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ORIGINAL ARTICLE OPEN ACCESS

Assessing Omnichannel Service Quality in the Public Sector

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ABSTRACT

Services in the public sector are often provided as a hybrid combination of both digital (e.g., online registration) and physical (e.g., offline appointment) service channels, which can be referred to as omnichannel services. There is a lack of instruments in the literature that can measure the perceived quality of public sector omnichannel services. The goal of this paper is to develop and empirically validate an instrument to fill this research gap. The key contribution of this paper is the Technology, Information, Human, Process, System (TIHPS) framework, which represents the first instrument designed to assess the quality of public sector omnichannel services. An empirical validation using responses from 365 service recipients supports the validity and robustness of this instrument. We discuss how the TIHPS framework can be useful to governments, practitioners, and researchers alike.

ZUSAMMENFASSUNG

Dienstleistungen im öffentlichen Sektor werden oft als hybride Kombination aus digitalen (z.B. Online-Registrierung) und physischen (z.B. Offline-Termin) Dienstleistungskanälen bereitgestellt, die als Omnichannel-Dienstleistungen bezeichnet werden können. In der Literatur fehlt es bisher an Instrumenten, welche die wahrgenommene Qualität von Omnichannel-Dienstleistungen im öffentlichen Sektor messen können. Ziel der vorliegenden Arbeit ist es, ein solches Instrument zu entwickeln und empirisch zu validieren, um diese Forschungslücke zu schließen. Der Hauptbeitrag dieser Arbeit ist das Technology, Information, Human, Process, System Rahmenwerk (TIHPS), welches das erste Instrument zur Bewertung von Omnichannel-Servicequalität im öffentlichen Sektor darstellt. Eine empirische Validierung mit Antworten von 365 Dienstleistungsempfängern unterstützt die Validität und Robustheit dieses Instruments. Es wird abschließend diskutiert, wie das TIHPS-Rahmenwerk für Regierungen, Praktiker und Forscher gleichermaßen nützlich sein kann.

1 | Introduction

Services in the public sector are often provided as a hybrid combination of both digital (e.g., online registration) and physical (e.g., offline appointment) service channels, which can be referred to as omnichannel services (Kemppainen and Uusitalo 2022). Less research has been done related to service quality measurements that are applicable in omnichannel

services (Zhang et al. 2019), whereby previous research has primarily focused on the private sector (Hartwig and Billert 2018), neglecting the public sector. In previous decades, the SERVQUAL instrument (Parasuraman, Zeithaml, and Berry 1988) was frequently used to measure the quality of traditional physical services (Hartwig and Billert 2018; Ladhari 2009) and many models and scales have been developed to measure quality in digital service channels

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(Ladhari 2010), including those in the public sector (e.g., Papadomichelaki and Mentzas 2012). The field of service quality measurements essentially comprises external perspectives of customers or citizens on quality (Hartwig and Billert 2018). Previous prominent measures in the public sector, however, focused less on external perspectives and more on internal perspectives and measurements, such as general policy alienation (van Engen 2017), public leadership (Vogel, Reuber, and Vogel 2020), and profiling hybrid professionals (Compagni et al. 2023). Literature regarding internal perspectives in public service organizations also focused on public service motivation (Jin, McDonald, and Park 2018; Jin et al. 2019) and the professionalization of public administration in terms of training and knowledge (McDonald 2010).

The issue of service quality in public services is both important and challenging at the same time (Walsh 1991). The importance of external citizen's perspectives on service quality, and maintaining a high level of service quality in omni (Latin for "all") service channels, became particularly apparent during the Covid-19 pandemic, which brought to light the weaknesses of public and private sector services. In a crisis, like the Covid-19 pandemic, a fast reaction of governments is key (Jugl 2022), whereby those external shocks may spur cross-organizational collaboration in the public sector (Bentzen and Torfing 2022). Especially, the public sector service quality of health, security, and regulatory authorities has been stress-tested by the pandemic, whereby citizens as service recipients have high demands on public services, even during a global pandemic (Bagheri Lankarani et al. 2021). Due to changing governmental regulations during the Covid-19 pandemic and increasing customer demand for digital services (McKinsey 2020), physical services were compelled to transition from physical to digital or omnichannel services. Consequently, the characteristics by which service quality is measured have also changed.

Hence, there is a need for a comprehensive instrument to measure the quality of omnichannel services in the public sector, which could identify opportunities for potential quality improvements. This, in turn, would allow for better-tailored public services that meet citizens' needs and provide an enhanced service experience. Omnichannel service quality and new public management (NPM) (Hood 1991) are interconnected through the objective of enhancing public services to be more customer-oriented (Kuhlmann 2010) and achieving greater efficiency by implementing explicit standards and measures (Hood 1991). Omnichannel services are intended to enable a seamless experience across all integrated channels (Verhoef, Kannan, and Inman 2015), aligning with the principles of NPM and transforming public sector services towards a more integrated service delivery.

The identification of these needs led to the research question of this paper: "How should an instrument be designed to assess omnichannel service quality in the public sector?" The paper's objective is to develop and validate an instrument, in the form of a framework and measurement scale, for measuring service recipients' perceptions of omnichannel service quality in the public sector. This paper presents the step-by-step development and empirical validation process. The first

step consists of a literature review, which uncovers the research gap (Section 2). The second step is a description of the used methodology (Section 3). Then follows the development of the framework and the identification of multiple quality factors and indicators related to service quality and adjacent research areas, and additionally, the measurement scale was designed as a questionnaire based on the quality factors and indicators (Section 4). Then follows an empirical validation of the framework and measurement scale (Section 5). Afterward, we discuss the results, design the final framework and explore the implications for theory and practice that emerged from this paper. Additionally, we present the limitations of this study and show possible directions for subsequent research (Section 6). Finally, the paper ends with a brief conclusion that summarizes the main points of the study (Section 7).

2 | Literature Review

Public sector services can be provided through both digital (e.g., online registration) and physical (e.g., on-site human interaction) channels, which can be combined classified as (1) multichannel services, (2) omnichannel services or (3) hybrid services, depending on (1) whether the focus is on the design, deployment, coordination and evaluation of different channels (Thaichon, Phau, and Weaven 2022), the (2) seamless experience across all integrated channels (Verhoef, Kannan, and Inman 2015) or on (3) the mix of technology (digital online channels) and human interaction (physical offline channels) (Ganguli and Roy 2010). Hybridity of services is considered in this paper as the degree of balance between physical and digital service components in multichannel or omnichannel services. The literature suggests that services move from multichannel to omnichannel service conditions (Verhoef, Kannan, and Inman 2015), why we refer to the term 'omni' regarding multiple service channels, with a seamless omnichannel experience as the desirable goal and as a possible underlying parameter for perceived service quality in omni service channels.

Our starting point was the literature review from Hartwig and Billert (2018) which provides an overview of 41 service quality measurements in the private sector. Hartwig and Billert (2018) only considered literature regarding the private sector. Therefore, we performed a structured literature review considering additional service quality measurements related to the public sector. In addition, and in contrast to Hartwig and Billert's (2018), we also searched for multichannel and omnichannel literature in the private and public sector. We followed the guidelines described by vom Brocke et al. (2015) and applied a sequential search process, a representative coverage, and techniques of keyword search, backward and forward search in different sources (citation indexing services, bibliographic databases, publications). The distinction between private and public sector was made on the basis of the legal form of the service organization (corporation under public law versus privately managed). As a result, we identified 24 service quality measurements related to the public sector, thus that in total 67 service quality measurements have been considered for this review. Table 1 shows a channel- and sector-based classification of the 67 given service quality measurement models. Considering only the public sector, the results show 20 contributions related to digital E-Government services

TABLE 1 | Classification of service quality measurement models (MM) on the basis of sectors and channels (adapted from Hartwig and Billert 2018).

