The effects of innovation types and customer participation on organizational performance in complex services

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Abstract

Purpose – This study aims to explain the effects of different types of innovations on organizational performance in terms of firms' external effectiveness and internal efficiency. The study examines the interrelationship of technical and nontechnical innovations in complex services and the mediating effect of customer participation on the relationship between innovation type and organizational performance.

Design/methodology/approach – The study draws on a neo-Schumpeterian model for innovation to examine the complex service setting of healthcare provision. Data from Statistics Sweden, containing 38 hospitals and 242 primary care units in Sweden, provided the study's results.

Findings – The findings show the importance of combining different types of innovations in complex services, demonstrating a mediating effect of nontechnical innovation on both the relationship between technical innovations and external effectiveness and internal efficiency. Moreover, the results show that customer participation has a positive mediating effect for technical innovation and nontechnical innovation on external effectiveness. However, there is no such significant effect on internal efficiency.

Research limitations/implications – The findings are based on self-assessment data, which has inherent limitations. The innovation data used were cross-sectional, which may lack reliability (although self-assessed data counter this risk to some extent).

Practical implications – Managers should pursue both technical and nontechnical innovations for gains in external effectiveness and internal efficiency. However, complex services call for technical innovations to be accompanied by nontechnical innovations to support positive effects. The results cause a dilemma for managing customer participation in complex services. As the results show customer participation resulting in external effectiveness, they also fail to establish an effect on internal efficiency.

Originality/value – The primary contribution is to add to the knowledge of different types of innovation in complex services by demonstrating their interdependent effects on both external effectiveness and internal efficiency. Furthermore, the study tests and advances the mediating effect of customer participation in complex services on organizational performance.

Keywords Innovation, Healthcare, Complex services, Organizational performance, Customer participation

Paper type Research paper

Introduction

Unraveling the question of how innovations perform is vital in any context. However, services have long been overlooked in the literature on innovation. Services are major

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drivers of the global economy, and research has acknowledged service innovation as a field of its own, emphasizing the heterogeneity of service organizations regarding innovation and their performance (Voss *et al.*, 2016). Among the types of service organizations, complex services have received increasing research focus (Keeling *et al.*, 2021). Compared with general services, complex services offer a more dynamic landscape for customers, providing integration with the service structure (Andreassen and Lindestad, 1998; Yo and Lin, 2005). An example of a complex service is healthcare provision, wherein customers with diverse needs require coordinated efforts from several actors to deliver services (Djellal and Gallouj, 2005; Keeling *et al.*, 2021). Furthermore, in many healthcare sectors, as in the case of Swedish healthcare provision, public and private actors interact with interdependent primary, secondary and tertiary care service structures requiring integration (Keeling *et al.*, 2018). The service structure and the care provided are also heavily dependent on technology (Damanpour *et al.*, 2009; Teece *et al.*, 1997), resulting in a highly complex service setting. In this highly complex service setting, understanding the role of innovation and its impact on performance, particularly regarding customer participation (CP), is essential.

To date, healthcare provision faces fundamental challenges (Samuelsson, 2021). Aging populations suffer from multiple chronic illnesses that call for customized care. Driven by digitalization, many customers are also requesting new and improved services to access healthcare provisions and the integration of user data for customized services and self-care. Although new digital services and user-data integration offer great potential (Cuomo *et al.*, 2020), they pose challenges for healthcare providers regarding acceptability, responsibility, accessibility, financing and ethics in this complex service setting (WHO, 2021). Moreover, this highly complex setting has increased the cost of healthcare provision (Samuelsson, 2019). Thus, healthcare provision faces the dual problem of providing better integrated, customer-focused services and achieving cost savings. In other words, they must balance external effectiveness (EE) and internal efficiency (IE) (Djellal *et al.*, 2013; McColl-Kennedy *et al.*, 2017; Snyder *et al.*, 2019). This pursuit of multiple agendas crucially depends on innovation (Tushman and O'Reilly, 1996), which can be defined as the process of organizing healthcare provision, moving beyond parallel operations and integrating new technology, thus enhancing customers' co-creation of their healthcare (Anderson *et al.*, 2018; Keeling *et al.*, 2018; Patrício *et al.*, 2018).

The complexity of dealing with multiple goals, such as technology advancement and reorganization, necessitates theoretical frameworks capable of measuring diverse types of innovation and outcomes. One example is the neo-Schumpeterian framework, which distinguishes between technical innovations (TI) and nontechnical innovations (NTI) and can measure their outcomes (Drejer, 2004; Hipp and Grupp, 2005; Gallouj, 1997; Windrum and Garcia-Goni, 2008). The dynamic role played by customers in complex services (Andreassen and Lindestad, 1998; Yu and Lin, 2005) calls for the use of methods such as CP in innovation activities to create new and improved services. Particularly interesting in healthcare provision, where customers can provide unique insights about the entire service process (Berry and Bendapudi, 2007), however having different levels of engagement, preferences, possibilities and capabilities when integrating resources into the service process (McColl-Kennedy *et al.*, 2015; Keeling *et al.*, 2019).

Previous studies have shown that customers play a dynamic role in complex services (Andreassen and Lindestad, 1998; Yu and Lin, 2005) and that technical and NTI are interrelated in complex services, in which sequential adoption and implementation foster organizational performance (Damanpour *et al.*, 2009; Lee *et al.*, 2019; Barras, 1986, 1990). However, this study aims to fill the gap in the literature by demonstrating the impact of CP and different types of innovation on organizational performance in terms of IE and EE.

Despite progress in understanding innovation in complex services, no research has demonstrated the impact of CP on organizational performance or the effects of different types of innovation on organizational performance in terms of IE and EE. Therefore, the current study draws upon a neo-Schumpeterian framework with a sample from Swedish healthcare provision to explain the effects of TI and NTI on organizational performance in terms of EE and IE. Specifically, the study examines the interrelationship of TI and NTI in complex services and the mediating effect of CP on the relationship between innovation type and organizational performance.

The current research contributes to the literature on innovation in complex services and organizational performance in three significant ways. First, the study responds to calls for further research on various types of innovation and their effects in complex service settings (Ostrom *et al.*, 2015; Voss *et al.*, 2016; Gustafsson *et al.*, 2020). The study supports previous research, confirming the positive effect of TI and NTI on organizational performance, but further unravels that TI only partially affects IE. Second, the present study contributes to research on innovation mechanisms and their outcomes in complex services by assessing the sequential introduction of different types of innovation on organizational performance, demonstrating that TI accompanied by NTI further affects organizational performance. Third, the study also contributes by articulating the role of CP in organizational performance in complex services. It confirms that CP leads to enhanced value creation for customers but also fails to establish an effect of CP on IE, suggesting that CP is more ambiguous than has been suggested in past studies on complex services.

The remainder of the paper is organized as follows. The literature review presents an overview of past research on innovation types and performance in complex services and provides the hypotheses. The context, data collection and sample, measures and analysis are presented in the methods section. The next section discusses the study's results, and the final section presents the implications and contributions.

Literature review

Applying a neo-Schumpeterian model of innovation to a complex service

The literature on innovation in services is based on several perspectives, each emphasizing different aspects of innovation (for a review, see Witell *et al.*, 2016). Much of the research has focused on the process of new service development or service design, overlooking the outcomes and effects of innovation in services (Gustafsson *et al.*, 2020). In addition to investigating the different aspects of innovation, the research has also looked at specific service contexts (Voss *et al.*, 2016). One specific service context is complex services. Service complexity is usually conceptualized in terms of a dynamic structure of multiple interconnected processes that influence later events (Benedettini and Neely, 2012). However, the research in this area has presented several factors that are exclusive to complex services. Here, the role of technology has been addressed, whereas in complex services, technology has swiftly changed this area and become crucial for service delivery (Damanpour *et al.*, 2009; Teece *et al.*, 1997). Yu and Lin (2005) list three other main factors that determine complex services: the sheer number of individual services that complex service organizations arrange, the dynamics of the customers regarding their needs and knowledge of the service process (see also Andreassen and Lindestad, 1998) and the fact that complex services differ in their multiple ways of integrating components into the service process, as presented in Table 1.

