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Investigating the transformative effect of technological and service innovations on postal sector adaptability during the pandemic Disruption in India

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Abstract

Purpose: This study aims to investigate the inventive adjustments that have been made to provide uninterrupted delivery services by the postal sector amidst the COVID-19 pandemic.

Design/methodology/approach: This is an empirical study on the primary data collected from 354 postal users who use the services during and after pandemic disruption. This study uses regression, partial least square structural modeling and correlation to find out the relationship between dependent and independent variables.

Originality/Value: This paper presents an empirical study that examines the determinants of innovation impacting customer satisfaction among postal users in India during the pandemic disruption, addressing the dearth of previous empirical research on the adaptability of the postal system in this context. The results of our study can help the postal sector create more effective strategies for utilizing cutting-edge logistics technology, enabling them to change into delivery service providers that are innovation-driven.

Findings: The postal sector incorporates both service and technological innovation. The study also includes the other two constructs of logistics efficiency and customer satisfaction. Both service and technological innovation have a significant impact on customer satisfaction; however, service innovation is found to be the reason behind the survivability of the postal sector during the pandemic disruptive environment. Logistics efficiency positively affects customer satisfaction. However, logistics efficiency partially mediates the relationship between innovation and customer satisfaction. Overall, postal customers' satisfaction improves when innovation and logistics efficiency are present.

Theoretical/methodological Contributions: This study connects innovation with logistics efficiency and customer satisfaction in the context of Indian postal system and their adaptability during COVID-19

Social/management Contributions: The impact of innovation on logistical efficiency and consumer perception can be better understood with the help of this study. This can then be used to formulate or adjust strategies to boost the India Post's revenues and productivity.

Keywords: innovation, customer satisfaction, logistics efficiency, postal sector, pandemic, disruption

Investigando o Efeito Transformador das Inovações Tecnológicas e de Serviços na Adaptabilidade do Setor Postal Durante a Disrupção da Pandemia na Índia

Resumo

Objetivo: Este estudo tem como objetivo investigar as adaptações inventivas que foram realizadas para garantir serviços de entrega ininterruptos pelo setor postal durante a pandemia de COVID-19.

Design/metodologia/abordagem: Este é um estudo empírico baseado nos dados primários coletados de 354 usuários de serviços postais que utilizam os serviços durante e após a interrupção da pandemia. Este estudo utiliza regressão, modelagem estrutural de mínimos quadrados parciais e correlação para descobrir a relação entre variáveis dependentes e independentes.

Originalidade/Valor: Este artigo apresenta um estudo empírico que examina os determinantes da inovação que impactam a satisfação do cliente entre os usuários postais na Índia durante a interrupção da pandemia, abordando a escassez de pesquisas empíricas anteriores sobre a adaptabilidade do sistema postal nesse contexto. Os resultados do nosso estudo podem ajudar o setor postal a criar estratégias mais eficazes para utilizar tecnologias logísticas de ponta, permitindo que se transformem em prestadores de serviços de entrega orientados pela inovação.

Constatações: O setor postal incorpora tanto inovação em serviços quanto inovação tecnológica. O estudo também inclui os outros dois conceitos de eficiência logística e satisfação do cliente. Tanto a inovação em serviços quanto a inovação tecnológica têm um impacto significativo na satisfação do cliente; no entanto, a inovação em serviços é considerada a razão por trás da sobrevivência do setor postal durante o ambiente disruptivo da pandemia. A eficiência logística afeta positivamente a satisfação do cliente. No entanto, a eficiência logística medeia parcialmente a relação entre inovação e satisfação do cliente. De modo geral, a satisfação dos clientes dos correios melhora quando há inovação e eficiência logística.

Teórico/metodológico Contribuições: Este estudo conecta inovação com eficiência logística e satisfação do cliente no contexto do sistema postal indiano e sua adaptabilidade durante a COVID-19.

Contribuições sociais/gerenciais: O impacto da inovação na eficiência logística e na percepção do consumidor pode ser melhor compreendido com a ajuda deste estudo. Isso pode então ser utilizado para formular ou ajustar estratégias para aumentar as receitas e a produtividade dos Correios da Índia.