	Physical	Omni	Digital
Public sector	<ul style="list-style-type: none"> • SERVQUAL (Donnelly et al. 1995) • MM (Scott and Shieff 1993) • SERVQUAL (Wisniewski 1996) • SERVQUAL (McFadyen et al. 2001) 	<p>None (research gap)</p>	<ul style="list-style-type: none"> • SQ mGov (Shareef et al. 2014) • E-Government SERVQUAL (Huai 2011) • E-GovQual (Papadomichelaki and Mentzas 2012) <ul style="list-style-type: none"> • E-Govqual (Shanshan 2014) • EGOSQ (Agrawal 2009) • WEQ (Elling et al. 2012) • COBRA (Osman et al. 2014) • MM (Sá, Rocha, and Cota 2016) <ul style="list-style-type: none"> • MM (Sá et al. 2017) • MM (Stiglingh 2014) • MM (Bikfalvi, Rosa, and Keefe 2013) <ul style="list-style-type: none"> • MM (Hien 2014) • MM (Kaisara and Pather 2011) • MM (Henriksson et al. 2007) • MM (Bhattacharya, Gulla, and Gupta 2012) <ul style="list-style-type: none"> • MM (Sigwejo 2015) • MM (Balushi and Ali 2016) • MM (Tan, Benbasat, and Cenfetelli 2013) <ul style="list-style-type: none"> • MM (Osei-Kojo 2017) • MM (Connolly, Bannister, and Kearney 2010)
Private sector	<ul style="list-style-type: none"> • SERVPERF (Cronin and Taylor 1992) • Retail Service Quality Scale (Dabholkar, Thorpe, and Rentz 1996) • Service quality model (Grönroos 1984); • P-E-SQ gap concept (Parasuraman, Zeithaml, and Berry 1985) • SERVQUAL (Parasuraman, Zeithaml, and Berry 1988) • SERVQUAL NQ and EP (Teas 1993) • IS SERVQUAL (Jiang, Klein, and Carr 2002) • SERVQUAL (Pitt, Watson, and Kavan 1995) • SERVQUAL (Pitt et al. 1994) 	<ul style="list-style-type: none"> • ASP model (Ma, Pearson, and Tadisina 2005) • ASP-Qual (Sigala 2004) • IT service climate (Jia, Reich, and Pearson 2008; Jia and Reich 2013) • SSTQUAL (Lin and Hsieh 2011) • IS ZOT SERVQUAL (Kettinger and Lee 2005) • OCX (Rahman et al. 2022) • MM (Zhang et al. 2019) • MM (Zhang et al. 2022) <ul style="list-style-type: none"> • MM (Sousa and Voss 2006) 	<ul style="list-style-type: none"> • MM (Aladwani and Palvia 2002) • WebQual (Barnes and Vidgen 2000, 2001a, 2001b, 2002) <ul style="list-style-type: none"> • MM (Hidayanto et al. 2013) • WebQualTM (Loiacono, Watson, and Goodhue 2002) <ul style="list-style-type: none"> • SITEQUAL (Webb and Webb 2001, 2004) • SiteQual (Yoo and Donthu 2001) • MM (Gounaris and Dimitriadis 2003) <ul style="list-style-type: none"> • MM (Yang et al. 2005) • PeSQ (Cristobal, Flavian, and Guinaliu 2007) <ul style="list-style-type: none"> • MM (Collier and Bienstock 2006) • IRSQ scale (Janda, Trocchia, and Gwinner 2002) • E-S-Qual/E-RecS-Qual (Parasuraman, Zeithaml, and Malhotra 2005) <ul style="list-style-type: none"> • E-tail SQ (Rolland and Freeman 2010) <ul style="list-style-type: none"> • MM (Santos 2003) • MM (Swaid and Wigand 2009) • etailQ (Wolfenbarger and Gilly 2003) • e-SQ (Zeithaml, Parasuraman, and Malhotra 2002) <ul style="list-style-type: none"> • PeSQ (Ho and Lin 2010) • MM (Wu, Tao, and Yang 2012) • MM (Yang, Jun, and Peterson 2004) • M-S-Qual (Huang, Lin, and Fan 2015) • MS-Qual (Hosseini, Zadeh, and Bideh 2013) <ul style="list-style-type: none"> • MM (Lu, Zhang, and Wang 2009) • SaaS-Qual (Benlian, Koufaris, and Hess 2011)

and four contributions related to traditional physical services in the public sector. Worth noting is that we found no contributions which compared the literature of service quality measurements in the private and the public sector. Additionally, we found no contribution which measure omnichannel service quality in the public sector. The digital and physical measurement models discovered thus far are formulated with such specificity that they cannot be applied simultaneously across various types of

channels. Existing omnichannel measurement models are tailored specifically to the private sector (e.g., retailers and their on-time delivery fulfillment) and have only been validated with samples obtained from the private sector. Consequently, neither the factors, indicators, nor the conclusions derived from these models can be directly transferred to the public sector. Therefore, these facts highlight the research gap of this paper and justify the focus of this instrument development paper.

3 | Methodology

The development and validation of the framework and measurement scale comprised *seven steps*. *First*, a comprehensive literature review was carried out to identify any research gap (as described in the previous section). The *second step*, which was based on the guidelines for scale development by Rossiter (2002), continued the literature review procedure to deductively derive suitable factors and indicators for the desired construct of service quality to be measured in public sector omnichannel services. In order to consider the service quality phenomenon holistically, the literature taken into account referred to public and private sector service quality and adjacent research areas (Section 4). In the *third step*, the factors and indicators obtained from the literature were translated into concrete items, as proposed by MacKenzie, Podsakoff, and Podsakoff (2011), which can be used as measures in a survey instrument (Section 4.6).

The *fourth step* included a data collection with $n = 365$ service recipients, following the guidelines by MacKenzie, Podsakoff, and Podsakoff (2011) and Hair et al. (2021, 2022), to empirically validate the instrument. The sample's descriptive statistics are provided in Table 2. Although this sampling approach favored certain age groups and education levels, we regard it as sufficient for the purpose of evaluating our instrument. The survey was administered online between May and December 2021 via an online survey and was distributed through participants (students) of a research seminar at our university in Germany. The service recipients were recruited from the personal networks of the students who attended this research seminar. These students did not participate in the survey and were only responsible for recruiting survey participants. This approach is intended to provide the broadest possible coverage of randomly selected service experiences. Inclusion criteria for participation in the survey required participants to have undergone a recent critical service experience in the public sector, and reported on this experience as the unit of analysis. The critical service experience selection followed the critical incident technique (Flanagan 1954), wherein both positively and negatively perceived service experience can be recorded. A critical case can be defined as having strategic importance in relation to the general problem and results in information that permits a logical deduction of the type (Flyvbjerg 2006). Especially, Germany, which makes up the majority of our sample, represents a critical case in terms of

public sector digitalization (Walke, Winkler, and Le 2023). The sample consists of service experiences across 41 different types of service organizations (e.g., passport office, registry office, city administration, vaccination center, police stations, public universities) in the public sector. Selecting such a broad sample offers advantages in terms of possible sample bias (Blair and Zinkhan 2006), which could arise, for example, if the focus is only on a specific type of organization.

