer relationships[a] • Blockchain-related transactions create a holistic (company/industry overarching) platform as a base for data analytics[k]
Front-office functionalities	Chatbots	• Offer digital and automated recommendations for products and services in relation to general inquiries[m,z] • Enable individual customer service that contributes to a positive customer experience and is easily scalable; especially if the chatbot is capable of distinguishing standard requests and complex matters, the customer can be appropriately served (in the case of complex matters, the customer can be transferred to a human account manager)[m]	• Not only ensure a basic service especially in peak hours (e.g. after a hurricane), but can also relieve existing customer service by answering simple, standard inquiries[m]	• Support claims registration[z]	• Can relieve existing customer service by answering simple, standard inquiries[z]
	Customer targeting	• Supports sales and distribution with regard to offering 'proper' products and services to the 'proper' target groups[h]	-	-	• Provides the base from which to distribute tailored products, marketing campaigns, products and services, e.g. aiming to attract underserved segments or avoid the churn of valuable customers[h]

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifi-cations	Event of damage	Further contacts
	Digital first notifi-cation of loss	-	-	• Collects relevant loss data in real time and processes the automated claims settlement with advantages in respect of the average duration[h] • Provides the basis for integrating additional services (e.g. automated help in case of a breakdown/accident)[h,l] • Allows transparent processes (for the insurer and the customer)[h] • By applying artificial intelligence and neural networks, the overall claims process can be accompanied with additional information for the policy-holder (e.g. including the application of chatbots, which are described in more detail below, assisting the customer with claims settlements or GDPR compliant, biometric customer authentication), but also for the insurer (e.g. predictions on required reserves)[j]	-

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
	Omni-channel approach (integrated customer portals)	• Focuses on 'convenience' and a customer-centric strategy as a fundamental customer requirement, resulting from the digital transformation[v] • Leads to an increasing level of standardisation for the customer,[v] which might also be positive in terms of the price (operational excellence)	• Fosters automated processes due to digital data availability in the presence of online services, reduces manual processing of customer requests and outsources capabilities for peaks[v] • Leads to an increasing level of transparency for the customer[v] • Allows process optimisation, e.g. by increasing self-service functions: possibility to execute minor adjustments and to access policies online[v]	• Supports the securing of claims settlement processes and increases transparency with regard to the overall customer interaction around 'the moment of truth'[i,v,w]	• Part of the increasing convergence of distribution channels (online, offline, mobile): 'seamless' transitions across all channels[i,r,v,w]

Table 2 (continued)

Category (main focus)	Digital application	Contract conclusion	Contract modifications	Event of damage	Further contacts
	Up- and cross-selling recommendations	• Extracted information, e.g. stemming from analysing big data, can be applied to e-commerce to increase the probability of a purchase, but also to ease the process of a buying decision[i,n,y] • Design customer-centric product bundles exceeding pure coverage based on individual information relating to the customer[h]	-	-	• Support the prioritisation and allocation of resources based on analytical results: address valuable customers with a high up- or cross-selling probability[b,l]

[a]Baron and Chaudey (2019); [b]Behm et al. (2019); [c]Brenner (2019); [d]Brüggemann et al. (2018); [e]Catlin et al. (2018); [f]Deloitte (2017); [g]Eckert and Osterrieder (2020); [h]EIOPA (2019); [i]Eling and Lehmann (2018); [j]Garde (2017); [k]Gatteschi et al. (2018); [l]Gatzert and Osterrieder (2020); [m]Gruhn (2018); [n]Gupta and Tham (2018); [o]Hall et al. (2016); [p]Helfand (2017); [q]Heo and Grable (2017); [r]Kotalakidis et al. (2016); [s]Lang et al. (2019); [t]Maas et al. (2019); [u]Maedche et al. (2016); [v]Matouschek and von Hülsen (2015); [w]Müller et al. (2015); [x]OECD (2017); [y]Owadally et al. (2019); [z]Riikkinen et al. (2018); [aa]SCOR (2018); [ab]Shang (2018); [ac]Sharma (2019); [ad]Sironi (2016); [ae]Spender et al. (2019); [af]Venkatesh (2019); [ag]Verbelen et al. (2018)

enhance customer satisfaction. While Table 2 shows the benefits and opportunities for customer satisfaction in terms of each digital application at each customer touch point in detail, the presented digital applications address all of the three components of customer satisfaction, namely service quality, corporate image and price, and therefore the perceived value (see Fig. 1). We subsequently provide a summary of the major findings aggregated for each touch point and *highlight* the main effects of utilising the applications as strategic measures for insurers.