Palavras-chave: inovação, satisfação do cliente, eficiência logística, setor postal, pandemia, interrupção

Investigando el Efecto Transformador de las Innovaciones Tecnológicas y de Servicios en la Adaptabilidad del Sector Postal Durante la Disrupción Pandémica en India

Resumen

Propósito: Este estudio tiene como objetivo investigar los ajustes innovadores que se han realizado para proporcionar servicios de entrega ininterrumpidos por parte del sector postal en medio de la pandemia de COVID-19.

Diseño/metodología/enfoque: Este es un estudio empírico sobre los datos primarios recopilados de 354 usuarios de servicios postales que utilizan los servicios durante y después de la interrupción provocada por la pandemia. Este estudio utiliza regresión, modelado de ecuaciones estructurales de mínimos cuadrados parciales y correlación para determinar la relación entre variables dependientes e independientes.

Originalidad/Valor: Este artículo presenta un estudio empírico que examina los determinantes de la innovación que impactan la satisfacción del cliente entre los usuarios postales en India durante la disrupción de la pandemia, abordando la escasez de investigaciones empíricas previas sobre la adaptabilidad del sistema postal en este contexto. Los resultados de nuestro estudio pueden ayudar al sector postal a crear estrategias más efectivas para utilizar tecnología logística de vanguardia, permitiéndoles transformarse en proveedores de servicios de entrega impulsados por la innovación.

Hallazgos: El sector postal incorpora tanto innovación en servicios como en tecnología. El estudio también incluye los otros dos constructos de eficiencia logística y satisfacción del cliente. T tanto la innovación en servicios como la innovación tecnológica tienen un impacto significativo en la satisfacción del cliente; sin embargo, se ha encontrado que la innovación en servicios es la razón detrás de la supervivencia del sector postal durante el entorno disruptivo de la pandemia. La eficiencia logística afecta positivamente la satisfacción del cliente. Sin embargo, la eficiencia logística media parcialmente la relación entre la innovación y la satisfacción del cliente. En general, la satisfacción de los clientes postales mejora cuando hay innovación y eficiencia logística.

Teórico/metodológico Contribuciones: Este estudio conecta la innovación con la eficiencia logística y la satisfacción del cliente en el contexto del sistema postal indio y su adaptabilidad durante la COVID-19.

Contribuciones sociales/gerenciales: El impacto de la innovación en la eficiencia logística y la percepción del consumidor puede entenderse mejor con la ayuda de este estudio. Esto se puede utilizar para formular o ajustar estrategias que aumenten los ingresos y la productividad de India Post.

Palabras clave: innovación, satisfacción del cliente, eficiencia logística, sector postal, pandemia, disrupción

Introduction

In today's rapidly evolving global environment, the postal service is caught between tradition and change. The advent of digital connectivity has forced the traditional postal service to reinvent itself and embrace new features to stay relevant and efficient. In the current era of rapid change and progress, particularly in the context of Industry 4.0, it is imperative for individual enterprises to prioritize their attention to the present circumstances. Organizations that do not adjust to changes are ultimately eradicated from the market (Koncova *et al.,* 2021). Innovation has become synonymous with growth, and the postal service (Felisberto, 2012) is no exception. As technology continues to evolve, new solutions are needed to streamline operations, optimize processes, and meet the evolving demands of a dynamic market. Sophisticated technology integration, from automated sorting to advanced tracking capabilities, increases service speed, accuracy, and reliability. The emerging key to success is the integration of new methods of innovation along with logistics efficiency (Laseind & Mpofu, 2017). This symbiotic relationship will not only boost postal services into the future but will also play a vital role in increasing customer satisfaction. The COVID-19 pandemic has presented unparalleled difficulties for companies worldwide. The evolving environment has compelled businesses across several industries, including travel, hospitality, retail, and entertainment, to swiftly adjust. Nevertheless, in the middle of this chaos, the postal industry has emerged as an essential lifeline for communities across the globe.