We identified in our sample 141 primarily physical, 168 primarily omnichannel, and 56 primarily digital service experiences, which were categorized by the level of digitalization of the service. We used a 7-point Likert scale with five items to measure the level of digitalization of the given service and to identify the distribution of physical, digital, and omnichannel services in our sample. This measure was inspired by digital maturity models of the public (Kim and Grant 2010) and private sector (Ilin, Levaniuk, and Dubgorn 2021; Thordsen, Murawski, and Bick 2020) and its frequently used five maturity levels. The level of digitalization was based on whether (1) the information, (2) the initiation, and (3) the completion of the service process, (4) the service outcome, and (5) the communication with the service provider were completely digital, ranging from “completely agree” to “completely disagree” for each item. The middle point of the 7-point Likert scale was “neutral.” The distribution of physical, digital, and omnichannel services was made by evenly distributing the 7-point values from the Likert scale to form three groups (Group1_Physical, Group2_Omni, and Group3_Digital). A mean value for every service experience was formed out of the five measurements (information, initiation, completion, outcome, and communication) of the level of digitalization. Mean values of less than 2.3 were categorized as primarily physical (offline) services and grouped in the physical group (Group1_Physical). Mean values that were higher than 4.6 were classified as primarily digital (online) services and grouped in the digital group (Group3_Digital). Last, mean values between 2.3 and 4.6 were categorized as primarily omnichannel services, which represent a balanced mix of digital and physical service components. The even distribution, based on the 7-point Likert scale, ensured a balanced distribution of the group differences to be examined.

Then, in *step number five* (Section 5), we developed and evaluated a partial least square structural equation model (PLS-SEM)

TABLE 2 | Descriptive statistics of the sample.

Sample ($n = 365$)		Age		Education	
Male	51.0%	< 20	1.4%	No school degree	0.3%
Female	48.5%	20–29	36.7%	Lower secondary school qualification	4.1%
Diverse	0.5%	30–39	29.3%	Higher secondary school certificate	12.6%
		40–49	9.9%	Technical college entrance qualification	7.1%
Collected in		50–59	12.1%	General university entrance qualification	12.9%
• Germany		≥ 60	10.7%	Bachelor's degree	28.5%
• Austria				Master's degree	32.9%
• Italy				Doctoral degree	1.6%

in the form of a formative measurement model. A formative model was chosen instead of a reflective model because the indicators define and cause the construct. We followed the guidelines and three evaluation steps from Hair et al. (2021, 2022): (1) the assessment of convergent validity, (2) indicator collinearity, and (3) statistical significance and relevance of the indicator weights. PLS-SEM is the preferred approach when formatively specified constructs are included in a PLS path model (Hair et al. 2019). In addition to the three-step validation of the measurement model recommended by Hair et al. (2021, 2022), we performed an exploratory factor analysis (EFA) (4), to enhance the understanding of the dimensionality of the acquired data, and a robustness check (5) of our model, with respect to generalizability of the results.

The convergent validity (1), which was originally proposed by Chin (1998), is also known as redundancy analysis and can be assessed by the extent to which the formative construct is positively correlated with an alternative measure using different indicators for the same construct (Hair, Howard, and Nitzl 2020; Hair et al. 2017). MacKenzie, Podsakoff, and Podsakoff (2011) recommended method for assessing convergent validity specified that “alternative measures of the same construct should be included as part of this data gathering effort.” Cheah et al. (2018) demonstrated that global single items, which capture the essence of the constructs, are generally sufficient as alternative measures. The relationship between the formative construct and the alternative measure is typically examined using correlation or regression (Cheah et al. 2018; Hair, Howard, and Nitzl 2020). We assessed convergent validity by including five additional single items as alternative quality measures for the five quality factors, consisting of service (1) technologies, (2) information, (3) human interaction, (4) processes and systemic conditions, (5) and containing a disconfirmed-expectancy approach (Zeithaml, Leonard, and Parasuraman 1993). The scale of these items ranged from “much better than expected” to “much worse than expected,” with “as expected” as the middle point of the scale. The overall service quality second order construct (ServiceQuality) was also examined in terms of convergent validity with an alternative measure construct (ServiceQ alt.), which consists of all alternative single item measures.

For the collinearity diagnosis (2) of the indicators, we used the variance inflation factor (VIF), which is suitable for a formative construct (Hair et al. 2021). The VIF indicates which factor increases the variance of a parameter in the presence of multicollinearity (Weiber and Mülhhaus 2014). We used a bootstrapping procedure (PLS-SEM) to test (3) the significance of the indicator weights and examined the relevance of the indicator based on their weights (Hair et al. 2021). Bootstrapping also facilitates deriving standard errors from the data without relying on any distributional assumptions (Hair et al. 2014).

We utilized SPSS software to perform an EFA (4) to improve our comprehension of the dimensionality of the acquired data. The robustness check (5) of our model with respect to generalizability of the results was performed using a bootstrapping-multigroup-analysis (MGA) to investigate the impact of different service channels on our research results. The generalizability of the results of the paper's sample, according to Blair

and Zinkhan (2006), was tested to ensure that different service channels have no influence on the results, so that in fact it is possible to assume that the research results are going in the direction of generalizability. The robustness check (5) was performed in three different service channels (physical, omni, and digital) and is related to the inner (factor weights) and outer (indicator weights) measurement model.

The *sixth step* featured a percentile bootstrapping algorithm that we applied in our PLS-SEM to examine the relevance of the quality factors regarding their relationship with the overall service quality construct, which consists of all quality indicators. As in the case of the indicators, relevance was determined through weights (Hair et al. 2021). The *last step* finalized the design of the framework (Section 6.1).

4 | Development of the TIHPS Framework

The literature review was extended to find suitable quality factors and indicators for the framework that would measure the phenomenon of service quality, while targeting public sector omnichannel services. In order to examine the service quality phenomenon holistically, our consideration focused on literature referring to the public and private sectors and adjacent research areas—in particular, previous service quality measurement models (Parasuraman, Zeithaml, and Berry 1985; Parasuraman, Zeithaml, and Berry 1988; Tan, Benbasat, and Cenfetelli 2013), general customer satisfaction (Smith, Bolton, and Wagner 1999; Tax 1993), service success factors (Wood-Harper, Ibrahim, and Ithnin 2004), service innovation, behavior, disruptions, failures and recoveries (Abdullah, Noor, and Ibrahim 2016; Ahearne, Jelinek, and Jones 2007; Hogle, Bilstein, and Hoerner 2019; Kelley, Hoffman, and Davis 1993; Michel 2001; Parasuraman 2010; Tan, Benbasat, and Cenfetelli 2016), and sustainable service quality (Bothe et al. 2016). Additional literature that was taken into account was related to public sector benchmarking (Dorsch and Yasin 1998), organization system fit (Strong and Volkoff 2010), digital sovereignty (Couture and Toupin 2019; Pohle and Thiel 2021), system theory (Luhmann 2017), and information theory (Shannon 1948; Shannon and Weaver 1949).

Wood-Harper, Ibrahim, and Ithnin (2004) described three main factors that could contribute to the success or failure of electronic services: process, people, and systems. Abdullah, Noor, and Ibrahim (2016) asserted that the literature on service disruptions and failures was often related to processes, technologies, and humans. For their theoretical service model, Tan, Benbasat, and Cenfetelli (2016) used a systems factor and an information factor regarding service failures. Michel (2001) also employed various factors, including systems, information, process, and human (advice) related to service failures and recoveries. Our examination of the service-related factors in the relevant literature revealed that the factors of systems and technology were used as equivalents and targeted technology-based systems. Dorsch and Yasin (1998) suggested using the factors technology, people, and procedures when benchmarking different public organizations. Dorsch and Yasin (1998) also described public organizations as an open organizational system and presented them in connection to a strategy and structure factor. Thus, in the

present paper, a factor linked to system theory (Luhmann 2017) could be appropriate for capturing overarching systemic and organizational (e.g., structural, strategic, economic, regulatory) components of service organizations.