Contract conclusion as a customer touch point: strengthening the position for sales and marketing

The digital applications with potential opportunities at contract conclusion are characterised by increasing *customer-centricity* (e.g. Matouschek and von Hülsen 2015; EIOPA 2019). In general, they aim to better understand the customers and to offer more tailored products to suit the individual needs of a customer perfectly (e.g. Brenner 2019; Eling and Lehmann 2018; Heo and Grable 2017). By building on refined customer segments of precise segmentation, for instance, customer targeting allows enhanced advertising and tailored product offers, based on comprehensive and customer-related data (Eling and Lehmann 2018; EIOPA 2019; Helfand 2017; Lehrer et al. 2018). In practice, the extracted information can be applied to e-commerce to increase the probability of a purchase, but also to ease the process of a buying decision for a customer (e.g. Eling and Lehmann 2018; Gupta and Tham 2018; Owadally et al. 2019).[4] Due to the high number of available data streams (e.g. conventional information of a policyholder, sensor data, social media, information of emotions) and the related methodologies to further process these, insurers have the opportunity to *precisely predict or anticipate recent customer needs* before and when concluding a contract (e.g. Brenner 2019; Heo and Grable 2017).[5] For this reason, the literature emphasises the strengthened position with regard to sales and marketing activities (e.g. EIOPA 2019; Catlin et al. 2015; Kotalakidis et al. 2016).

To this end, the literature addresses the importance of the *'seamless' customer experience* by integrating insurance products into their own respective partner websites and mobile applications or by engaging in e-commerce and online marketplaces. Insurers can also place their products on online comparison websites (e.g. Gupta and Tham 2018; Matouschek and von Hülsen 2015). In this context, the digital applications provide the basis for offering the required, convenient solutions (e.g. product bundles) via flexible channels (e.g. due to integrated customer portals and the omnichannel approach). The resulting customer experience is thus characterised by a *lack of friction* in relation to switching

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[4] The internet of things and social media help to offer tailored insurance products, e.g. by implementing machine learning, which is based on social media data, to understand users' habits and to deduct implications on related risks, which can form the basis for insurance recommendations (Spender et al. 2019).

[5] With regard to applying big data (analytics), Lehrer et al. (2018) highlight clickstream and social media data, data lakes, web analytics, as well as social media analytics, predictive analytics and visualisation applications.

between different channels, enabling customers to make an informed decision on a particular insurance policy, independent of time and location (e.g. Müller et al. 2015).

However, the application process can be secured, e.g. due to digital ratemaking and underwriting (Gupta and Tham 2018). In this context, the results in Table 2 point to the fact that the applications can help to *enhance actuarial models* with a more precise risk assessment (e.g. digital monitoring and telematics). In general, the digital applications support *optimising core capabilities*, such as underwriting, risk selection or claims prevention (e.g. Catlin et al. 2015, 2018). The latter, moreover, causes a shift from indemnifying losses to predicting and preventing risks, with regard to the role of an insurer (e.g. Spender et al. 2019), while the latest initiatives of insurers focus on the fields of 'mobility', 'home' and 'health' (e.g. Lang et al. 2019).