Northeast India has long been experiencing political unrest due to ethnic variety, historical backdrop, and socioeconomic issues. Mountain terrain, frequent natural disasters, inadequate infrastructure, and economic stagnation are a few examples of geographical challenges that intensify logistical problems and discontent in northeast India. The occurrence of frequent landslides, intense rainfall, and flooding causes disruptions in logistical operations, hence making efficiency a major problem.

In the midst of these difficulties, the importance of innovation in postal services becomes evident as a critical element in improving connectivity, delivering services, and satisfying customers. The Indian postal sector, because of its expansive network, has the capacity to fill the infrastructural deficiencies in

the region and enhance the availability of crucial services. By utilizing these advancements, the postal industry can alleviate a portion of the territory's logistical obstacles, promote economic progress, improve overall consumer contentment, foster stability, and expansion in the region. Additionally, the postal sector is encountering difficulties in upholding its universal service obligations. The importance of innovation in postal services lies in its ability to enhance operational efficiency, minimize delivery times, and fulfill the changing demands of customers (Crew & Brennan, 2015). By incorporating technical improvements and using new techniques, postal services can more effectively tackle logistical issues, especially in challenging terrains, and little infrastructure, such as Northeast India. Gaining insight into the significance of innovation aids in recognizing methods to improve customer pleasure and trust, ultimately bolstering the overall efficacy and flexibility of postal services amid disruptive occurrences.

There is less information available regarding innovation in the service market because people mistakenly believe that innovation is only relevant to manufacturing companies (Awuku et al., 2023). There are studies to address these issues in the logistics sector (Uzir et al., 2021; Masudin et al., 2022), but there is a dearth of studies focusing on the capabilities of the age-old postal services in an Indian context. This study has also gained significant importance due to the increasing competitiveness in the logistics industry and the postal sector's inability to tolerate customer turnover. Innovation is the medium through which the postal sector will be able to improve its service delivery and compete with the other players in this industry. Therefore, there is an absolute requirement for empirical evidence to support this aspect. This study aims to investigate the inventive adjustments that have been made to provide uninterrupted delivery services by the postal sector amidst the COVID-19 pandemic.

Literature Review

Innovation

Innovation refers to the systematic introduction of new ideas, goods, or techniques that lead to favorable transformation and enhancement (Abdallah et al., 2016). On the other hand, according to Wagner and Busse (cited in Cui et al., 2012), innovation is a form of subjective newness that emerges

from a deliberate management process with the intention of maximizing economic gain. The ability to innovate is crucial for maintaining a competitive edge and satisfying the ever-changing requirements and desires of customers (Dai et al., 2020). It stimulates economic expansion, nurtures innovation, and enables both institutions and individuals to adjust and flourish in a dynamic and evolving context. One of the strategic methods for a company to survive is service innovation, which has attracted a lot of interest from both academic researchers and business professionals (Tajeddini et al., 2020).

Innovation in logistics is positively correlated with better customer service, which in turn boosts performance (Cui et al., 2012). Technology, service, and product improvements should all be part of logistics innovation (Oke, 2004). Logistics innovation should be both manageable and have an exploitation objective (Lin, 2007). This article aligns with Cui et al.'s (2012) definition, advocating for logistics companies to perceive replication as innovative. The results and impact of logistics innovation was the subject of research. Logistics innovation, according to Persson (1991), can result in competitive advantages, distinctiveness, and other positive outcomes (Twede, 1992). Rising levels of supply chain instability and turbulence always compel logistics service providers (LSPs) to adapt to their environments, whether it's through the adoption of new technologies or the introduction of new strategies (Daugherty et al., 2011). Innovations in logistics and LSPs are distinct from one another (Busse & Wallbenburg, 2013). The study of how a corporation generates and implements innovations is known as process-oriented innovation (Busse & Wallbenburg, 2014).