In summary, in the organization-related service sector, technology, information, human, process, and system factors were used in different publications for benchmarking purposes and as relevant categories in determining the success or failure of services. In this light, we adopted the factors technology, information, human, process, and system for our framework (Table 3), which we call the Technology, Information, Human, Process, System (TIHPS) framework. These factors were sufficiently generic to cover different types of service channels, as well as several types of services, organizations, and application areas. These five factors are particularly suitable for omnichannel services, as technologies, information, humans, processes, and systems can be present in both digital and physical services and, therefore, also in omnichannel services (see “description” in Table 3).

This paper refers to a user-oriented (service recipient; e.g., end customer or internal employee) and a service-oriented quality perspective. The user-oriented quality perspective is the ability of a service to satisfy human needs and is equivalent to customer’s contentment with service indicators (Forker 1991; Garvin 1984; Tan, Benbasat, and Cenfetelli 2013; Teas 1993). The service-oriented perspective is a function of the discrepancy between actual and ideal indicators of a service that determines its desirability (Forker 1991; Garvin 1984; Hauser and Clausing 1988; Tan, Benbasat, and Cenfetelli 2013). The next step entailed identifying quality indicators from the literature for the proposed quality factors *technology, information, human,*

process and *system*. The quality indicators represent the causes of changes in the quality of a factor as a formative construct. The given quality factor construct was designed as an explanatory combination of indicators.

4.1 | Technology Quality Factor and Indicators

The technology quality factor describes technology-based systems that provide digital (e.g., website for appointment booking) and/or physical (e.g., physical self-service desk on-site) services. Tan, Benbasat, and Cenfetelli (2013) proposed four suitable technology-related service quality indicators—accessibility, adaptability, interactivity, and navigability. *Accessibility* has the goal of providing assurance of universal accessibility of services in the face of diverse needs and presenting technical capabilities while running flawlessly. Thus, we define *accessibility* as the extent to which the service technology is compatible with the users’ technology. *Navigability* has the goal of categorizing and presenting service technologies in a clear and uncluttered format to ensure the maximum level of ease and comfort for service recipients. We therefore define this indicator as the extent to which the service technology can be used easily and in a user-friendly manner. The goal of *adaptability* is to accommodate unpredictable usage demand patterns resulting from the diversity in the lifestyles and needs within a population. We define *adaptability* as the extent to which the service technology accommodates fluctuations in use patterns. *Interactivity* aims to reward service recipients with an engaging experience with the service provider during service transactions. Thus, we define *interactivity* as the extent to which the service technology proactively engages the user during transactions. Additionally, we propose the

TABLE 3 | TIHPS quality factors, descriptions, and related contributions.

Factor	Description	Related contributions
Technology	The technology quality factor describes technology-based systems that provide digital (e.g., website for appointment booking) and/or physical (e.g., physical self-service desk on-site) services.	Tan, Benbasat, and Cenfetelli (2016); Abdullah, Noor, and Ibrahim (2016); Michel (2001); Dorsch and Yasin (1998); Wood-Harper, Ibrahim, and Ithnin (2004)
Information	The information quality factor describes information that is provided by the service digitally (e.g., on a website) and/or physically (e.g., information brochure).	Tan, Benbasat, and Cenfetelli (2016); Michel (2001)
Human	The human quality factor describes the human interaction between the service recipient and the service provider, along with aspects of employees’ work quality in the service organization. The interaction can take place digitally (e.g., via e-mail) and/or physically (e.g., in front of a physical service desk).	Abdullah, Noor, and Ibrahim (2016); Michel (2001); Dorsch and Yasin (1998); Wood-Harper, Ibrahim, and Ithnin (2004)
Process	The process quality factor describes processes carried out digitally (e.g., during online-registration) and/or physically (e.g., on-site check-in) during the service.	Wood-Harper, Ibrahim, and Ithnin (2004); Dorsch and Yasin (1998); Abdullah, Noor, and Ibrahim (2016); Michel (2001)
System	The system quality factor describes overarching systemic conditions related to the organizational system of the service provider, which are perceived digitally (e.g., during online registration) and/or physically (e.g., on-site check-in) during the service.	Luhmann (2017); Dorsch and Yasin (1998)

quality indicator quickness, fit, and sovereignty for the technology factor. The goal of *quickness* is to enable service technology to be used quickly and without delay. Specifically, we define *quickness* as the extent to which the technology reacts rapidly when used. *Fit*, which is inspired by the organization-system fit framework (Strong and Volkoff 2010), has the goal of providing need-oriented service technologies. We define *fit* in this paper as the extent to which the service technology is tailored to the needs of the user. *Sovereignty*, an indicator related to digital technologies, has previously been discussed in the literature (Couture and Toupin 2019; Pohle and Thiel 2021). Scholars have increasingly used the notion of *sovereignty* to describe various forms of independence, control, and autonomy over digital technologies and data (Couture and Toupin 2019). The aim of sovereignty as a quality indicator is to ensure that the service recipient has a high degree of privacy and control over the technologies. Accordingly, we defined *sovereignty* as the extent to which the service technology provides self-determination in terms of control over technologies and personal data.

4.2 | Information Quality Factor and Indicators

The information quality factor describes information that is provided by the service digitally (e.g., on a website) and/or physically (e.g., information brochure). Tan, Benbasat, and Cenfetelli (2016) proposed a service-failure classification system that included four suitable informational quality indicators called inaccurate, incomplete, irrelevant, and untimely information. We reverse these indicators from a negative to a positive connotation and choose the labels accuracy, completeness, timeliness, and relevance. *Accuracy* is defined as the extent to which the service information is correct. *Completeness* refers to the extent to which the service information is exhaustive. *Timeliness* is the extent to which the service information is up-to-date. *Relevance* is the extent to which the service information can be utilized. Additionally, we propose the quality indicators conciseness, intelligibility, and findability for the information quality factor due to their relevance in terms of capturing additional characteristics of information quality. The increasing availability of information in society and information systems leads to the inclusion of *conciseness* as an indicator, which we define as the extent to which the service information is succinct. In addition, the language used, especially in the case of legal language in the public sector, can be difficult to understand, which leads to the introduction of the indicator *intelligibility*, which we define as the extent to which the service information is easy to understand. Last, the *findability* indicator is suggested by the increasingly vital role that the search possibilities for information play in times of frequently used online search engines. We therefore defined *findability* as the extent to which the service information can be found easily.

4.3 | Human Quality Factor and Indicators

The human quality factor describes the human interaction between the service recipient and the service provider, along with aspects of employees' work quality in the service organization. The interaction can take place digitally (e.g., via e-mail) and/

or physically (e.g., in front of a physical service desk). Ahearne, Jelinek, and Jones (2007) used the indicator *diligence* in analyzing salesperson service behavior. This indicator is highly human-related and is defined as the extent to which the service employees' work is characterized by carefulness. Parasuraman, Zeithaml, and Berry (1988) introduced in their SERVQUAL measurement model the quality indicator *empathy*, defined as the extent to which the service employees are caring and providing attention to the service recipient, which was also deemed suitable for this quality factor. Michel (2001) employed the indicators not attainable and incompetent, which we reverse from a negative to a positive connotation, applying the labels *attainable* and *expertise*. *Attainable* is defined as the extent to which the service employees are easy reachable via the offered communication channels. *Expertise* referred to the extent to which the service employees have sufficient skills to fulfill their tasks. In their analysis of customer satisfaction, Smith, Bolton, and Wagner (1999) and Tax (1993) used items that measured the *appropriateness* of employees' communication and the employees' *effort* invested in resolving the service recipients' concerns. Both indicators are highly human-related. *Appropriateness* of communication is defined as the extent to which the service employees' communication is adequate. *Effort* describes the extent to which the service employees invest sufficient energy in their work. According to Shannon and Weaver's classic transmitter-receiver model (Shannon 1948; Shannon and Weaver 1949), interference can occur when two people communicate, leading to the consequence, for example, that what the sender (e.g., service employee) says is received differently by the recipient (e.g., service employee). Such possible interference was covered by the quality indicator *transmission*, defined as the extent to which the service employees understand what the service recipient said correctly.