In terms of innovation, healthcare has been characterized as a particularly complex service context (Berry and Bendapudi, 2007; Djellal and Gallouj, 2005). The literature addresses three general factors contributing to the complexity of innovation in healthcare provision. First, although healthcare has long depended on medical advances, it increasingly relies on developments in IT and other technologies (Djellal and Gallouj, 2005; Thakur *et al.*, 2012). Second, because healthcare customers are ill, there is a risk that innovation may contribute to distress, resulting in customers being unengaged in, e.g. digital service provision, endangering cocreation practices (Berry and Bendapudi, 2007; Keeling *et al.*, 2019). Therefore, healthcare organizations are reluctant to develop or implement any change or innovation that has not been scientifically proven, hence indicating a risk-averse agenda (Osborne and Brown, 2011; Brown and Osborne, 2013). Third, in what is partially a public context, the market situation is ambiguous, with multiple agendas for innovation (Gallouj and Zanfei, 2013). For this reason, healthcare and other complex services need a model of innovation that delivers formally accountable outcomes and that can encompass risk aversion and multiple perspectives on outcomes and the impact of technology.

The ensuing neo-Schumpeterian framework for service innovation acknowledges the tacit and idiosyncratic influence of technology on services (Gallouj, 1997), here referring to both technical product components and employee skills and knowledge. In a further modification of this model, services are seen as exploiting technological potential to provide customer value (Gallouj, 1997). The advantage of applying this neo-Schumpeterian framework to innovation in complex services is that it formalizes innovation as the outcome of a process that can be classified in terms of its technological and service characteristics (Gallouj and Weinstein, 1997), enabling innovation to be operationalized and measured (Drejer, 2004). For this reason, a neo-Schumpeterian model of innovation is well suited for complex services such as healthcare. The neo-Schumpeterian model commonly distinguishes between TI (or technological) and NTI (also referred to as administrative, management, organizational or people-enabled innovations) (Kimberly and Evanisko, 1981; Lam, 2005; Birkinshaw *et al.*, 2008; Damanpour *et al.*, 2009; Dotzel *et al.*, 2013; Camisón and Villar-López, 2014). In general, TI refers to using technologies to develop new products, services or processes that relate directly to an organization's work activities (Gopalakrishnan and Damanpour, 1997), while NTI refers to the new organizational elements and marketing of new services (OECD, 2005).

The Oslo manual

The Oslo Manual is a widely recognized framework for measuring innovation based on the neo-Schumpeterian model. However, it has been heavily criticized for subordinating services to the manufacturing sector by emphasizing technological advantages and products rather

Table 1.
Complex vs. conventional services

Type of service	No. of atomic services	Dependency and rate of technology change	The interconnectedness of service processes	Customer dynamics	Possibilities for integrating resources and components to the service process	Service structure (for supply chain and service network)
Complex services	Multiple	Strong/swift	High	High	Multiple	Dynamic
Conventional services	Few	Moderate/ slow	Low	Low	Few	Stable

Sources: Adapted and synthesized by the author from the following: Teece *et al.* (1997), Andreassen and Lindestad (1998); Yu and Lin (2005), Damanpour *et al.* (2009); Benedettini and Neely (2012) than services (Djellal and Gallouj, 2000). This critique targets the construct definitions of different types of service innovation, most notably their lack of specification, which weakens the internal validity of such studies. These criticisms have triggered several revisions of the manual that have sought to better accommodate services by strengthening the emphasis on NTI and public services (OECD, 2005; Bloch and Bugge, 2013).

The manual distinguishes between TI and NTI and identifies two types of each case (OECD, 2005). Technological innovations include product and process innovations. Product innovation involves the introduction of a new or significantly improved good or service with respect to its characteristics or intended uses, including significant improvements in technical specifications, components and materials (OECD, 2005). Process innovation involves implementing a new or significantly improved production or delivery method, including significant changes in techniques, equipment and software (OECD, 2005). These new production and delivery methods reconfigure internal and external organizational processes and integrate new elements of technology or administrative knowledge into an organization's delivery of services to customers (Damanpour *et al.*, 2009; Piening and Salge, 2015). In service contexts, separating product and process innovation can be difficult because a new "service product" often incorporates one or more new processes (Weitlaner and Kohlbacher, 2015). It follows that product innovations in services and process innovations are interrelated because the introduction or improvement of one inevitably leads to the other (Fritsch and Meschede, 2001; Damanpour *et al.*, 2019). Both product and process innovations are regarded as technological innovations because they utilize new knowledge or technology; they also tend to have the same determinants, indicating that they are complementary instead of distinct or separate (Damanpour and Aravind, 2006).

NTI includes organizational and marketing innovation (OECD, 2005). Organizational innovation involves implementing new organizational methods in the firm's business practices, workplace organization or external relations, including new routines and procedures, best practices and management systems (OECD, 2005; Camisón and Villar-López, 2014). The conceptualization of organizational innovation involves extending the focus beyond the organization. In healthcare settings, which are partly public, resources for service innovation are scarce (Djellal *et al.*, 2013), and external actors are often the most valuable resources in this regard (Håkansson and Snehota, 2006). Marketing innovation involves implementing a new marketing method involving significant changes in product, design or packaging, product placement, product promotion or pricing (OECD, 2005). However, in the present study, marketing innovation relates to communication innovation involving new or significantly improved ways of communicating internally or externally that deviate from an organization's existing methods (Bloch and Bugge, 2013). The relevance of communication innovation is that all organizations, either private or public, must promote the services to their customers.

In conclusion, the Oslo Manual provides a framework for measuring innovation that distinguishes between technological and non-technological innovations and identifies two types for each case. Although it has been criticized for emphasizing technological advantages and products over services, the manual has been revised to better accommodate services and public services (Bloch and Bugge, 2013). Furthermore, the manual's clear conceptualizations and classifications help researchers and practitioners better understand and measure innovation in diverse contexts, such as complex services, as shown by previous seminal innovation research (Camisón and Villar-López, 2014).

Innovation types and performance in complex services

The literature on innovation in complex services has historically focused on the ability to adopt technologies from the manufacturing sector (Djellal and Gallouj, 2005). Although it has been argued that innovation research is biased toward manufacturing (Ostrom *et al.*, 2010), a growing stream of research now also encompasses complex service firms (see Table 2). Much of the previous research on innovation and performance in complex services uses the Oslo Manual to assess innovation types or bundles of innovation types and their effects on organizational performance. Previous research has targeted all four types of innovation described in the Oslo Manual, both alone and in different combinations (see Table 2). The present study adopts the latter approach to explore two types of innovation – technical and nontechnical – for three reasons. First, as previously mentioned, it is difficult to separate process and product innovations in the service sector, and combining the two reduces the risk of confusion. Second, in exploring all four types of innovation, combining them broadens the basis for comparison with studies that use all four types and those that explore combinations of the four types. Third, previous research has also shown that TI and NTI are interdependent and that TI fosters NTI (Barras, 1986, 1990).

Previous research has typically measured the effects of innovation as organizational performance, here operationalized in financial terms (see Table 2). However, objective financial measurement is problematic in this context, partly because of delays in adoption and potential gains (Barras, 1986, 1990). For example, adopting an innovation can result in major costs for organizations, here with no short-term profit or gain. Additionally, intertwining different types of innovation creates complexity, making objective measurement of their respective contributions problematic at least and at worst impossible. However, the subjective performance measures used in the current study align with existing complex service research (see Table 2), and some authors (Lee *et al.*, 2019) have argued that this approach is better for the comprehensive assessment of innovation activities and outputs (see also Mairesse and Mohnen, 2010). Organizational performance has also been measured both externally and internally; for example, Damanpour *et al.* (2009) use external and internal indicators, and Liu (2016) distinguishes between the exploration and exploitation of innovations.

It has been argued that in healthcare and other complex services, the EE and IE of organizational performance should be measured separately (Osborne *et al.*, 2013; Tolf *et al.*, 2015). In a nutshell, efficiency refers to doing things right, and effectiveness is about doing the right things (Drucker, 1977). More specifically, IE is a measure of the organization's utilization of finite resources (input) to maximize the output –in other words, it is the lowest input required to deliver a specified output as customer value (Grönroos and Ojasalo, 2004; Vourinen *et al.*, 1998). In turn, EE relates to an organization's output in fulfilling service delivery goals for its users (Vourinen *et al.*, 1998; Osborne *et al.*, 2013). In complex service contexts, IE and EE together drive organizational performance, reflecting the need to understand and enhance service user value while minimizing expenditures and providing acceptable services at a low cost (Osborne *et al.*, 2013; Tolf *et al.*, 2015).