Overall, Table 2 shows that 13 out of 14 digital applications (except the digital first notification of loss) provide benefits and opportunities at the contract conclusion as customer touch point. Some digital applications with a focus on back-office functionalities (digital monitoring and telematics, digital ratemaking and underwriting, as well as fraud detection) allow insurance companies to more precisely assess risks and to improve risk selection, leading to a better pricing. The depicted applications can thus be connected to increasing customer satisfaction in the context of insurance in the context of insurance. Further digital applications such as image recognition, digital claims management or smart contracts, however, support to accelerate and automate processes. Consequently, these digital applications can enhance service quality, as well as they support to reduce costs (with the potential to lower premiums), resulting in higher customer satisfaction. Another strand of the digital applications with a focus on back-office functionalities aims to better understand customers (e.g. customer segmentation and sentiment analysis). Moreover, by using gathered information in combination with the digital applications that are assigned to the category of front-office functionalities, such as customer targeting and up- and cross-selling recommendations, insurers are able to increase service quality. Further digital applications with a focus on front-office functionalities do not only allow a more targeted customer approach, but also faster responses and better availability (chatbots or robo-advisory) on the preferred channels (omni-channel approach), also increasing service quality and thus addressing customer satisfaction.

Hence, our results show that digital applications at contract conclusion allow insurance companies to benefit in various ways from refined pricing, faster processes and customer centricity, which positively influence the components of customer satisfaction (service quality, corporate image, as well as price, and consequently the perceived value). Moreover, our results show synergies between certain digital applications (e.g. customer segmentation, customer targeting and up- and cross-selling recommendations), implying that implementing all of these respective digital applications is especially valuable for insurance companies.

✳

Contract modifications as a customer touch point: simplifying and accelerating standard processes

Based on the literature, the opportunities for insurers at the touch point of contract modifications range from improving the customer experience by providing fast services with sufficient capabilities, even at peak times, (e.g. Matouschek and von Hülsen 2015) to *improving transparency* in relation to customers' policies and the status of specific requests, e.g. by configuring standardised self-service functions (e.g. Matouschek and von Hülsen 2015; Müller et al. 2015). The applications, moreover, allow the *simplification of standard processes*, such as authenticating a customer employing image recognition (e.g. Shang, 2018). In addition, automation due to digital data availability *reduces the manual (time intense) processing times* of standard customer requests, which is especially beneficial from the perspective of *optimising internal processes* (e.g. Matouschek and von Hülsen 2015). Against this background, the results in Table 2 emphasise the relevance of the presented digital applications for the automation of internal processes, which primarily result in economies of time, but also prevent human error (e.g. Sharma 2019).

To summarise, Table 2 illustrates that 6 out of 14 reviewed digital applications provide considerable benefits and opportunities for insurance companies at the touch point of contract modifications. While the applications with a focus on enhancing back-office functionalities (digital ratemaking and underwriting, image recognition, digital claims management, smart contracts) positively affect insurers' key activities by simplifying and accelerating processes, digital applications with a focus on front-office functionalities (omni-channel approach with integrated customer portals, chatbots) particularly enable self-services for customers and improve service availability. Consequently, these selected digital applications aim to improve service quality as a component of customer satisfaction. Moreover, they have the potential to reduce costs because of increasing automation. Thus, the presented applications contribute to lower premiums that address price as a component of customer satisfaction.

Event of damage as a customer touch point: creating intuitive processes for customers, with a positive impact on efficiency

The main opportunities regarding the event of damage are reflected in the digital (and/or automated) assessment of loss and repairment costs, claims management and claims settlement, which provide the basis for creating *fast and intuitive processes* for the customer (e.g. Brüggemann et al. 2018; EIOPA 2019; Helfand 2017).[6] For instance, handling claims can be complemented with further applications, such

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[6] Helfand (2017) refers to transparent, app-based status reports on a claim in real time. Moreover, applying e.g. big data and artificial intelligence in this context enables the precise prediction of the attributes of claims and the clustering of claims by type and complexity, resulting in granular claims segments. This positively affects fraud detection and thus the efficiency of insurers (e.g. Brüggemann et al. 2018; EIOPA 2019).

as image recognition or speech recognition for assessing or settling claims or for processing automated payments (e.g. Brüggemann et al. 2018; EIOPA 2019).[7] However, due to the previously mentioned, numerous evaluable streams of customer data, a major opportunity is reflected in *enhancing service management* (e.g. Catlin et al. 2018): the interplay between the digital applications, e.g. digital monitoring and telematics, supports the shift from insurers' role of indemnifying losses to *loss prediction and prevention* (e.g. EIOPA 2019).[8] In the context of customer satisfaction, the event of damage, in particular, as a major customer touch point, can be eased by the availability of (automated) additional services (e.g. Behm et al. 2019; EIOPA 2019).