4.4 | Process Quality Factor and Indicators

The process quality factor describes processes carried out digitally (e.g., during online-registration) and/or physically (e.g., on-site check-in) during the service. Parasuraman, Zeithaml, and Berry (1988) proposed a process-related quality indicator called *reliability*. For this paper, we define *reliability* as the extent to which the service process deadlines are met. Another vital indicator inherent to service processes is *transparency*, which acts as an important signal of quality (Hogreve, Bilstein, and Hoerner 2019). In the public and private sectors alike, work processes and the status of processing can be opaque to service recipients. For our purposes, we define *transparency* as the extent to which the service process is clear and observable. Prompt service was a quality indicator used by Michel (2001) in analyzing service failures and recoveries. In this paper, we referred to this concept as *immediacy* in the process factor and define it as the extent to which the service process is characterized by promptness. *Efficiency* represents one of the main characteristics examined in business and public administration and has been used, among others, by Zeithaml, Parasuraman, and Malhotra (2002) and Connolly, Bannister, and Kearney (2010). Thus, we defined *efficiency* as the extent to which the service process can be completed with least amount of effort. Since processes always include communication (i.e., the exchange of information from A to B),

this indicator is listed in the process factor. For this paper, we defined communication as the extent to which the service process is characterized by good and effective communication. Furthermore, we propose the quality indicators *order* and *logic* for this factor. Bureaucracy or various specifications of the service provider can insert illogical steps into the process from the service recipients' point of view. Therefore, we define *logic* as the extent to which the service process steps are characterized by a consequential sequence. Since individual process steps can also appear disordered from the point of view of the service recipient, we added the process *order* as a quality indicator and defined *order* as the extent to which the service process steps are expediently arranged.

4.5 | System Quality Factor and Indicators

The system quality factor describes overarching systemic factors related to the organizational system of the service provider, which are perceived digitally (e.g., during online registration) and/or physically (e.g., on-site check-in) during the service. Since systemic perspectives always include *structures* (e.g., departments, hierarchies, responsibilities), this indicator is listed in the system factor. Similarly, Dorsch and Yasin (1998) also mentioned a structure factor for the benchmarking of public sector organizations. *Structure* can be defined as the extent to which the service provider structure is designed expedient related to the service aim. Since an organization as well as its umbrella organizations often want to present a uniform appearance (e.g., corporate design) and the appearance of the organizations that the service recipient perceives can also reflect the current conditions and circumstances of an organization (e.g., modernity of infrastructure), we included an *appearance* indicator. *Appearance* has also been used by the SERVQUAL instrument (Parasuraman, Zeithaml, and Berry 1988) related to service tangibles. We define *appearance* as the extent to which the service provider presentation is appealing. *Policies* of organizations have been described as indicators that influence service quality; in particular, inadequate policies can result in service failures (Kelley, Hoffman, and Davis 1993). We determine that *policies* are related to the system quality factor and define this term as the extent to which the service provider regulations are expedient related to the service aim. Also, because *sustainability* has become a crucial factor in ensuring the quality of services (Bothe et al. 2016), we include it in the system factor and define *sustainability* as the extent to which the service provider is future viable and not acting temporarily related to its resources. One example of a lack of *sustainability* might be duplicate and paper-based record keeping. Innovations that address service recipients' unmet needs can enhance their assessment of service quality (Parasuraman 2010), which is why we use the *innovation* indicator in the system factor. Specifically, we define *innovation* as the extent to which the service provider is progressive. *Innovation* could be characterized, for example, by particularly advanced service features that the service recipient would not have expected. We also include the indicator *security* in the system factor as a determinant of service quality (Parasuraman, Zeithaml, and Berry 1985). *Security* is defined as the extent to which the service provider ensures freedom from danger, risk, or doubt; examples include physical safety or confidentiality (Parasuraman, Zeithaml, and Berry 1985).

Additionally, we propose the quality indicator *resources* for the system factor. An essential building block for an organization to ensure high service quality lies in the resources available. *Resources* can be, for example, equipment, the number of employees, or the financial resources of the service provider. *Resources* may also be visible in service experiences to the external service recipient (e.g., overworked employees or outdated IT equipment). Thus, we define *resources* as the extent to which the service provider has sufficient means to fulfill its tasks.

4.6 | Measurements

All of our results for the quality indicators are summarized in Table 4. In the next step, the factors and indicators were transformed into concrete survey items (Table 5). The original items were developed in German and later translated to English for the purpose of presentation in this paper. We chose 7-point Likert scales, ranging from “completely agree” to “completely disagree” for each item. The middle point of the Likert scale “neither nor” could be selected if the item was not suitable for the respondent. Our design followed a recommendation by Oaster (1989) showing that a 7-point Likert scale has the highest test-retest reliability compared with lower and higher numbers of alternatives per choice.

Compared with expectancy-related approaches, our measurement items can be considered mainly independent of the dynamics of customer, cultural, individual, and contextual expectations. This expectation independence is crucial, especially considering the potential changes in customer expectations over time (e.g., through changed technologies), cultural expectation variations in values and norms, unique individual expectations, and specific contextual influences on prior expectations.

5 | Empirical Validation

We developed a PLS-SEM (Figure 1) using the SmartPLS software 4.0.9.3 (Ringle, Wende, and Becker 2022). The evaluation of this PLS-SEM in the form of a formative measurement model followed the guidelines and evaluation steps provided by Hair et al. (2021, 2022), consisting of the (1) assessment of convergent validity, (2) indicator collinearity, and (3) statistical significance and relevance of the indicator weights.

The convergent validity (1) was assessed by correlating the constructs with five single items that provided alternative quality measures of the service: (1) technology, (2) information, (3) human interaction, (4) processes, and (5) systemic conditions (additional designation “alt.” in Figure 1 and Table 6). Additionally, the overall service quality construct (ServiceQuality) was correlated with an alternative service quality construct (ServiceQ alt.).

The path strengths between the quality factors and alternative measures (“alt.”; omitted in Figure 1 for reasons of visual clarity) are all significant ($*p < 0.001$) and shown in Table 6. This outcome supports the convergent validity of our formative quality

TABLE 4 | TIHPS quality factors (F), indicators, definitions, and related contributions.