Studies suggest that LSPs in developing countries exhibit lower levels of innovation in comparison to other service sectors, mostly due to the elevated costs and diminished returns associated with innovation (Dai et al., 2020). Although there have been several studies, the research on innovation in LSPs is still in its early stages (Buss & Wallenburg, 2013). The significance of logistics service innovation in emerging markets is not well known, despite being influenced by elements such as consumer preferences, capability to absorb, environmental concerns, and geographical reach (Chu et al. 2018). More in-depth research on innovation is crucial for logistics and other service providers in the industry (Dai et al., 2020). Considering the special characteristics of India's postal system, such as its

unique organizational culture, government oversight, and thriving competition in the logistics industry, it is crucial to gain a comprehensive understanding of the innovative efforts undertaken by postal service providers in India. The present study examines innovations in the postal industry, specifically focusing on the encapsulation approach. In this approach, service and technological innovation are defined as newly developed or substantially improved services provided by the postal sector.

Researchers in the field of innovation have also noted that organizations can strategically utilize innovations to compete in both local and global markets (Bhattacharya et al., 2017). Innovation enables companies to realign and adjust their strategies in response to evolving market trends and dynamics. Additionally, it enhances customer value, resulting in improved business performance (Drejer, 2002).

Innovation is traditionally divided into two categories: process innovation and product innovation. These categories correspond to new offerings made in response to external requests and new enhancements made to current internal processes (Wang et al., 2015). Within this study, we utilize the product/process dichotomy as a component of the innovation paradigm employed by the postal sector.

The COVID-19 epidemic expedited the transition to a world where digital technology takes precedence. The move was unequivocal, necessitating organizations to discover novel methods to oversee and bolster their employees via a triumphant transformation (World Economic Forum, 2021). Thus, in the digital age, it is imperative for postal organizations to embrace innovation in order to fulfill the needs and expectations placed upon them (Laseind & Mpofu, 2017). Therefore, in our paper, we focus on innovations adopted by the postal department in response to the pandemic.

Logistics efficiency

Logistics is all about information sharing between parties and the management of logistics infrastructure, including transportation, warehousing, and last-mile delivery (Novack et al., 1992). Efficiency, however, is the backbone of a successful logistics system (Chu et al., 2018). The ability to effectively manage origin-to-destination routes is essential to meeting customer expectations (Zhang et al., 2019). Efficient logistics not only saves costs but also reduces delivery times, providing customers with faster and more reliable service (Boysen et al., 2021). This efficiency is especially important at a

time when customers demand immediate gratification and expect greater accuracy in the delivery of their shipments (Uzir et al., 2021). The majority of previous research studies have highlighted the critical significance that logistics efficiency plays in the shipper's performance (Masudin et al., 2022). Research indicates that integrating logistics into strategic management has a favorable impact on both customer satisfaction and company performance (Tracey, 2006). Gil Saura et al. (2008) acknowledged the significance of logistics efficiency and its effect on customer satisfaction. Research by Panayides et al. (2005) found a favorable correlation between logistics innovation and the efficiency of logistics service providers. According to Richey et al. (2005), there is a favorable correlation between logistical innovation and service efficiency.

Customer satisfaction

Customer satisfaction occurs when the perceived performance meets their needs (Huang et al., 2019). There should be no gap between the expectations and perceptions of the customer about what they get. Essentially, the customer's future purchase intention is determined by their current level of satisfaction with the service. Customers' opinions can generate innovative ideas for the development of courier services (Gulc, 2017). Studies have shown a positive relationship between customer satisfaction and service providers' capability to provide service efficiency (Gulc, 2017; Rao et al., 2011; Alabboodi, 2019). Customers' satisfaction level is high when they receive more benefits at a lower cost. A satisfied customer can give you ten more customers, and the cost of retaining the existing customers is much lower than attracting potential new customers (Heskett, 1971). Multiple studies offer convincing evidence that the improvements made by LSPs result in heightened customer satisfaction (Gaudenzi et al., 2021). Abdallah et al. (2016) found that innovation influences customer satisfaction levels, as innovation in turn enhances the performance capability of organizations.