Moreover, the results in Table 2 point to (digital) fraud detection, which is especially relevant, amongst further digital applications with a focus on back-office functionalities, in terms of increasing the efficiency of operations, also as a result of (partial) automation. Digital fraud detection and prevention lead to reduced operational costs, as a result of reduced fraudulent claims, but also due to released internal capacities (e.g. Deloitte 2017; EIOPA 2019; Gruhn 2018).

Overall, 9 out of the 14 digital applications provide benefits and opportunities for the event of damage as a further customer touch point (see Table 2). One strand of the applications with a focus on back-office functionalities supports insurers with reducing fraud (digital monitoring and telematics, fraud detection, image recognition, sentiment analysis) and positively affects price as a component of customer satisfaction. In this regard, the mentioned digital applications have numerous synergies; for instance, image recognition and sentiment analysis may provide valuable information for a fraud detection system. Besides, digital applications with a focus on back-office functionalities aim to automate and accelerate processes (digital claims management, smart contracts), while the applications with a focus on front-office functionalities particularly support customers in claims registration with the aim of increasing process transparency (chatbots, digital first notification of loss, omnichannel approach with integrated customer portals). For this reason, there is a clear interlinkage to increasing service quality as a component of customer satisfaction.

Further contacts as a customer touch point: increasing customer interaction as a result of precise targeting

Table 2 additionally emphasises the opportunities with regard to further contacts with customers: one major aspect refers to the *identification of hidden patterns* (in line with the results at the touch point of contract conclusion), which impact the measures to steer customer demand, in order *to precisely attract specific target groups*, e.g. customers with a high up- or cross-selling probability (e.g. Eling

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[7] Automated processes in this regard allow for the reduction of costs and are especially relevant for property and casualty insurance (e.g. EIOPA 2019; Brüggemann et al. 2018).

[8] In terms of preventing claims for health and automobile insurance, EIOPA (2019) enumerates a specific security warning (e.g. app-based), but also feedback and coaching in relation to the individual behaviour of a policyholder.

and Lehmann 2018; Heo and Grable 2017). Targeting customers with personalised content allows for the compilation of personalised policy suggestions, e.g. consumption-based offerings on smartphones (Eling and Lehmann 2018; EIOPA 2019; Helfand 2017; Lehrer et al. 2018). With regard to the specific touch point, the digital applications also focus on extending the (relevant) communication with a customer over the event of damage, by generating more occasions to interact with the customer. Consequently, the utilisation of the applications helps *increase the density of customer interaction* (e.g. EIOPA 2019; Spender et al. 2019). Moreover, the literature points to the relevance of collaborations with external partners (e.g. Google as a tech company), which support access to non-insurance customer data to consequently attract customers (e.g. Venkatesh 2019). For instance, an ecosystem strategy is based on the shift of "acquiring customers for a specific financial product and then cross-selling other financial products over the customer lifetime" to "acquiring users with primary needs and then converting them into a customer with financial needs over the user lifetime" (Gupta and Tham 2018, p. 435).[9]

As Table 2 shows, 10 out of 14 digital applications provide benefits and opportunities at the touch point of further contacts. Digital applications with a focus on back-office functionalities, as well as those with a focus on front-office functionalities might, again, positively affect a customer's perception of service quality that is, for instance, due to advanced, consistent and transparent digital advice, fluent data management or the creation of explicitly addressable customer groups with automated updates for an insurance company.

Discussion of limitations and requirements from the perspectives of customers and insurers

The results of the previous section display the potential opportunities for increasing customer satisfaction at each of the major customer touch points. Our results reveal that by implementing digital applications, insurance companies can improve customer satisfaction in various ways. However, one has to take into account that the implementation of these digital applications comes with limitations and requirements from the perspective of customers as well as insurers.