Factor	Indicator	Definition (The extent to which the service ...)	Related contributions
Technology	Accessibility	technology is compatible with the users' technology.	Tan, Benbasat, and Cenfetelli (2013)
	Adaptability	technology accommodates fluctuations in use patterns.	Tan, Benbasat, and Cenfetelli (2013)
	Navigability	technology can be used easily and in a user-friendly manner.	Tan, Benbasat, and Cenfetelli (2013)
	Interactivity	technology proactively engages the user during transactions.	Tan, Benbasat, and Cenfetelli (2013)
	Fit	technology is tailored to the needs of the user.	Strong and Volkoff (2010) ^a
	Sovereignty	technology provides self-determination in terms of control over technologies and personal data.	Couture and Toupin (2019); Pohle and Thiel (2021) ^a
	Quickness	technology reacts rapidly when used.	Self-developed
Information	Accuracy	information is correct.	Tan, Benbasat, and Cenfetelli (2016)
	Timeliness	information is up-to-date.	Tan, Benbasat, and Cenfetelli (2016)
	Relevance	information can be utilized.	Tan, Benbasat, and Cenfetelli (2016)
	Completeness	information is exhaustive.	Tan, Benbasat, and Cenfetelli (2016)
	Conciseness	information is succinct.	Self-developed
	Intelligibility	information is easy to understand.	Self-developed
	Findability	information can be found easily.	Self-developed
Human	Attainable	employees are easy reachable via the offered communication channels.	Michel (2001)
	Appropriateness	employees' communication is adequate.	Smith, Bolton, and Wagner (1999); Tax (1993)
	Diligence	employees' work is characterized by carefulness.	Ahearne, Jelinek, and Jones (2007)
	Transmission	employees understand what the service recipient said correctly.	Shannon (1948); Shannon and Weaver (1949) ^a
	Expertise	employees have sufficient skills to fulfill their tasks.	Michel (2001)
	Effort	employees invest sufficient energy in their work.	Smith, Bolton, and Wagner (1999); Tax (1993)
	Empathy	employees are caring and providing attention to the service recipient.	Parasuraman, Zeithaml, and Berry (1988)
Process	Reliability	process deadlines are met.	Parasuraman, Zeithaml, and Berry (1988)
	Immediacy	process is characterized by promptness.	Michel (2001)
	Transparency	process is clear and observable.	Hogreve, Bilstein, and Hoerner (2019) ^a
	Efficiency	process can be completed with least amount of effort.	Zeithaml, Parasuraman, and Malhotra (2002); Connolly, Bannister, and Kearney (2010)
	Logic	process steps are characterized by a consequential sequence.	Self-developed
	Communication	process is characterized by good and effective communication.	Self-developed
	Order	process steps are expediently arranged.	Self-developed

(Continues)

TABLE 4 | (Continued)

Factor	Indicator	Definition (The extent to which the service ...)	Related contributions
System	Appearance	provider presentation is appealing.	Parasuraman, Zeithaml, and Berry (1988)
	Structure	provider structure is designed expedient related to the service aim.	Dorsch and Yasin (1998) ^a
	Policy	provider regulations are expedient related to the service aim.	Kelley, Hoffman, and Davis (1993)
	Security	provider ensures freedom from danger, risk, or doubt.	Parasuraman, Zeithaml, and Berry (1985)
	Sustainability	provider is future viable and not acting temporarily related to its resources.	Bothe et al. (2016) ^a
	Innovation	provider is progressive.	Parasuraman (2010)
	Resource	provider has sufficient means to fulfill its tasks.	Self-developed

^aLiterature is related to the topic of the given quality indicator and the service quality measure was self-developed.

factors. Since the alternative single-item measures are based on a different scale (disconfirmed expectancy) than the scale of the quality factors (completely agree/disagree), it can be assumed that higher correlations can be measured with the same scale as the quality factors, since a noteworthy discrepancy between the incoming expectations of the subjects and the actual perceived service experience can be present.

The VIF has been described as suitable for the collinearity diagnosis (2) of the indicators of a formative construct (Hair et al. 2021). The VIF should be close to 1 to indicate no multicollinearity, and it should not exceed 10 (Diamantopoulos and Winklhofer 2001). Hair et al. (2021) assumed a VIF value ≥ 5 as the critical threshold that should not be exceeded. All indicators in our formative measurement models are below this threshold (Table 7). The inner VIF values (Table 6) are related to the overall service quality construct, and each VIF calculated has a value close to 1, which indicates that none of the factors are redundant. Each factor can therefore stand on its own and is suitable to represent a service quality factor.

Significance testing (3) of the indicator weights relied on the bootstrapping procedure (PLS-SEM). PLS-SEM should be based on at least 10,000 bootstrapping subsamples to estimate the PLS path model (Streukens and Leroi-Werelds 2016). The percentile bootstrapping method is preferred, as it exceeds other methods in terms of coverage and balance, producing comparably narrow confidence intervals (Aguirre-Urreta and Rönkkö 2018). The significance testing (3) of our formative measurement model (Table 7) revealed that all indicator weights of our model are statistically significant ($p < 0.001$; 0.1% probability of error), which indicates that none of the indicators should be removed from the measurement model.

After the statistical significance of the formative indicator weights was assessed, the next step was to examine the relevance (3) of the indicator weights. Relevance is assessed through weights (Hair et al. 2021) and larger significant indicator weights indicate a higher relative contribution of the indicator to the construct (Hair et al. 2021), while the construct represents

the quality factor (Table 7). The listed indicators are ordered by weight per quality factor in Table 7. This weighted order shows that the indicators technology fit, information findability, human effort, process efficiency, and system resource have the highest relevance in their given quality factor. The implications arising from these results will be further explored in the discussion that follows.

The next step entailed an EFA (4), which we conducted to enhance our understanding of the dimensionality of the data acquired with the measurement instrument. Stevens (1992) suggests a factor threshold of 0.40, while we used an even higher value (0.47) as the minimum loading threshold for this analysis in order to obtain the most conclusive result possible. The results reveal no cross loadings and a clear separation of the five individual factors representing the developed quality factors (TIHPS). With regard to the robustness check (5) of the service channels (physical vs. digital, physical vs. omni, and digital vs. omni) using bootstrapping-MGA (containing unchanged bootstrapping settings), the results show no significant differences ($\alpha = 0.01$) in the inner and outer model weights (Figure 1), which supports the robustness of our instrument. This also confirms that the results seem to be generalizable and lead to the same results across different service channels, so they actually remain consistent regardless of the service channel.

The next step was to examine the relevance of the quality factors regarding their relationship with the overall service quality construct. As in the case of the indicators, relevance was determined through weights (Hair et al. 2021). The results regarding the relationship between the five quality factors and the overall service quality construct are presented in Table 6, wherein all factors show significant results. In addition, two control variables were used (C1 = age and C2 = gender). As is typical for a formative measurement model, the R^2 of the overall service quality construct is 1.000. The results reveal that process quality has the highest relevance in terms of service quality. The discussion that follows will delve deeper into the implications arising from these results.

TABLE 5 | TIHPS Measurement Scale.

Factor	Attribute	Items
Technology	Accessibility	The technologies used in the service were accessible and worked flawlessly.
	Quickness	The technologies used in the service executed quickly.
	Adaptability	The technologies used in the service were adapted to my personal usage behavior.
	Navigability	The technologies used in the service were easy to navigate.
	Interactivity	The technologies used in the service proactively asked for my personal data and stored it digitally.
	Fit	The technologies used in the service were tailored to my needs.
	Sovereignty	The technologies used in the service gave me complete control over my personal data and self-determination was guaranteed.
Information	Accuracy	The information of the service was free of errors.
	Timeliness	The information of the service was up-to-date.
	Relevance	The information of the service was relevant for my concern.
	Completeness	The information of the service was sufficient to help me with my concern.
	Conciseness	The information of the service was concisely worded and not too extensive.
	Intelligibility	The information of the service was easy to understand.
	Findability	Information for my concern was easy to find.
Human	Attainable	The service employees were easy to reach via the offered communication channels.
	Appropriateness	The service employees communicated appropriately with me.
	Diligence	The service employees worked meticulous and diligently.
	Transmission	The service employees correctly understood what was said.
	Expertise	The service employees had sufficient expertise to deal with my concern.
	Effort	The service employees have made enough effort with my concern.
	Empathy	The service employees cared about my concern.
Process	Reliability	In the service process, agreed dates were met.
	Immediacy	The service process was immediate and without delay.
	Order	The order of the service process was expedient and makes sense.
	Communication	The service process was characterized by good and effective communication from the service provider.
	Transparency	The individual steps of the service process were designed clearly and transparently.
	Logic	The individual steps of the service process were structured in a logical sequence.
	Efficiency	The service process was efficiently designed so that my concern could be completed with little effort.
System	Appearance	The appearance of the service provider was appealing.
	Structure	The structures of the service provider were designed expediently.
	Policy	The regulations and rules of the service provider were expedient and helpful.
	Resource	The service provider had sufficient resources to fulfill its tasks.
	Security	Security was guaranteed by the service provider.
	Sustainability	The service provider acted sustainably and not temporary.
	Innovation	The service provider was innovative and progressive.