Research hypotheses and framework

Innovation is commonly defined as a force that helps firms adapt to market changes and enhance consumer satisfaction, loyalty, and business performance (Taghizaden et al., 2017). Nevertheless, there is a dearth of literature on service innovation because of unsubstantiated assumptions within academia and

among practitioners that service innovation is exclusive to industrial organizations. However, little is known about how service providers might use their innovations in services to increase consumer satisfaction (Waren et al., 2018).

Researchers have examined the impact of innovations on how service delivery affects customers' perception (YuSheng & Ibrahim, 2019) and have discovered a favorable correlation. It has been determined that organizations that focus on providing services are less advanced in their methods of innovation compared to firms that focus on producing products (Awuku et al., 2023). The findings suggest that the implementation of technology-focused and customized service-oriented innovations has a significant impact on the efficiency and performance of businesses (Woo et al., 2021). The empirical findings also demonstrate that the process of digitalizing has a favorable impact on the performance of LSPs by enhancing customer satisfaction (Zhou et al., 2023). The findings suggest that previous examinations based on technology service innovation primarily regarded technology as a service or a means of delivering services, with little emphasis on the marketing, management, and organizational aspects of service innovation (Park et al., 2023).

Efficiency is a crucial metric for evaluating firms' operational analysis. Despite the anticipated impact of the COVID-19 pandemic on satisfaction among consumers, it is intriguing to discover that innovation had a positive effect on customer satisfaction when organizational efficiency was taken into account (Udofia et al., 2021). Improvements in operational performance can be achieved through innovation, which enhances effectiveness, efficiency, and service capabilities (Abdallah et al., 2016). Logistics efficiency plays a crucial role in connecting innovation and consumer pleasure. Implementing novel methodologies enhances the effectiveness of logistical operations, resulting in increased levels of customer contentment. Therefore, the effect of innovation on customer satisfaction is frequently achieved through the efficiency of logistics (Zang et al., 2005). It is crucial to comprehend how innovations might improve the efficiency of logistics and consumer satisfaction during disruptive periods in order to construct resilient logistics systems that can resist future disruptions (Ivanov et al., 2019).

Empirical evidence which specifically examines the interplay between innovation, logistical efficiency, and customer satisfaction within the Indian postal sector is scarce. Hence, the following hypotheses are developed in light of the literature investigation and the desire to comprehend the postal sector's capacity for change management in the disruptive COVID-19 pandemic environment.

H1 Innovation positively influences customer satisfaction during disruptions

H2 Logistics efficiency positively influences customer satisfaction during disruptions

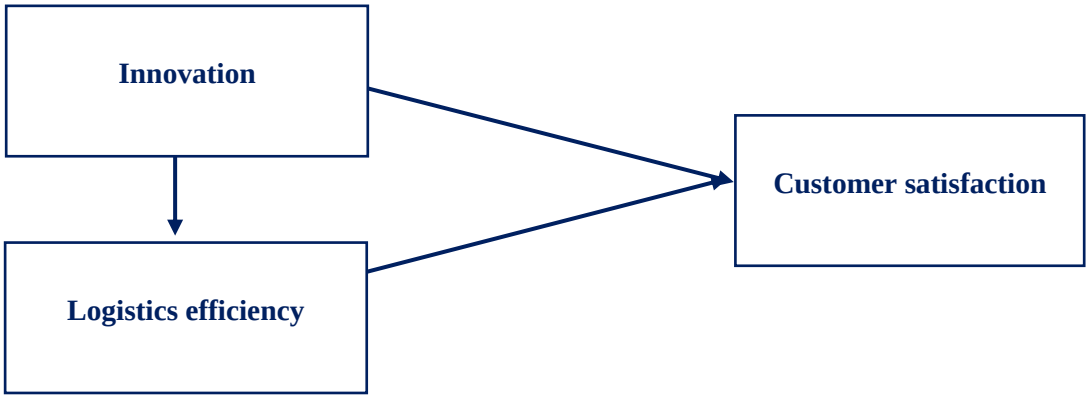
H3 The introduction of innovation positively influences logistics efficiency during disruptions

H4 Logistics efficiency mediates the relationship between innovation and consumer satisfaction during disruptions

A framework has been proposed in this research in Figure 1. The framework considers the effects of innovation on customer satisfaction and logistics efficiency. Innovation, when combined with logistics efficiency, enhances service delivery through more satisfied customers.