Besides the benefits of more precise risk assessment and improved risk selection, as shown in the previous section, customers often have data privacy concerns in this regard (e.g. BaFin 2018; Venkatesh 2019). In certain cases, a defensive attitude of customers toward data sharing can be observed (e.g. BaFin 2018; Behm et al. 2019). Reasons for this include ethical issues and fairness concerns due to potential discrimination (e.g. BaFin 2018; EIOPA 2019; SCOR 2018). Moreover, the set of digital applications comes with increased cyber risks and risks posed by the IT. For instance, from a customer's perspective, personal data utilisation might not always be clear (EIOPA 2020) and consequently impair the potentially positive impact on

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[9] In this context, the literature highlights the Chinese insurer, Ping An, as an example of best practice (e.g. Catlin et al. 2018; Gupta and Tham 2018; Miehé and Lingens 2019).

customer satisfaction. Even though there are very strict regulatory requirements, e.g. GDPR compliance with the regulation of using personal data (e.g. BaFin, 2018; EIOPA 2019), and potential legal requirements for data acquisition (e.g. Helfand 2017), black boxes due to the use of potentially unclear algorithms substantiate the necessity of employing trustworthy and explainable artificial intelligence (e.g. Franke 2019; Helfand 2017). Hence, in order to be able to exploit the full potential of increasing customer satisfaction due to digital applications in this regard, insurance companies have to consider the specific needs and concerns of their customers, find the right balance, and are challenged to provide a sufficient degree of transparency to customers.

Moreover, while e.g. chatbots, robo-advisory or an omni-channel approach with integrated customer portals can accelerate responses, improve availability, or enable self-services, the option for human interaction at each of the customer touch points remains important (e.g. Eckert et al. 2021; Müller et al. 2015), especially when considering customers who are less familiar with the use of digital technologies. Human interaction is, for example, relevant for the touch point of contract conclusion and the case of purchasing complex products such as life insurance policies. In this context, a robo-advisory, for instance, might not entirely replace human advice; inaccurate algorithms can cause errors that reduce the quality of the opportunities when managing customer satisfaction in practice (e.g. EIOPA 2020). To manage customer satisfaction, it is important for insurance companies to provide customers with the possibilities afforded by these digital applications but also to continue to be available in person if necessary. Insurers are required to define a balanced mix of utilising digital applications and performing physical processes, especially at interfaces with customers. Improving customer experience or accelerating operations are rather a result of combining the advantages of the digital and analog worlds instead of focusing solely on automating or digitizing them (e.g. Müller et al. 2015).

From the perspective of insurance companies, the employment of digital applications comes with specific risks (see Fig. 1). These risks require consideration, as (a) digitalization considerably intensifies their relevance (e.g. EIOPA 2020) and (b) they directly affect the relationship with customers.[10] In what follows, we provide a list of the overarching concerns and issues when implementing digital applications to improve customer satisfaction from the perspective of insurers:

- Insufficient data availability, data access and data quality[11]
- Data security and data protection issues[12]
- Challenges around data processing as a result of a huge amount of (continuously) changing data[13] and portability of data[14]

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[10] EIOPA (2019, p. 45, 47) provides a ranking of the opportunities and challenges facing automobile and health insurers in the limited context of big data, incorporating big data analytics.

[11] See, e.g. BaFin (2018), EIOPA (2019) and Helfand (2017).

[12] See, e.g. Derikx et al. (2016), EIOPA (2019) and Spender et al. (2019).

[13] See, e.g. Venkatesh (2019).

[14] See, e.g. EIOPA (2019).