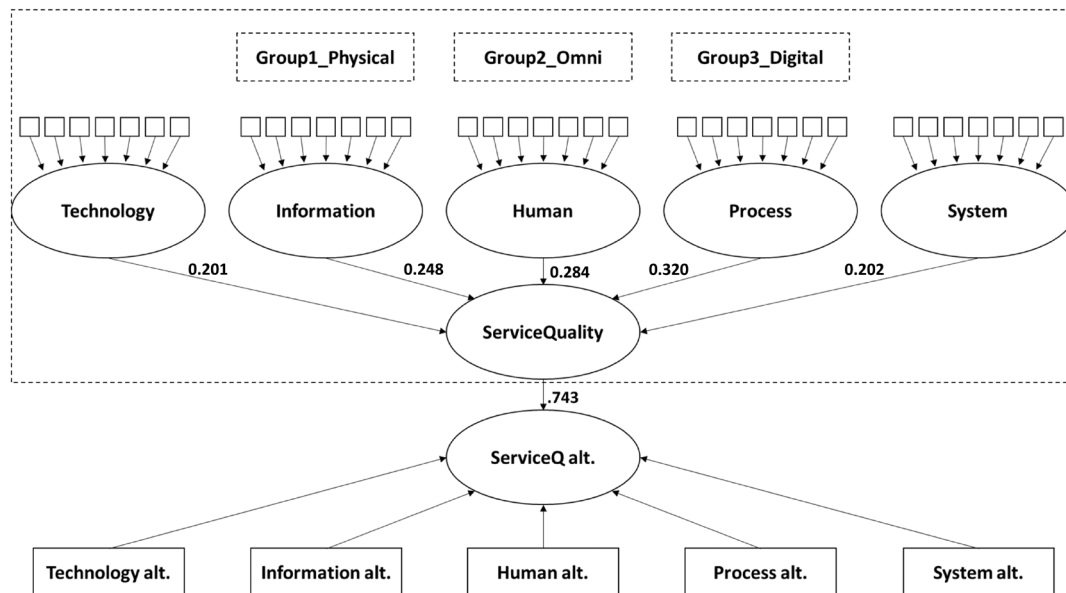


FIGURE 1 | Partial least square structural equation model.

TABLE 6 | Inner model assessment.

Factor	Weights	T	Alt.	VIF
Technology	0.201*	17.274*	0.605*	1.951
Information	0.248*	20.299*	0.538*	1.742
Human	0.284*	23.691*	0.681*	1.675
Process	0.320*	28.080*	0.717*	2.414
System	0.202*	19.209*	0.520*	2.210
ServiceQuality	—	33.452*	0.743*	—
C1 gender	0.000	0.401	—	—
C2 age	0.000	0.539	—	—

Note: SmartPLS Software V.4.0.9.3 was used for weights, *T* value, VIF, and alt.; mode A (correlation weights) was used in SmartPLS; percentile bootstrapping with 10,000 subsamples for *T* values; PLS-SEM algorithm was used for the variance inflation factor (VIF); C1 and C2 are control variables; “alt.” means alternative measure correlation (path strength to alternative measure).
**p* < 0.001.

6 | Discussion

This paper’s research question addressed the design of an instrument to assess quality in omnichannel services in the public sector. The results demonstrate that process quality has the highest overall impact on service quality. This result is in line with the previous research showing that process quality represents one main quality of public services (Rhee and Rha 2009). Based on the results of this paper, a service should be understood primarily as a process and giving process quality indicators a higher attention. This should be, especially, the case if service recipients feel uncertain about the service outcome prior to consumption because they share a tendency to use process quality as a heuristic substitute in their assessment (Hui et al. 2004). According to our results, efficiency of processes seems to have the highest influence on perceived service quality of the service recipients in our sample, showing

that efficiency is not only important from a NPM (Hood 1991) and a service organization perspective to ensure economy’s scarce resources are not being wasted (Ramírez-Hurtado and Contreras 2017). The resource-saving consideration and importance can also be transferred to the system quality factor, which includes systemic resources of the service provider, which are rated as most important by the service recipient. Here, a link between efficiency and the available resources of the system seems to be present and also perceivable by the service recipient, which may show a connection between a lack of resources on the part of the service provider and the service recipient’s raising of additional own resources. (e.g., time resources).

The indicator technology fit, which is inspired by Strong and Volkoff (2010), shows the highest relevance in the technology quality factor, which underlines the importance of the organization–technology fit from both sides, an internal customer perspective on technologies (employees needs to do their work) and external perceptions on provided service technologies (tailored to the needs of the service recipients). Information findability shows the highest relevance in the information quality factor, which underlines the importance of findability of administrative documents for citizens (e.g., through search functions in digital services or easier provision in physical appointments). Human effort shows the highest relevance in the human quality factor, which supports the view that effort is considered particularly important by the service recipient and confirms its importance in measuring service quality.

6.1 | Designing the Framework

The research question was addressed by the fact that quality factors and indicators were used for this framework, which can be applied in omnichannel services. The research process yielded 35 quality indicators sorted by weights classified under

TABLE 7 | Outer model assessment.

Factor	Indicator	Weights	T	VIF
Technology	Fit	0.272*	16.312*	2.032
	Quickness	0.232*	18.769*	2.062
	Adaptability	0.231*	16.312*	1.771
	Accessibility	0.200*	13.726*	1.538
	Navigability	0.195*	13.883*	1.765
	Sovereignty	0.156*	8.704*	1.276
Information	Interactivity	0.148*	7.689*	1.191
	Findability	0.198*	20.194*	1.881
	Relevance	0.194*	21.139*	1.896
	Timeliness	0.193*	21.139*	2.199
	Completeness	0.190*	22.459*	2.292
	Intelligibility	0.187*	20.028*	2.416
	Accuracy	0.183*	21.404*	2.255
	Conciseness	0.177*	18.505*	2.174
Human	Effort	0.194*	28.907*	4.180
	Diligence	0.189*	24.497*	3.619
	Expertise	0.183*	21.354*	2.629
	Appropriateness	0.176*	20.457*	2.235
	Empathy	0.175*	19.069*	1.944
	Transmission	0.175*	22.079*	2.394
	Attainable	0.158*	13.966*	1.383
Process	Efficiency	0.201*	32.373*	3.085
	Order	0.198*	33.287*	2.904
	Communication	0.190*	29.443*	2.093
	Logic	0.189*	29.370*	2.210
	Transparency	0.187*	30.531*	2.330
	Immediacy	0.165*	26.512*	2.071
	Reliability	0.127*	13.838*	1.598
System	Resource	0.259*	15.649*	1.394
	Policy	0.254*	18.035*	1.692
	Structure	0.239*	17.482*	1.718
	Innovation	0.232*	18.807*	1.694
	Sustainability	0.182*	10.787*	1.507
	Security	0.171*	9.940*	1.226
	Appearance	0.164*	9.419*	1.308

Note: SmartPLS Software V.4.0.9.3 was used for weights, *T* value and VIF; mode A (correlation weights) was used in SmartPLS; percentile bootstrapping with 10,000 subsamples for *T* values; PLS-SEM algorithm was used for the variance inflation factor (VIF); indicator is ordered by weight per quality factor.