Figure 1

Conceptual framework



Methodology

To accomplish the study's objectives, primary data was utilized. To gather primary data, a structured questionnaire was created by examining existing literature. The questionnaire consisted of closed-ended questions that focused on five demographic variables, nine statements regarding innovation,

five statements regarding logistics efficiency, and five statements regarding the satisfaction of postal customers. We adapted the indicators assessing logistics efficiency from studies conducted by Rafiq and Jaafar (2007) and Thai (2015). The innovation indicators used in this study have been derived from the works of Restuputri et al. (2020), Paul and Chowdhury (2021), and Masudin et al. (2022). The authors also came up with specific questions, like *"responding to requests in bad situations during disruptions," "ensuring sanitized packages during disruptions*," and "*adoption of digital payment methods during disruptions"* based on what they learned from talking to postal sector managers during the pilot survey. We adapted the customer satisfaction indicators from Uzir et al. (2021). The measurements for all the claims were recorded using a 7-point interval scale. Data collection involved the utilization of offline as well as online approaches. Out of a total of 500 questionnaires, only 354 were completed correctly and could be included in the study.

The data relating to demographic characteristics was analyzed using descriptive statistics. Factor analysis was utilized to extract the elements included in this study, while partial least squares structural equation modeling (PLS-SEM) in SmartPLS software was employed to investigate the relationship between these factors in order to comprehend the extent to which the postal department has adapted in response to the disruption caused by the pandemic. The results of hypothesis testing indicate that all relationships have a statistically significant value below 0.05 (see Table 10).

Data Analysis and Interpretation of Results

The study found that the largest group of consumers are male (254, 62.3%), aged 25–34 (198, 48.5%), employed in the private sector (152, 37.3%), possess a bachelor's degree (178, 43.6%), and have an income between 20,000 and 40,000 (139, 34.1%).

Initially, we performed an exploratory factor analysis utilizing principal components analysis and varimax rotation. to determine the underlying factor structure of the study as perceived by the customer. The sample adequacy tests and the total variance explained were examined to validate the grouping of constructs obtained from the rotated component matrix. The Kaiser Meyer Olkin (KMO) value is 0.950, indicating a reasonable level for the application of factor analysis (Hair et al., 2019). The Bartlett's Test of

Sphericity generated a substantial value of 0.000 (Hair et al., 2019), representing that all the claims pertaining to factors are valid. In addition to these two measures, the total variance explained was also deemed sufficient (i.e., 73.305) for the application of factor analysis. The factor analysis grouped the items into 4 constructs (see Table 1) with a threshold level of 0.50 or more (Hair et al., 2019). The construct of innovation has two sub-dimensions, namely service innovation and technological innovation. The reliability of the scales was assessed using Cronbach's α-coefficient (see Table 1). All scales fulfilled the minimum suggested threshold of $\alpha \geq 0.70$ and composite reliability values over 0.70 (Hair et al., 2019). Descriptive statistics provide a concise representation of the general pattern and variability of the data (See Table 2). The average scores (M) show that respondents evaluate logistical efficiency (M = 3.79), service innovation (M = 3.82), and consumer satisfaction (M = 4.18) above the average value, and technological innovation (M = 3.50) at the bar. The standard deviations (σ) indicate moderate diversity in responses for logistical efficiency (σ = 1.11) and customer satisfaction (σ =1.15), and slightly higher variability for service innovation (σ = 1.18) and technological innovation (σ = 1.20). The skewness and kurtosis values (refer Tables 1, 3) fall within the acceptable threshold ranges, indicating that the data follows a normal distribution (Cain et al., 2016). The correlation among the construct's matrix (refer Table 2) reveals that no multicollinearity exists among the observed variables, as no value is close to 0.80 or more (Hair et al., 2019). According to Hair et al. (2012), the VIF values, which are less than 5, and the tolerance values, which are greater than 0.25, also suggest that multicollinearity is not a serious issue in the regression models (refer to Tables 3). Discriminant validity elements HTMT and Fornell larker criteria were also under acceptable limit (refer Table 3 and 4). Harman's (1967) single-factor test was conducted to assess the presence of Common Method Bias (CMB). The results revealed that the largest component explained 21.85% of the variation, indicating that CMB was not a significant issue in our study.