Scholars from diverse disciplines have long highlighted the challenge of pursuing efficiency and effectiveness simultaneously (or in similar terms, such as exploration vs. exploitation, flexibility vs. efficiency and revenue expansion vs. cost reduction) and how there is an inherent tradeoff between the concepts that results in goal incongruency and the need for an ambidextrous organization (Ghemawat and Ricart Costa, 1993; Tushman and O'Reilly, 1996; Adler *et al.*, 1999; Rust *et al.*, 2002). Organizational ambidexterity is often conceptualized as the ability to pursue different types of innovation simultaneously (Tushman and O'Reilly, 1996). It follows that these dimensions of organizational performance must be separated to determine which types of innovation drive which types of effects. For three reasons, the present study addresses IE and EE as linked requirements. First, because the immediate purpose of innovation in complex services is to adjust internal and external functions to the dynamic demands of the environment (Damanpour *et al.*, 2009)

Table 2. Overview of research linking innovation types and organizational performance in complex services

Author	Aim	Innovation operationalization	Effect operationalization	Data and analysis	Main contribution
Yunis *et al.* (2018)	To develop and test a framework for exploring the relationship between ICT adoption and use, corporate entrepreneurship and organizational performance	Innovation treated as a higher-order multidimensional construct by assessing two lower-level constructs: innovation atmosphere (6 items) and innovation opportunities (5 items)	Organizational performance; measured on a 7-item scale inviting respondents to assess the organization's performance in relation to competitors	374 organizations (service and other); PLS-SEM multi-group analysis	The results support the study's thesis that ICT adoption and innovation enhance organizational performance and that the effect is in part mediated by corporate entrepreneurship
Lee *et al.* (2019)	To investigate synergy effects of product, process, marketing and organizational innovation in relation to innovativeness levels and industrial categories	Types of product, process and organizational and marketing innovation	Firm performance; measured as turnover caused by innovations	856 high- and low-tech firms from the Korean Innovation Survey (KIS) 2014; SEM – path analysis	The study confirms the synergy effect and how it can change according to innovativeness level and industrial category
Liu (2016)	To explore the relationship between interaction orientation and service innovation	Explorative and exploitative service innovation	Organizational performance; measured as explorative and exploitative service innovation (The study does not assess the effects of service innovation but treats service innovation as organizational performance.)	152 service providing electronics manufacturing firms; PLS-SEM analysis	The study clarifies the links between an organization's strategic orientation and the development of organizational capabilities that result in service innovation
Piening and Salge (2015)	To investigate the antecedents, contingencies and performance consequences of interfirm	Two dimensions of process Innovation: propensity and effectiveness	Financial performance; measured as profit margin	German manufacturing and service firms; two-step regression procedure	The study provides new insights into the configuration of process innovation capabilities, enabling firms to increase

(*continued*)

Author	Aim	Innovation operationalization	Effect operationalization	Data and analysis	Main contribution
	differences in successful process innovation				the likelihood of process innovation activity and associated profit margins
Ngo and O'Cass (2013)	To explore the relationship between service innovation, customer participation and service quality	Two types of organizational innovation capability: technical and non-technical	Firm performance; measured as relative success in the marketplace on a range of financial and non-financial performance indicators	155 Australian service firms; PLS analysis	The study demonstrates that innovation capabilities affect service quality, and that the effect is mediated by customer participation
Damanpour *et al.* (2009)	To investigate the consequences of three types of innovation in the service sector and whether the impact of innovation on organizational performance depends on the configuration of innovation types over time	Three types of innovation: service, technological process and administrative process	Organizational performance; measured as core service performance (CSP), largely based on archival performance indicators, supplemented by inspection results and assessments of statutory plans	428 public service organizations in the UK; cross-organizational times series data, regression analysis	The study concludes that it is unwise to focus on a single type of innovation, that adopting the same set of innovation types may have no effect, and that diverging from industry norms may prove advantageous for organizational performance
(Cainelli *et al.*, 2004)	To empirically explore the relationship between innovation and economic performance, and in particular to assess whether innovation and level of resources spent on innovation can explain economic performance in the service sector	Uses of the community innovation survey, should entail the Oslo Manual definition of innovation. However, innovation is not operationalized but is measured as the absence/presence of innovation activity	Economic performance; measured by three indicators: average sales growth rate, average employee growth rate and average level of labor productivity	735 service firms; regression analysis	The results show that innovating firms outperform non-innovating firm in terms of both productivity and economic growth

Source: Research presented in the table were compiled and summarized by the author

Table 2.

rather than to maximize profits or gain competitive advantages, it may not be appropriate to measure outputs in these terms. Second, because complex services such as healthcare provision are partly in the public domain, traditional financial measures of profit or revenue are not valid; instead, it is necessary to assess whether optimal use is being made of the available resources to create as much value as possible for the service users. In this context, innovation encompasses internal organizational performance as efficiency and external organizational performance as value creation (Samuelsson *et al.*, 2019). Third, as previous research has indicated, IE and EE are interlinked, and there are potential tradeoffs between them. No organization can neglect either; however, no organization should pursue both of them simultaneously (Ghemawat and Ricart Costa, 1993; Rust *et al.*, 2002).

Table 2 summarizes the studies that relate closely to the present research. The literature shows that in complex service contexts, different types of innovation (both technical and nontechnical) affect organizational performance (Piening and Salge, 2015). Previous research has also shown that these different types of innovation are interrelated and produce synergistic effects (Damanpour *et al.*, 2009; Lee *et al.*, 2019). However, it remains unclear how different types of innovation interrelate or how they affect EE and IE. Although the case for CP has been well argued in previous studies (Sweeney *et al.*, 2018; Snyder *et al.*, 2019), the role of CP in innovation and performance in complex service contexts has generally been neglected (for a notable exception, see Ngo and O'Cass, 2013).

Hypothesis development

As demonstrated in earlier studies, TI (as product/process) enhances customer value by using new or novel technologies that differ from those employed in existing products or services (McNally *et al.*, 2010). TI, including process innovation, also plays an internal role. Barras (1986, 1990) concludes that TI in the services sector first targets employee productivity and then employee cutbacks. Here, process innovations facilitate organizational processes for the delivery of goods and services with the aim of increasing efficiency (Damanpour *et al.*, 2009). As Boer and During (2001) note, process innovations are commonly used to reduce delivery times, increase operational flexibility and reduce production costs.

H1a. TI positively affects EE.

H1b. TI positively affects IE.

NTI that involves new ways of communicating services affects customer perceptions and the effective use of services. According to Grönroos and Ojasalo (2004), enabling customers to use and integrate resources to cocreate services is vital for EE and IE. The organization's structure and interrelation of different processes also impact resource utilization in service settings, along with the service's value to individual customers (Mahmoud *et al.*, 2018). The ability to create and adopt innovations that reshape and restructure the organization can affect customer value cocreation in much the same way that NTI can enhance service quality, which also has external and internal dimensions (Ngo and O'Cass, 2013).

H2a. NTI positively affects EE.

H2b. NTI positively affects IE.

The mediating effect of nontechnical innovation

NTI is indirectly linked to an organization's work activities, hence encompassing managerial concerns such as organizational structure, administrative processes and human resources (Gopalakrishnan and Damanpour, 1997; Crossan and Apaydin, 2010). Because an organization's structure and resource management affect service utilization, these can be understood as NTI that can be used for improving IE. However, because complex services are commonly said to involve interrelated processes (Benedettini and Neely, 2012) across different organizational and technical areas, innovation in one area often depends on innovation in others (Djellal and Gallouj, 2005). Barras (1986, 1990) describes how TI in the healthcare sector and elsewhere aims to achieve cost reduction, in turn requiring major organizational restructuring and further innovation.