- Lack of compatible datasets to collaborate or combine insights from different data sources (e.g. relevant in the context of fraud detection)[15]
- Lack of accurate and reliable data models[16] and resistance to manipulation[17]
- Reputational risks[18] and increasing exposure to cyber risks[19]

Furthermore, the implementation of digital applications leads to significant change for insurance companies and entails high investment costs, especially regarding IT (e.g. Eckert and Osterrieder 2020). Apart from a lack of appropriate IT infrastructure and required facilities, the literature points to limitations due to data utilisation, the related customer attitude and regulatory requirements. For instance, as digital/automated claims management is closely related to big data and artificial intelligence, major limitations are posed by regulatory requirements, a lack of policyholders' trust with regard to the technology and data access, the necessity of precise data modelling, issues related to fairness or the ethical dilemmas surrounding black boxes, cyber risks and the related reputational risks for an insurer (e.g. BaFin 2018; EIOPA 2019, 2020). Moreover, in the context of improved customer targeting through big data, insurers need to increasingly access private customer information, which can be perceived negatively by the involved insureds (e.g. Venkatesh 2019). However, using social media data is controversially discussed; insureds are only partially poised to share social media information with insurers (e.g. Spender et al. 2019). General limitations are also a result of insufficient data quality. While data can either be entered manually or are automated, errors may occur due to human but also technical failures (Xu and Hoesch 2018). Apart from the presented limitations, further concerns for the implementation of each digital application also incorporate skilled worker shortage, general project risks, as well as issues of compatibility with the corporate culture (e.g. BaFin 2018; EIOPA 2019).

To utilise the previously explained opportunities at each customer touch point, insurers must consider numerous requirements, based on the literature. For this reason, Table A1 in the Appendix provides a set of major requirements, clustered for each digital application.

Conclusion

In this article, we comprehensively analyse a set of digital applications, including their benefits for insurers, when managing customer satisfaction. Based on an extensive analysis of the literature, we first present the digital applications with their characteristics and state their relevance by clustering their beneficial effects in relation to customer satisfaction at each of the four customer touch points, namely, contract conclusion,

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[15] See, e.g. Garde (2017).

[16] See, e.g. EIOPA (2019).

[17] See, e.g. Shang (2018) and Spender et al. (2019).

[18] See, e.g. EIOPA (2019) and Shang (2018).

[19] See, e.g. BaFin (2018), Gatteschi et al. (2018), SCOR (2018) and Shang (2018).

contract modifications, the event of damage as the moment-of-truth and further contacts. In addition, we focus on the limitations and address specific concerns that accompany the utilisation of digital technologies (e.g. artificial intelligence, cloud computing). Based on this, we address the specific requirements for each digital application.

The main findings substantiate how the set of digital applications strengthens the position of sales and marketing, simplifying and accelerating (standard) processes, along with creating intuitive processes for customers, increasing efficiency and enhancing the density of customer interaction. In the context of customer satisfaction in the insurance industry, the results indicate the positive effects on a customer's perception of service quality along with the perceived value, which have been previously defined as the components of customer satisfaction within the theoretical framework of the paper. Moreover, we emphasise the opportunity to offer more attractive pricing for the customer, which might affect the perception of price as a further driver of customer satisfaction.

However, the implementation of digital applications results in high investment costs for insurance companies. As managing customer satisfaction poses a major strategic challenge, we emphasise the strategic relevance of defining a selected portfolio of digital applications over the course of an insurer's holistic digital strategy. The strategic implications from the depicted 'opportunity landscape' thus depend on each specific insurer, as, for instance, the service leader might prioritise digital applications to foster service quality or the perceived value, while cost leaders might prefer to design their business processes (in general, but also at the customer touch points) more efficiently, with an impact on price.

Currently, the academic research on customer satisfaction management in insurance companies is rather limited, especially with a focus on the opportunities resulting from digital transformation. While our paper provides an overview of opportunities for customer satisfaction management based on digital applications, further research should empirically investigate whether (and to which degree) customer satisfaction of insurance companies that increasingly implement the presented digital applications improves. Moreover, since transparency is an important factor for insurance customers, future research should particularly focus on explainable artificial intelligence to increase the transparency of digital applications and therefore win the trust of customers and fully exploit the potential of digital applications.

Appendix

See Table A1.