Table 1

Factor analysis, reliability, and descriptive statistics

Constructs	Source(s)	Items	Factor loadings	Cronbach alpha	Mean	Std. Deviation	Skewness	Kurtosis
Logistics efficiency								
Ontime delivery during disruptions	Rafiq & Jaafar, 2007; Thai 2015	LGE1	.830	0.913	4.04	1.412	-.100	-.382
Safe and secure delivery during pandemic disruption		LGE2	.809		3.62	1.281	.219	-.659
Provides services at reasonable price during pandemic disruption		LGE3	.784		3.66	1.422	.365	-.284
Enough counters and transportation facilities during pandemic disruption		LGE4	.763		3.65	1.241	.563	.194
Handles service failure appropriately during pandemic disruption		LGE5	.736		3.87	1.295	.045	-.185
Provides accurate and real-time information during pandemic disruption		LGE6	.703		3.91	1.330	-.047	-.171
Service innovation								
Facilitates contactless delivery during pandemic disruption	Restuputri et. al. 2020; Paul & Chowdhury, 2021 Masudin et al. 2022	SI1	.771	0.924	4.03	1.466	-.069	-.596
Responsive to requests during an adverse situation during pandemic disruption		SI2	.755		3.74	1.417	.024	-.434
Completely follow pandemic protocols during disruption both at the counter and at the time of delivery during pandemic disruption		SI3	.744		3.94	1.355	.076	-.373
Innovative ways for last-mile delivery during pandemic disruption		SI4	.740		3.84	1.341	.118	-.373

Constructs	Source(s)	Items	Factor loadings	Cronbach alpha	Mean	Std. Deviation	Skewness	Kurtosis
Assurance of sanitized packages during pandemic disruption		SI5	.729		3.98	1.313	-.062	-.356
Facilitates home pickups during pandemic disruption		SI6	.728		3.38	1.440	.217	-.404
Technological innovation								
Innovation in information quality and confirmation of delivery during pandemic disruption		TI1	.830	0.809	3.56	1.425	.344	-.210
Innovation in tracking and tracing to assure secured delivery during pandemic disruption		TI2	.781		3.56	1.347	.346	-.238
Adoption of digital payments methods during pandemic disruption		TI3	.668		3.38	1.462	.521	-.106
Customer satisfaction	Uzir *et al.*, 2021							
The shipping service fulfills my expectations during pandemic disruption		CSAT1	.788	0.852	4.04	1.260	-.079	-.290
I am content with my choice to utilize the postal delivery service during pandemic disruption		CSAT2	.765		4.37	1.318	-.207	-.212
I intend to utilize their delivery service in the future during pandemic disruption		CSAT3	.765		4.15	1.357	-.257	-.340
I will advocate for others to utilize this delivery service during pandemic disruption		CSAT4	.742		3.92	1.273	.306	-.061
I am quite pleased with the deliveryman's service during pandemic disruption		CSAT5	.716		4.44	1.367	-.202	-.282

Table 2

Correlation and descriptive statistics of the constructs

Descriptive statistics					Correlation			
Constructs	**Mean (M)**	**SD (σ)**	**Skewness**	**Kurtosis**	**LGE**	**SI**	**TI**	**CSAT**
LGE	3.79	1.11	.246	-.473	1			
SI	3.82	1.18	.078	-.618	.608***	1		
TI	3.50	1.20	.517	.099	.443***	.588***	1	
CSAT	4.18	1.15	-.154	-.446	.594***	.705***	.602***	1

Note: *** p < .001

Source: Author(s)