Other studies have noted the effects of interdependence (Amara *et al.*, 2009) and synergy (Piening and Salge, 2015; Damanpour *et al.*, 2009) across different types of service innovations. Innovation activities of various kinds will likely enhance organizational performance more than any single type of innovation. As for TIs, new service products that affect customer value also depend on having organizational structures that can harness and deploy those TIs (Mahmoud *et al.*, 2018). For this reason, TI in complex service settings must be coupled with NTI to achieve significant gains in organizational performance (Damanpour *et al.*, 2009). For example, the implementation of TI sometimes depends on restructuring operations (organizational innovation) and communication to support customer value creation processes. In this sense, TI partly depends on NTI in the same way that process innovations are vital for successful product innovation (Crossan and Apaydin, 2010; Keupp *et al.*, 2012; Damanpour *et al.*, 2009).

H3a. The positive relationship between TI and EE is partly mediated by nontechnological innovations.

H3b. The positive relationship between TI and IE is partly mediated by nontechnological innovations.

The mediating effect of customer participation

The literature on complex services has seen an increasing interest in the role of CP in developing and implementing innovations (Sweeney *et al.*, 2018; Snyder *et al.*, 2019; Wang *et al.*, 2022; Pai *et al.*, 2022). However, the conceptualization of CP in services has recently been debated, with studies pursuing several avenues, leading to a distortion of conceptual boundaries and conceptual confusion (Dong and Sivakumar, 2017). Much of the research studied CP in service processes as cocreators of value (see Vargo and Lusch, 2016), while others targeted customers' roles in innovation activities using the same term (Chang and Taylor, 2016). The current study refers to the latter: those innovational activities facilitated by organizations in which customers participate in innovation development (Dong and Sivakumar, 2017). However, CP should not be confused with customer-centric innovation. Even though it shares some fundamental ideas with firms drawing on customers' insights and needs to design and develop new products and services, it is described as an overarching business strategy implemented in distinct phases (Selden and MacMillan, 2006). In comparison, CP actively integrates customers (Dong and Sivakumar, 2017) at different phases of the innovation process to prompt ideation and development performance (Wang *et al.*, 2022), accelerate market acceptance (Chang and Taylor, 2016; Fang, 2008) and achieve product success (Gustafsson *et al.*, 2012). These activities are especially valid in services (Alam and Perry, 2002) and turbulent technological environments (Chang and Taylor, 2016), such as complex services.

Complex services have a unique opportunity to involve customers in their innovation activities because the latter are the only ones with complete insights into their value-creating processes (Berry and Bendapudi, 2007). Customers are remarkably well informed about their needs in relation to complex services and their interconnected processes (Keeling *et al.*, 2021), enabling them to contribute relevant novel insights. Moreover, by integrating customers into the innovation process, the service provider can learn about their competencies and resources, facilitating the intensification of resource integration and strengthening IE (Grönroos and Ojasalo, 2004). CP also contributes to new customized service offerings (Fuat Firat *et al.*, 1995). These are essential aspects of the dynamic nature of complex service customers (Andreassen and Lindestad, 1998; Yu and Lin, 2005) and can prompt EE. Indeed, CP has previously been known to mediate the effects of technical and NTI on important service outputs, such as service quality (Ngo and O'Cass, 2013). Thus, CP can be expected to positively affect EE and IE and should partly mediate the main effects of TI and NTI innovation on EE and IE, as depicted in Figure 1.

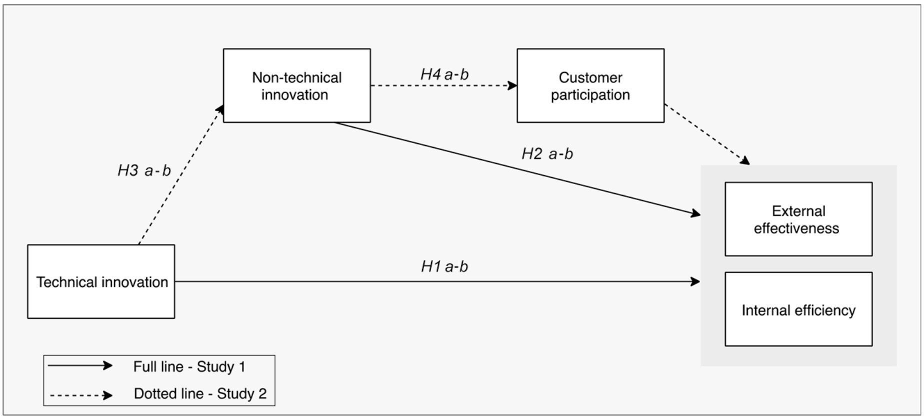
H4a. The positive relationship between technical and NTI and EE is partly mediated by CP.

H4b. The positive relationship between technical and NTI and IE is partly mediated by CP.

Research methodology

Contextual background

The empirical data for the current study were obtained from Statistics Sweden, the country's central agency for official statistics. The study was part of a four-year Swedish Government project to improve statistics on innovation in the public and private sectors. To acquire relevant policy knowledge, the survey was conducted in the context of Swedish healthcare provision, which serves the entire population and is mostly publicly funded, with about 10% of the country's resources invested in healthcare. The system is managed at the state, county



Source: Model developed and illustrated by the author based on reviews of relevant literature and theoretical frameworks

Figure 1. Visual representation of *H1–H4*. *H1a-b*: technical innovations affect external effectiveness and internal efficiency. *H2a-b*: non-technical innovations affect external effectiveness and internal efficiency. *H3a-b*: the effect of technical innovations on external effectiveness and internal efficiency is in part mediated by non-technical innovations

council and municipality levels, all of which are governed by democratically elected representatives.

Healthcare is provided through a complex service system that is comparable to a chain. The first link is the primary care unit, which is the foundation of the Swedish healthcare system. Providing basic medical treatment, nursing and proactive treatments, these units are also the first points of contact for those in need of more specialized hospital care. Every citizen is free to choose between different primary care units, many of which are run by private organizations (about 40%). Nevertheless, the vast majority are funded by county councils – both private and public units. Every publicly funded primary care unit must meet quality demands and is regarded as a separate unit, even though it might be part of a larger organization. County hospitals, which make up the second link in the chain, provide healthcare services to customers on a walk-in basis and by admission to the hospital. Regional hospitals, which comprise the third link, provide more specialized care for inpatients. Working at multiple levels with different actors across various sectors, these service processes are intertwined in complex ways and heavily depend on technology integration.

Data collection, sample and participant information

The current study utilized data from a survey developed in several steps by Statistics Sweden. In the first step, a pilot study (the MEPIN study), which is a modified study based on the Oslo Manual for Public Sector Organizations, was conducted in Nordic countries. One issue with the pilot study was the heterogeneity of public organizations, as the survey questions were deemed too general to suit healthcare organizations. Therefore, as a second step, the survey was modified with healthcare provision in mind. A working group consisting of several experts from academia, Swedish healthcare, Sweden's innovation agency and the Swedish Agency for Growth Policy Analysis collaborated with Statistics Sweden to make the necessary modifications. In the second step, Statistics Sweden conducted a secondary pilot study on the target group in healthcare provision after final modifications were made to the survey. These modifications included specifying the questions to be more relevant to healthcare organizations. Overall, the survey was aimed at assessing the organization's innovation activities, outputs and effects and contained five areas of questions:

(1) general information about the respondent;
(2) the occurrence of different types of innovation and their effects;
(3) support for innovation activities;
(4) driving forces and strategies for innovation; and
(5) the radicality of the innovations.

The third step was the main study utilized in this research, which employed a paper survey with the same questions. The survey was distributed through the mail to the responsible operation managers, who should be assigned to every healthcare unit by Swedish law, within all the targeted primary care units (>10 employees) and hospitals (>100 employees, both county and regional). The survey aimed to elicit a self-assessment of their respective organizations' innovation activities, outputs and effects. To obtain full coverage of all hospitals and primary care units, Statistics Sweden sent the survey to all organizations listed under the tax authorities' industry standard classification system of NACE codes (for international comparison of official statistics): 86,102 (hospitals) and 86,211 (primary care units). To maintain the homogeneity of the sample, some forms of organization were excluded (e.g. physical persons, simple companies, nonprofit associations and foreign legal persons) because these were deemed not to run comparable operations. In some cases, the operation managers handed the survey over to the person responsible for quality and development at the location because of the latter's better knowledge and insights into the innovation operations. The respondents were validated in the survey by filling in their positions at the hospital or primary care units and the number of years in that position. The survey was voluntary (this is not always the case for publicly governed healthcare units). However, different points of action, such as follow-up phone calls to operation managers, were taken by the county councils to increase the response rate.