**p* < 0.001.

five quality factors: technology, information, human, process, and system. Indicators with low weights are related to the outer border, while indicators with higher weights tend towards the

inner border (Figure 2). This circular-centric arrangement thus illustrates the importance of the individual quality indicators in relation to overall service quality.

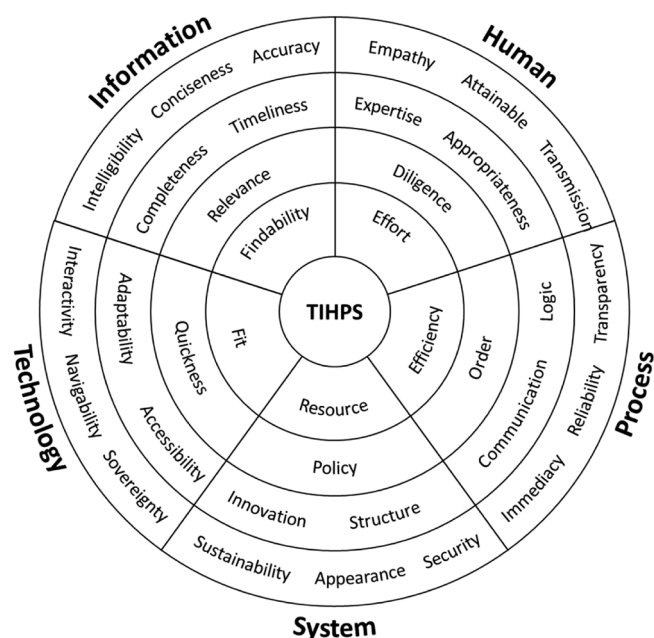


FIGURE 2 | The TIHPS framework.

6.2 | Implications for Theory

Our research fills a gap that emerged in the literature concerning public sector omnichannel service quality assessments. In the organization-related service sector the factors technology, information, human, process, and system were used with partly different designations in different scientific publications as relevant categories that determine the success or failure of services, whereby also near neighboring areas were taken into account (e.g., benchmarking). These factors are sufficiently generic to cover different types of service channels across the public sector. The quality factors can be clearly separated according to EFA, show no multicollinearity and have significant path strengths, therefore, all factors have their own justification when assessing service quality. Thus, one theory-related implication that can be drawn is that each of the factors has its own unique validity and should be taken into account in further theory building. The importance of process quality in terms of perceived service quality, which was also recognized by previous studies (Hui et al. 2004; Rhee and Rha 2009; Victor Chen et al. 2013), can be confirmed. The results are also in line with the efficiency principle of NPM (Hood 1991). Even the definition of omnichannel services, which are intended to enable a seamless experience across all integrated channels (Verhoef, Kannan, and Inman 2015), are reflected in the research results, as the seamless experience is achieved in particular through process quality and is reflected through the high impact of the process quality in our study. The deliberately broad sample in our paper could further contribute to the generalizability of the paper's research results (Blair and Zinkhan 2006) and possibly have a lower sample bias, which could support the transferability of the results in different service channels across the public sector.

6.3 | Implications for Practice

Our research indicates the high relevance of process quality in terms of service quality, independently of the service channel.

In other words, processes, compared with the other four quality factors (technology, information, human, and system), seem to be the strongest lever for improving the service quality of public service organizations. Especially, the efficiency of processes could be achieved, according to NPM, by implementing explicit standards and measures NPM (Hood 1991), where TIHPS could represent one of these measures, making services in the public sector more customer-oriented (Kuhlmann 2010). Process mining could also be a useful approach to diagnose complaint handling service process problems, such as bottlenecks and deviations (Wu et al. 2019). Therefore, process mining could be one possible approach to increase process efficiency, but there also exist other approaches to improve service outcomes, for example, high performance work systems (Lee, Lee, and Kang 2012). High-performance work systems are an integrated system of human resources (HR) practices that is internally and externally consistent and includes selective staffing, self-managed teams, extensive training, open communication, and performance-compensation (Evans and Davis 2005). HR practices could also positively influence the human effort indicator, which has been identified as most important in our sample in the human quality factor. Therefore, the service staff should be trained to put enough effort into addressing the concern of the service recipient. Besides the training of the HR, in service delivery practice also enough resources itself must be present, which is confirmed by the high relevance of the system resource indicator. System quality shows a significant impact with regard to service quality, that is why the systemic quality of an organization must also be ensured to provide high service quality. This finding relates in particular to the resources available (system resources). An effective lever is the human quality factor—here, in particular, referring to the effort that employees put into processing a service concern and that service employees work meticulous and diligent (human diligence). This could be achieved, for example, through high performance work systems as a human resource practice. When aiming to improve service quality in a public service organization the findability of information should receive high prioritization and also the fit of service technologies should be tailored to the needs of the service recipient.

6.4 | Limitations and Future Research

The study sample included 365 selected subjects. Even if this sample size appears sufficient for a very first validation of the framework and measurement scale, an increased sample size in different contexts is important in future research to ensure empirical validity. In addition, the participants were limited to a specific age group with a high level of education. Other values may possibly arise in other age groups with lower educational qualifications. The survey in our study was conducted using a German questionnaire. Further research and testing in different languages are needed in order to be able to speak of valid and transferable results in other languages. Moreover, other, even more specialized services (e.g., disability services, elderly care) may yield different results when employing our instrument. The sample contains a critical case selection (Flyvbjerg 2006; Walke, Winkler, and Le 2023) with critical incidents of service experiences (Flanagan 1954) in the public sector. Further investigations could follow in noncritical cases, also with experiences in the private or nonprofit sector, as the quality factors and

indicators could possibly be applied to these areas. It should also be noted that the literature assumes that measurement without considering the expectations of service recipients may measure expectations rather than actual quality (Deora et al. 2003). This issue is particularly addressed through our alternative measures in the validation, using single item measures with a disconfirmed expectancy approach. The results show a high correlation between the model results and the alternative measures. In selecting the factors and indicators, we primarily relied on the variables mentioned in the literature. There may be additional variables that could describe the phenomenon and be explored further.

This paper addressed the characteristics of service channel independency in the form of physical, digital, and omnichannel services. There may alternatively be other ways to go into service channel independency in more detail. The broad focus of our sample in different types of channels across the public sector could positively counteract sample bias (Blair and Zinkhan 2006) and in particular, the robustness check of our sample indicates the generalizability of our research results in terms of service channel independency. Further research could examine the specific characteristics of the difference between the service channels more closely, for example, with different measurement approaches. Future research should also focus on the internal perception of service and organizational quality, while the TIHPS framework could possibly also be suitable for evaluating internal quality perspectives.

7 | Conclusion

In this paper, we have developed and validated a framework and measurement scale to assess service recipients' perceptions of omnichannel service quality in the public sector. We also assessed the relevance of multiple quality factors and indicators regarding their impact on service quality. The key contribution of this paper is the TIHPS framework, which represents the first instrument targeting public sector omnichannel service quality assessments. Our study reveals the high relevance of process quality in terms of service quality. The TIHPS framework can be useful to organizations, governments, practitioners, and researchers interested in measuring the quality of services across the public sector independently of the service channel, in order to receive information about opportunities for potential quality improvements. The results of our study provide insightful guidance about quality-oriented service delivery, which can be used for further research as well as practical application.

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Ethics Statement

We hereby confirm that we have complied with the ethics guidelines (<https://authorservices.wiley.com/ethics-guidelines/index.html>).

Consent

The participants took part in our data collection on a voluntary basis.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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