Table A1 Major requirements for the implementation of digital applications (see Table 1) from the perspective of insurers

Category (main focus)	Digital application	Requirements
Back-office functionalities	Customer segmentation	• Accurate customer database and accessible information[h,i] (*see also requirements for customer targeting and up- and cross-selling recommendations*)
	Digital monitoring and telematics	• Installation of appropriate sensors, based on the Internet of Things[b,l] with accurate data models[e,h] • Assurance of sufficient data storage capacities[g,i] • Insurance products that take into account data from the respected devices/sensors, e.g. pricing[i,n]
	Digital ratemaking and underwriting	• Collection of comprehensive data regarding the applicant and automation of the respective processes[i] along with the trained models to apply, e.g. artificial intelligence (descriptive, predictive and prescriptive analytics tools) • Appropriate IT architecture[g]
	Fraud detection	• Implementation of technologies to interlock existing data with the aim of developing comprehensive customer databases (including past data)[j] • IT solutions to centrally store policy-related documents of customers with insurance line overarching databases to create a 'global picture' on a customer's (potentially fraudulent) behaviour[j] • Development of trained models (based on previous data) especially for motor and health insurance as these are prone to fraudulent claims[h,j] • Establishment of internal structures to share best practices of fraud management, but also to centrally point to conspicuous claims[j]
	Image recognition	• Availability of sufficient data: data collection to train the underlying models[i,k] • Accurate (analytical) and trained models to operate the underlying machine learning algorithms[i,k]
	Sentiment analysis	• Accurate (analytical) models trained on previous data[f] • Design of business processes, which integrate the results of the application resp. underlying the models[h]
Back-office and front-office functionalities	Digital claims management	• Installation of a comprehensive digital customer journey for the claims process[h] • Implementation of big data and related big data analytics approaches, including artificial intelligence[h,i,r,t] • Suitable infrastructure and facilities to implement related notifications, including the first notification of loss, to manage claims digitally and to settle them[d,h]
	Robo-advisory	• Installation of accurate and robust algorithms[p] to allow 'intelligent' interaction with customers[c]
	Smart contracts	• Development of appropriate product design[s] • Implementation of blockchain technology/accessibility of blockchain along with the requirements for IT[g]

Table A1 (continued)

Category (main focus)	Digital application	Requirements
Front-office functionalities	Chatbots	• Reliable installation of the dialog systems, which generate usable output for customers[a,q]
	Customer targeting	• Access to private/personal data of a customer[t], e.g. the possibility to collect data based on the Internet of Things • Integration of the application for existing marketing and sales activities (e.g. a more precise calculation of a customer lifetime value, with enhanced, digital customer segmentation)[h]
	Digital first notification of loss	• Installation of the required hardware/sensors to document and report potential losses, e.g. with regard to automobile insurance[h] • Integration of the notification to business processes, e.g. via smartphone applications[h]
	Omnichannel approach (integrated customer portals)	• Online/mobile access to the products and related services[o] • Accurate data management to assure robustness and sufficient capabilities to process input of numerous channels and to install the appropriate analytics tools[m,o]
	Up- and cross-selling recommendations	• Adjustment/transformation of existing capabilities with regard to customer service centers and equipment/ training of salespersons to link the digital technologies to their processes[o] • Collection of behavioural information on the customer (across a customer's lifetime or previously) so as to train accurate models based on big data analytics/artificial intelligence (machine learning)[h]

[a]Abdul-Kader and Woods (2015); [b]Banafa (2016); [c]Belanche et al. (2019); [d]Brüggemann et al. (2018); [e]Catlin et al. (2018); [f]Deloitte (2017); [g]Eckert and Osterrieder (2020); [h]EIOPA (2019); Eling and Lehmann (2018); [j]Garde (2017); [k]Hall et al. (2016); [l]Lang et al. (2019); [m]Matouschek and von Hülsen (2015); [n]Miehé and Lingens (2019); [o]Müller et al. (2015); [p]OECD (2017) [q]Riikkinen et al. (2018); [r]SCOR (2018); [s]Sheth and Subramanian (2019); [t]Venkatesh (2019)

Declarations

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