To embrace the diversity of healthcare provision within primary care units, the present study focused on both public and private units. However, to avoid issues of within-sample heterogeneity, the inclusion criterion for primary care units was a staffing level of more than 10 (Spanos and Lioukas, 2001). This yielded a sample of 941 primary care units, of which 286 responded (about 30%). However, of these, 45 units were excluded because of incomplete or incorrect completion of the survey form, yielding a final sample of 241 primary care units and a sampling error of 15.7%. To validate the main effects and identify any potential contextual differences among the healthcare units, the current study also utilized a second data set from hospitals consisting of both secondary and tertiary care units. Among the 97 Swedish hospitals that were targeted (both county and regional hospitals), 46 responded (about 47%). Of these, eight were excluded for incomplete or incorrect completion of the survey, yielding a final sample of 38 and a sampling error of about 17%.

Measurement variables

TI (IV1) was operationalized as an additive index of the two variables, product innovation and process innovation. As a starting point, the survey used the Oslo Manual's definitions of product innovation and process innovation and then contextualized cases of the different types (see the Appendix for survey items). The individual indexes ranged from 0 to 5 (product innovation) and 0 to 8 (process innovation), yielding an additive index ranging from 0 to 13. NTI (IV1/M1) was operationalized as an additive index based on the two variables of organizational innovation and communicative innovation. The NTI index was created in the same way as for TI – here, as an additive index scale ranging from 0 to 15 because the scales for organizational and communicative innovation ranged from 0 to 7 and 0 to 8. To assess the effect of innovation on value creation for customers, the EE variable (DV1) was also generated as an additive index, constructing an ordinal scale ranging from 0 to 7. To assess the effect of innovation, the IE variable (DV2) was generated by an additive index, constructing an ordinal scale ranging from 0 to 3. The mediating variable CP (M2) was generated by an additive index, constructing an ordinal scale ranging from 0 to 2. This scale was used to assess whether the primary care unit involved patients/relatives in identifying problems and possible solutions and/or involved patients/relatives in testing and implementing innovations. The respondents could also respond that they did not know, which was treated as missing data and removed from the analysis (n = 38).

Control variables

To evaluate the main effects (TI/NTI → EE/IE), the current study controlled for disposable resources and established innovation structures. The control variables were measured on a dichotomous scale (yes/no); a third option (do not know) was treated as missing data (n = 39 for primary care units, n = 5 for hospitals). To control for the effect of established structures and active management of innovations (which might exert a positive effect on the innovation operation) and to prevent potential bias as a result of over-reporting the positive effects of innovation, the respondents were asked whether their healthcare organization had (1) specific targets for innovation activities and (2) a department or unit for innovation. Because employees have unique insights into customers' needs and the organization's operations, employees play an essential role in developing innovations. The study controlled for this by asking the respondents whether their organization had (3) a system for evaluating and developing employees' innovation ideas. Because it is also important for the organizations to be able to work systematically and have the necessary resources to develop, adopt and implement innovations, the present study also controlled for whether the organization had (4) a system for evaluating and deploying new medicines or treatments and (5) sufficient resources (time, money and competence) to develop innovations. Because innovation operations commonly occur between established organizational structures, the current study controlled for whether the organization had (6) assigned responsibility to specific individuals for taking innovations from idea to completion.

Among the primary care units, all but the second control variable (innovation department or unit) showed a significant relationship ($p > 0.005$) between TI and NTI and EE. Regarding the relationship between TI and NTI and IE, three of the control variables were significantly correlated (see Table 3 for a complete overview). Among the hospitals, none of the control variables showed a significant effect on either the IVs or DVs.

Reliability and construct validity

Because the items in the current study describe the constructs rather than vice versa, they are formative in nature (Petter *et al.*, 2007). Having formative variables makes the traditional methods for testing reliability, such as internal consistency and convergent/discriminant validity tests, not meaningful (Bollen and Diamantopoulos, 2017; Diamantopoulos and Winklhofer, 2001). The current study has followed the four essential aspects, as presented by Diamantopoulos and Winklhofer (2001), to control for reliability and construct validity when dealing with formative variables. First, as previously described, the current study departed from well-established constructs (the Oslo Manual and MEPIN study). Second, the study used a contextual review of healthcare professionals and academics to apprehend the contextual domain and find items capturing the variables' entire spectra. The final survey instruments were also subject to a pilot study, making sure the items were straightforward, easy to understand and would be able to predict validity (Bergkvist and Rossiter, 2007). Third, the study controlled for multicollinearity among the items (see Table 4), here showing no multicollinearity signs. The maximum variance inflation factor came to 2.696, far below the common cutoff value of 10 (Kleinbaum *et al.*, 1988). Fourth, by testing the study's main effects of the innovation variables against the control variables and the effect variables, significant positive correlations were shown, proving nomological validity among the variables (see Malhotra, 2004).

Common method bias

Several premeasures were taken to reduce the risk of common method bias (CMV), which is a general concern among self-reported data (Hulland *et al.*, 2018; Podsakoff *et al.*, 2012). Because survey instrument design can severely impact CMV (Hulland *et al.*, 2018), a study was conducted to test the survey design in other public contexts (the MEPIN study). The design was later adjusted with the help of academic and healthcare professionals in the healthcare context. Furthermore, a pilot study of the final survey instrument was undertaken to validate the items and overall design. The questionnaire also employed different response scales to diminish the risk of systematic under/over-reporting, combining Likert, ordinal and binary scales. For the same reason, all respondents were also anonymized. As previously reported, the study also successfully controlled for collinearity, which is a known CMV issue dealing with formative constructs (Kock, 2015).

Table 3. Correlation matrix (standardized variables)

	External effectiveness	Internal efficiency	Technical innovation	Non-technical innovation	Specific targets	Specific department	System for ideas	System for treatments	Sufficient resources	Specific persons
External effectiveness										
Pearson correlation	1									
Sig. (2-tailed)										
N	241									
Internal efficiency										
Pearson correlation	0.555**	1								
Sig. (2-tailed)	0.000									
N	241	241								
Technical innovation										
Pearson correlation	0.599**	0.438**	1							
Sig. (2-tailed)	0.000	0.000								
N	241	241	241							
Non-technical innovation										
Pearson correlation	0.644**	0.605**	0.720**	1						
Sig. (2-tailed)	0.000	0.000	0.000							
N	241	241	241	241						
Specific targets										
Pearson correlation	0.314**	0.274**	0.350**	0.383**	1					
Sig. (2-tailed)	0.000	0.000	0.000	0.000						
N	202	202	202	202	202					

(*continued*)

Table 3.

	External effectiveness	Internal efficiency	Technical innovation	Non-technical innovation	Specific targets	Specific department	System for ideas	System for treatments	Sufficient resources	Specific persons
Specific department										
Pearson correlation	0.095	0.099	0.163*	0.183**	0.187**	1				
Sig. (2-tailed)	0.183	0.164	0.021	0.009	0.008					
N	200	200	200	200	198	200				
System for ideas										
Pearson correlation	0.168*	0.121	0.173*	0.247**	0.243**	0.232**	1			
Sig. (2-tailed)	0.017	0.087	0.014	0.000	0.001	0.001				
N	202	202	202	202	197	196	202			
System for treatments										
Pearson correlation	0.327**	0.108	0.326***	0.292**	0.146*	0.167*	0.300**	1		
Sig. (2-tailed)	0.000	0.131	0.000	0.000	0.043	0.021	0.000			
N	199	199	199	199	193	192	196	199		
Enough resources										
Pearson correlation	0.254**	0.205**	0.347**	0.249**	0.146*	0.080	0.169*	0.048	1	
Sig. (2-tailed)	0.000	0.004	0.000	0.000	0.045	0.276	0.020	0.515		
N	193	193	193	193	188	189	190	187	193	
Specific persons										
Pearson correlation	0.352**	0.224**	0.390**	0.369**	0.349**	0.052	0.209**	0.076	0.477**	1
Sig. (2-tailed)	0.000	0.002	0.000	0.000	0.000	0.473	0.003	0.293	0.000	
N	197	197	197	197	195	194	195	192	187	197

Notes: $*p < 0.05$; $**p < 0.01$
Sources: Table developed by the author. The results presented were derived from a statistical analysis by the author of data provided by Statistics Sweden, using SPSS software (version 26)

Scale and items	Collinearity statistics (VIF)
Product innovation	
Medical treatments	1.383
Medical equipment or instruments	1.186
Non-medical equipment or instruments	1.559
Services used by patients or other citizens	1.275
Other services or products	1.428
Process innovation	
Treatment program or therapeutic strategy	1.341
Diagnostic methods	1.233
Guidelines for coordinating care of individual patients	1.632
Methods for involving patients/relatives in decision making	1.601
Methods for engaging patients in their own care	1.646
Methods for reducing waiting times	1.394
Service operations	1.441
Other methods for production of services and products	1.271
Organizational innovation	
Organization of operational responsibilities or decision making	1.269
Management control systems for improved efficiency and better results	1.461
Systems for collecting and treating knowledge and information	1.238
Education or training systems for staff and management	1.323
Measures for reducing the administrative burden on medical staff	1.224
Cooperation between municipality and county council	1.307
Other methods for organizing work	1.554
Communicative innovation	
Promotion of the organization and its services	1.341
Improving communication with patients/relatives	1.574
Involving patients/relatives in decision making	1.676
Promoting a healthier lifestyle among patients	1.351
Promoting communication between staff and non-Swedish-speaking patients	1.265
Promoting communication between municipality and county council	1.549
Promoting communication between employees	1.828
Other forms of promotion	1.675
External effectiveness	
Options for providing care to a broader patient group	1.457
Quicker and/or better patient recovery	2.299
More efficient treatment	2.186
Quicker treatment	2.073
Reduced suffering	2.458
Improved patient safety	2.131
Improved patient access to information	1.661
Improved self-determination for patients/relatives	2.696
Internal efficiency	
Reducing healthcare staffs administrative burden	1.264
Using resources more efficiently	1.419
Reducing costs	1.485
Customer participation	
Involving patients/relatives to identify problems and possible solutions	1.267
Involving patients/relatives in testing and introducing innovations	1.267
Acceptable (VIF < 10)	

Sources: Table developed by the author. The results presented were derived from a statistical analysis by the author of data provided by Statistics Sweden using SPSS software (version 26)

Table 4. Collinearity statistics (collinearity assessment approach)

Endogeneity issues

Several endogeneity issues can cause bias in marketing research (Zaefarian *et al.*, 2017; Hult *et al.*, 2018). The first and most common of these is the omission of variables, which was addressed here in two ways. First, the current study introduced a specified set of control variables (Bernerth and Aguinis, 2016) that have been known to substantially alleviate endogeneity (Papies *et al.*, 2017). However, because control variables may not deal with all such issues and add unwanted complexity to models (Hult *et al.*, 2018), subjective data were also used for the dependent variables. Although this is not a guaranteed solution, it can reduce the likelihood of omitting variables because the respondents make a causal connection between innovation and its effects. The rationale behind this is that it allows professionals to judge the effect of innovation alone compared with the multiple causes that emerge from objective measures of innovation, such as turnover or profit.

Another endogeneity-related issue is errors-in-variables, in which scale items are improperly adapted to the context (Zaefarian *et al.*, 2017). As previously mentioned, this has been an issue when using the Oslo Manual approach to measure innovation in services. Here, the issue has been addressed in three ways. First, the variables were adapted to the context by 1) merging product and process innovation, which are often intertwined in service contexts; 2) using the MEPIN guidelines for public services (Bloch and Bugge, 2013); and 3) grounding the survey design in a thorough investigation of a specific healthcare context for both types of innovation and potential effects (Zaefarian *et al.*, 2017). Simultaneous causality among the independent and dependent variables is another endogeneity issue (Zaefarian *et al.*, 2017), and subjective assessment of the dependent variables can again reduce this risk. The current study also followed Zaefarian *et al.*'s (2017) recommendations for reducing such risks by collecting a dual data set to validate the main effects.

Procedure and analytical approach

The present study used a two-step research design to empirically test the hypotheses (see Table 5 for an overview). First, a multiple regression analysis was conducted using SPSS software to test the first two hypotheses (*H1a-b* and *H2a-b*). The multiple regression test was performed on two separate data sets, one containing the data from hospitals and the other from primary care units. Second, two serial mediation analyses were made using the SPSS software and PROCESS macro (model 6, two mediators) to test the study's third and

	Analysis 1	Analysis 2
Purpose	To test the effect of technical and non-technical innovations on external effectiveness and internal efficiency	To test the mediating effect of non-technical innovation and customer participation in technical innovations on external effectiveness and internal efficiency
Method	Survey	Survey
Data and context	Two data sets: hospitals < 100 employees and primary care units > 10 employees	One data set: primary care units > 10 employees
Analysis	Multiple regression analysis	Serial mediation analysis
Hypotheses	*H1a-b, H2a-b*	*H3a-b, H4a-b*
Sample size (n)	38*, 202**	241**

Notes: *Hospitals; **primary care units
Sources: Developed by the author. Statistics Sweden provides the data presented

Table 5.
Overview of analysis 1 and 2

fourth hypotheses (*H3a-b* and *H4a-b*). Serial mediations were performed on one data set containing the primary care units.

There are two reasons for this stepwise analysis approach. The first reason is to validate the main effects of the different types of innovations on organizational performance in different healthcare provision settings (primary and secondary/tertiary care in hospitals), as found in previous research (Damanpour *et al.*, 2009). Second, the two serial mediation analyses make it possible to test a more complex relationship of a process of variables, the sequential implementation of service innovations and CP, to different organizational performance outcomes, one by one, in a robust and parsimonious way.

Analyses and results: serial mediation

The main effects of technical and nontechnical innovation on external effectiveness and internal efficiency (multiple regression results)

To test *H1a-b* and *H2a-b*, two multiple regression analyses were used to determine whether the independent variables TI (IV1) and NTI (IV2) had a direct positive effect on the dependent variables EE (DV1) and IE (DV2). The results indicated a significant effect of both technical and NTI on EE and IE for hospitals; model 1 explained 55% of the variance in EE [F(2.35) = 10.654, $p < 0.001$, adj. $R^2 = 0.552$, VIF < 3], and model 2 explained 28% of the variance in IE [F(2.35) = 5.985, $p < 0.005$, adj. $R^2 = 0.285$, VIF < 3] (see Table 3 for more information).

For the primary care units, the results of the multiple regression models (including control variables) were not significant in all cases. For model 1, TI and NTI and EE showed a significant relationship [F(7.172) = 22.915, $p < 0.001$, adj. $R^2 = 0.461$, VIF < 3]; both IVs had a significant effect on EE (DV1), TI (IV1) ($\beta = 0.124$, $p < 0.005$) and NTI (IV2) ($\beta = 0.199$, $p < 0.001$). The results for model 2 were only partially significant; NTI (IV2) had a significant effect on IE ($\beta = 0.143$, $p < 0.001$), but TI (IV1) had no significant effect on IE ($\beta = -0.004$, $p < 0.900$) (DV2) [F(5.179) = 20.847, $p < 0.001$, adj. $R^2 = 0.350$, VIF < 3].

To summarize, the results from the multiple regression analysis confirmed *H1a* (TI positively affects EE), *H2a* (NTI positively affects EE) and *H2b* (NTI positively affects IE). However, *H1b* (TI positively affects IE) was rejected.

Mediation effects of nontechnical innovation and customer participation (serial mediation results)

In relation to *H3a-b* and *H4a-b*, the two serial mediation models tested whether the positive relationship of TI (IV) on EE (DV1)/IE (DV2) was mediated by NTI (M1) and CP (M2). In model 1, the output variable was EE, the predictor was TI (IV), NTI was the first mediator (M1) and CP was the second mediator (M2). The total effect of TI on EE was significant and positive ($\beta = 0.307$, $t = 9.512$, $p < 0.001$), confirming that TI had a positive effect on EE, validating the results of the multiple regression analysis and *H1a*. The effect of TI on NTI was also positive and significant ($\beta = 0.699$, $t = 13.434$, $p < 0.001$). NTI also had a significant positive effect on CP ($\beta = 0.133$, $t = 2.654$, $p = 0.0250$). Both NTI ($\beta = 0.214$ $t = 5.310$, $p < 0.001$) and CP ($\beta = 0.184$, $t = 3.298$, $p = 0.001$) had a positive effect on EE, as depicted in Figure 2. When including the declined mediators ($\beta = 0.120$ $t = 2.946$, $p = 0.004$), the effect of TI on EE verified a mediating effect, hence confirming *H3a* and *H4a*.

In model 2, the output variable was IE, and the predictor was TI. The first mediator was NTI, and the second mediator was CP. The total effect of TI on IE was significant and positive ($\beta = 0.224$ $t = 6.025$, $p < 0.001$), confirming that TI alone had a positive effect on IE, contradicting the results of the multiple regression in Study 1. However, in the total effect model, TI had a nonsignificant negative effect on IE ($\beta = -0.010$, $t = -0.225$, $p = 0.822$), here

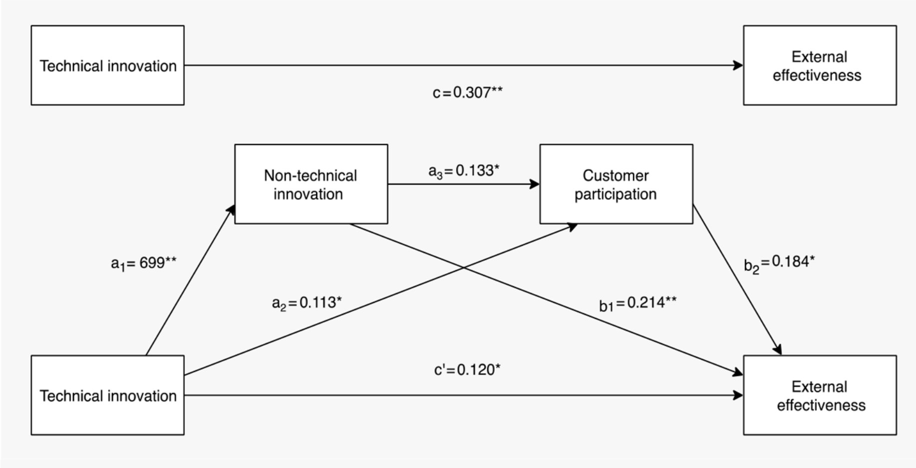


Figure 2.
Results of serial mediation model 1: technical innovation → non-technical innovation → customer participation → external effectiveness

Sources: Model developed and illustrated by the author. The results presented were derived from a statistical analysis by the author of data provided by Statistics Sweden using SPSS software (version 26) and the PROCESS macro (version 4)

when combined with the effect of the mediating variables. These results validated the findings from the multiple regression analysis, rejecting *H1b* (that TI positively affects IE) as depicted in Figure 3. As in the previous model, the effect of TI on NTI was positive and significant ($\beta = 0.699$, $t = 13.434$, $p < 0.001$), as was the effect of NTI on CP ($\beta = 0.133$, $t = 2.654$, $p = 0.009$). The effect of NTI on IE was positive and significant ($\beta = 0.337$, $t = 7.404$,

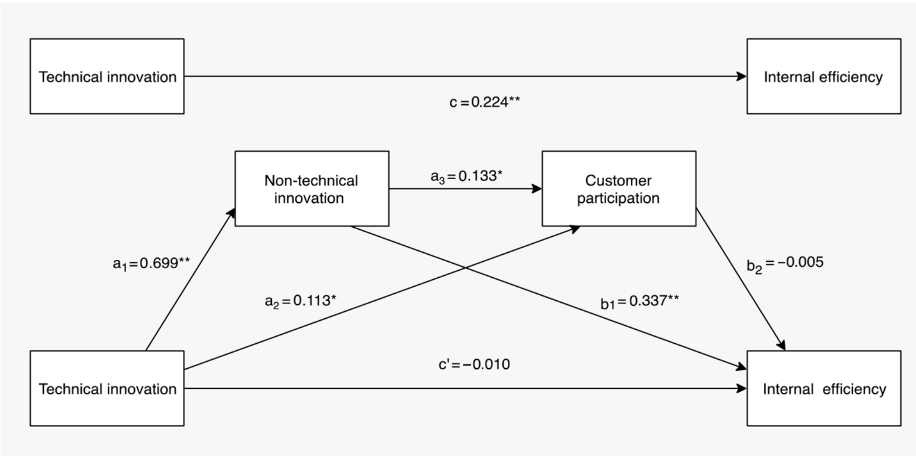


Figure 3.
Results of serial mediation model 2: technical innovation → non-technical innovation → customer participation → internal efficiency

Sources: Model developed and illustrated by the author. The results presented were derived from a statistical analysis by the author of data provided by Statistics Sweden, using SPSS software (version 26) and the PROCESS macro (version 4)

$p < 0.001$), confirming *H3b*. However, the effect of CP on IE was negative and nonsignificant ($\beta = -0.005$, $t = -0.082$, $p = 0.935$), thus rejecting *H4b*; see Table 6 for an overview of the mediation results.

Discussion

The current study set out to explain the relationships between different types of innovation, CP and their effects on organizational performance in complex services. Based on the four analyses and a sample of 38 hospitals and 241 primary care units, the findings demonstrate a more complex relationship between TI and NTI and organizational performance than is previously known, thus offering insights into not only the outcomes of innovation in complex services but also the mechanisms driving it. Furthermore, the findings offer a more refined view of the outcomes of CP in complex service innovation activities.

Theoretical implications

The present research makes three main contributions. First, this study answers the call for more innovation research in complex service contexts (Voss *et al.*, 2016), advancing the knowledge of innovation effects (Gustafsson *et al.*, 2020). The findings support the idea that TI has a positive effect on EE. High-level usage and rapid changes in technology can explain this finding in complex services (Djellal and Gallouj, 2005; Thakur *et al.*, 2012) because meeting new customer needs and enhancing customer value require TI. For example, customized diabetes care can be achieved by integrating customer device data into the service process. Unsurprisingly, the findings also support that NTI positively affects both EE and IE. Organizational structures and the interrelation of complex service processes impact resource utilization and customer value (Mahmoud *et al.*, 2018). However, the results of the current study show that TI only has a partial effect on IE, which can be explained by the disparities in complex service customers' technology adaptation (Keeling *et al.*, 2019). If not all customers are willing to adopt new services, these services will be added on top of old ones, diminishing potential efficiency gains.

Second, the current study reveals a more complex relationship between TI and IE by showing that this effect is fully mediated by NTI. This extends and revises existing knowledge by demonstrating the substantive effect of TI on cost savings in terms of reduced delivery time, increased operational flexibility and reduced production costs (Boer and During, 2001; Damanpour *et al.*, 2009). The study interprets this result in the context of healthcare provision as a complex service in which service processes are highly embedded in other processes (Benedettini and Neely, 2012). For this reason, TI, such as digital primary care units, do not

Hypothesis	*H3a*	*H3b*	*H4a*	*H4b*
Path	Technical innovation → non-technical innovation → external effectiveness	Technical innovation → non-technical innovation → internal efficiency	Technical innovation → non-technical innovation → customer participation→ external effectiveness	Technical innovation → non-technical innovation → customer participation → internal efficiency
Beta	0.214**	0.337**	0.184*	−0.005
Outcome	*Confirmed*	*Confirmed*	*Confirmed*	*Discharged*

Sources: Table developed by the author. The results presented were derived from a statistical analysis by the author of data provided by Statistics Sweden using SPSS software (version 26) and the PROCESS macro (version 4)

Table 6. Results of the serial mediation study: hypothesis, path, beta and outcome

necessarily directly increase IE; instead, they trigger organizational restructuring, in turn affecting IE (see also Barras, 1986, 1990). As Grönroos and Ojasalo (2004) point out, NTI in the form of new ways of communication also enables customers to use new services vital for cocreation and resource integration. Enabling cocreation is likely to be important in complex contexts such as healthcare, which is challenging for customers to navigate. Customers are also ill in the healthcare context, so they may be reluctant to cocreate (Keeling *et al.*, 2019; McColl-Kennedy *et al.*, 2015). It follows that NTI, such as new ways of communicating the use of new services, should follow TI, leading to internal efficiencies and cost savings. The findings also support previous suggestions that technical and nontechnical service innovations have synergistic effects when introduced sequentially (Barras, 1986, 1990; Damanpour *et al.*, 2009). Indeed, the findings from the present study confirm that TI has a direct effect on EE but that the effect is in part mediated by NTI. This means that when TI is followed by NTI, the effect on EE increases. As Barras (1986, 1990) notes, introducing new technology drives a more radical shift in organizational structures (i.e. NTI), which creates more significant effects on EE. A parallel can be drawn here with the distinction between digitalization and digitization, in which the latter refers to a straight-forward process of converting analog service elements to digital ones, while the former refers to a more fundamental shift in value creation using digital technology – resulting in a completely new service (Brennen and Kreiss, 2016).

Third, the findings also further articulate the mediating effect of CP on organizational performance in complex service settings, especially given the significant effects of both TI and NTI on EE. In other words, CP leads to enhanced value creation for customers, hence confirming the mediating effect. This result is not surprising because the customers of complex services that involve multiple actors are the only ones involved in the entire process (Berry and Bendapudi, 2007) and should provide valuable insights into how their needs can best be served. Also, the turbulent dynamics around technology in complex services have been shown to affect CP outcomes positively (Chang and Taylor, 2016). However, contrary to common belief and Ngo and O'Cass (2013) results, this effect does not affect IE. The surprising results can derive from customers favoring their own needs in the service processes over IE. However, the results can further be explained by recent studies in complex services suggesting that customers are well informed regarding their needs for interconnectedness in the service providers' processes (Keeling *et al.*, 2021). Customers with a high degree of user experience and awareness of contextual restrictions tend to be drawn less toward radical innovations (Kristensson and Magnusson, 2010), implying that CP has a less impactful on, for example, organizational restructuring. However, because many incremental innovations yield a high impact on organizational performance over time (Bolton *et al.*, 2014), CP might still be a valuable contribution to IE; however, this is not reflected in the observable results.

Managerial implications

Several managerial implications can be drawn from the current study. As previously mentioned, the results show that innovations in complex services have a positive effect on organizational performance. Hence, managers in complex service organizations should pursue both technical and NTI gains in both EE and IE. However, as the results show, the nature of complex services, in which multiple service processes are interwoven (Benedettini and Neely, 2012), calls for the adoption and development of TI to be accompanied by NTI to support positive effects. In practice, this could include allocating resources to support NTI initiatives, creating a culture that values and rewards innovation and investing in employee training and development programs. The failure to realize the importance of TI and NTI interdependence might hinder the leveraging of technical advancements for potential performance gains.

Furthermore, the results from the current study cause somewhat of a predicament for managing CP in the innovation of complex services. Because the results verify the positive results from other service settings for complex services regarding CP resulting in EE, the results also fail to establish an effect on IE. However, to be clear, it would be imprudent to rule out the role of CP in complex services. Rather, the results indicate that customers participating in the process of innovation in complex services should be balanced with other actors who have different perspectives and resources. This may involve creating structured and systematic ways to collaborate with various actors, customers included, at different phases in the innovation process. Dismissing CP and their valuable insights would probably lead to second-order issues for IE because the customers in this particular complex service setting tend to come back to the service organization rather than moving on to another one. In other words, the customers would still be ill and need further care, rather than being unsatisfied and choosing a different service provider.

Limitations and further research

As is always the case, the present research has some limitations. Given that innovation is difficult to measure objectively, the findings are based on self-assessment data with inherent limitations, including exaggerated or otherwise biased responses. Apart from being subjective, the data used to explore the connections between the different types of innovation and their effects were cross-sectional. Given that certain innovation effects might not be immediately apparent, cross-sectional studies may lack reliability (although self-assessed data counter this risk to some extent). Even though the sample targets independent healthcare organizations, these are most likely under a centralized governing body, such as the county councils, and/or are affiliated with private parenting organizations, which might have skewed the results. For example, a majority of organizations from one governing body heavily targeting innovation might have answered the survey, while a plethora of organizations under another governing body – not devoted to innovation – did not. Although complex services, such as healthcare, afford opportunities to test and further develop innovation theory (Voss *et al.*, 2016; McColl-Kennedy *et al.*, 2017), single-sector studies like the current one have limited generalizability.

The special nature of complex services also requires their own considerations. The Swedish healthcare provision, as used in this study, is a good example of a complex service in terms of its technological dependency and process interconnectedness, in line with other complex services such as legal, educational and financial services. However, it is also its own beast. Compared with other complex service settings, such as legal and financial services, it differs in terms of customers' free choice of service provider, ill customers and funding. Even within the EU, countries with fundamentally different healthcare provision models impact actor constellations and their incitements for innovation and change in various ways. In light of the setting, apart from exploring generalizability in different healthcare provision settings, further research could extend the current work by acknowledging the particulars of complex services and unravel contextual interactions between TI and NTI effects on organizational performance.

Furthermore, this study could be extended by examining innovation processes such as service design and new service development. In particular, it would be useful to adopt Miles (2008) recommendation to integrate different innovation processes with outcomes and effects to further advance innovation theory in complex service settings. Especially given the high degree of process interrelation, finding optimal mechanisms for managing and structuring innovational processes would be of significant importance. In relation to complex services, having a multiple-actor perspective on innovation processes could also highlight the implications for some participants to facilitate such processes to avoid becoming passive receivers of innovation (Samuelsson, 2021). Implying that, for example, healthcare provision would need to adopt technology that is not suited for operations, potentially adding costs and requiring reorganization.

The current study's surprising findings in relation to CP effects also warrant further investigation. Specifically, it would be useful to link these results to research on the outcomes of various forms of CP (Fang, 2008), which investigates the different aspects of complex services that might have yielded the results. Moreover, customers of healthcare provision are unique in the sense of being ill but also diverse in terms of their engagement, illness, knowledge and desire for participation (McColl-Kennedy *et al.*, 2015; Keeling *et al.*, 2019). Thus, further investigations into the details of CP must be conducted. For example, previous research has shown that different dimensions of communication in CP affect innovation success in services (Gustafsson *et al.*, 2012) and that dialogic engagement impacts knowledge resource integration between customers and service providers in complex services (Keeling *et al.*, 2021). Therefore, exploring the interaction in CP could facilitate forms that overcome the lack of effect on IE in complex services.

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Appendix

The product innovation index comprised a set of five indicators asking the respondent to reply yes, no or do not know when asked whether the organization had implemented an innovation in that specific product category. The indicators refer to innovation in (1) medical treatments, (2) medical equipment or instruments, (3) nonmedical equipment or instruments, (4) services used by patients or other citizens and (5) other services or products.

Process innovation was measured in the same way, using eight indicators that refer to new or significantly changed processes in the following areas: (1) treatment program or therapeutic strategy, (2) diagnostic methods, (3) guidelines for coordinating care of individual patients, (4) methods for involving patients/relatives in decision-making, (5) methods for engaging patients in their own care, (6) methods for reducing waiting times, (7) service operations (maintenance, catering, procurement, logistics, etc.) and (8) other methods for production of services and products.

Organizational innovation was assessed by a set of seven indicators, here referring to new or significantly changed arrangements in the following areas: (1) organization of operational responsibilities or decision making, (2) management control systems for improved efficiency and better results (e.g. lean management), (3) systems for collecting and treating knowledge and information (e.g. quality registry), (4) education or training systems for staff and management, (5) measures for reducing the administrative burden on medical staff, (6) cooperation between municipality and county council and (7) other methods for organizing work.

Communication-related innovation was assessed by a set of eight indicators, referring to new or significantly changed provisions in the following areas: (1) promotion of the organization and its services, (2) improving communication with patients/relatives, (3) involving patients/relatives in decision making, (4) promoting a healthier lifestyle among patients, (5) promoting communication between staff and non-Swedish-speaking patients, (6) promoting communication between municipality and county council, (7) promoting communication between employees and (8) other forms of promotion.

EE was assessed by a set of seven indicators that are measured in the same way as internal organizational performance: (1) options for providing care to a broader patient group, (2) quicker and/or better patient recovery, (3) more efficient treatment, (4) quicker treatment, (5) reduced suffering, (5) improved patient safety, (6) improved patient access to information and (7) improved self-determination for patients/relatives. IE was assessed using three indicators to measure the IE effect of innovations on (1) reducing healthcare staff administrative burden, (2) using resources more efficiently and

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