Table 3

Construct's reliability and validity

Constructs	Outer loadings	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)	VIF
CSAT1	0.868	0.924	0.925	0.942	0.766	2.741
CSAT2	0.863					2.628
CSAT3	0.885					3.011
CSAT4	0.868					2.622
CSAT5	0.893					3.128
LGE1	0.884	0.911	0.915	0.931	0.693	3.071
LGE2	0.832					2.409
LGE3	0.818					2.220
LGE4	0.771					1.933
LGE5	0.865					3.536
LGE6	0.819					2.852
SI1	0.869	0.924	0.926	0.941	0.726	2.872
SI2	0.854					2.602
SI3	0.853					2.612
SI4	0.870					2.895
SI5	0.846					2.516
SI6	0.818					2.303
TA1	0.816	0.810	0.824	0.887	0.723	1.700
TA2	0.864					1.920
TA3	0.869					1.735

Source: Author(s)

Discriminant Validity

Table 4

Heterotrait-monotrait ratio (HTMT)

Constructs	CSAT	LGE	SI	TA
CSAT				
LGE	0.666			
SI	0.763	0.675		
TA	0.696	0.515	0.679	

Source: Author(s)

Table 5

Fornell-Larcker criterion

Constructs	CSAT	LGE	SI	TA
CSAT	0.875			
LGE	0.613	0.832		
SI	0.708	0.621	0.852	
TA	0.608	0.451	0.595	0.850

Source: Author(s)

Structural model analysis

The partial least squares method has been used to test the hypotheses set for this study. A stage-by-stage relationship assessment has been done to come up with overall structural framework.

Table 6

Regression Model 1

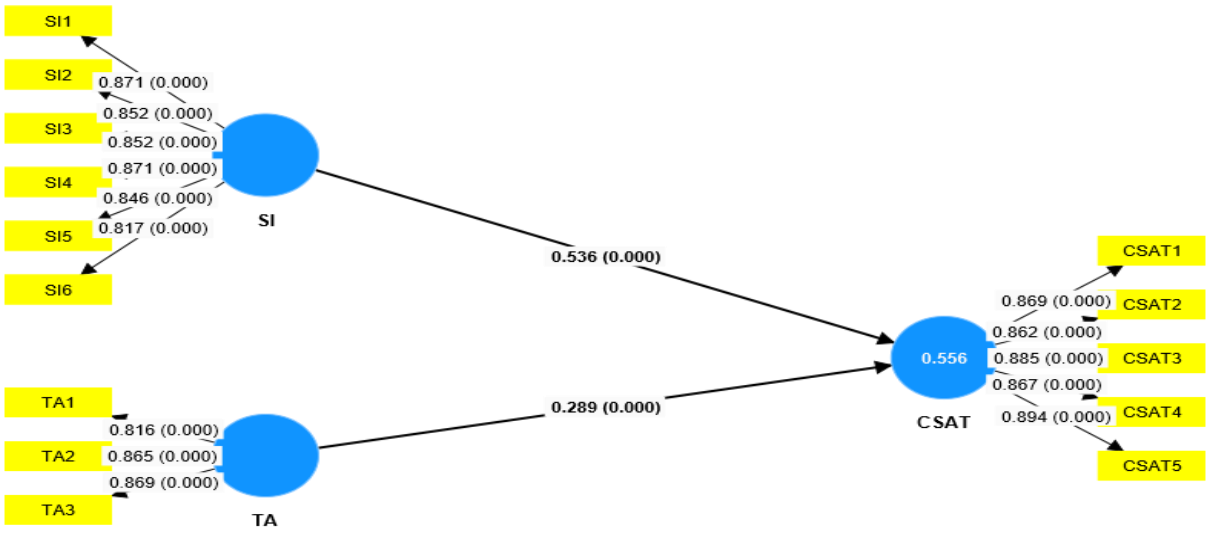
Dependent variable	Independent variable	Beta coefficients	Std. Error	t- value	R Square	Tolerance	VIF
Service innovation	Customer Satisfaction	0.521***	0.04	13.00	0.550	0.654	1.53
Technology innovation		0.276***	0.04	6.97		0.654	1.53

Note: *** p < .001

Source: Author(s)

Figure 2

Relationship between service and technological innovation and customer satisfaction



Source: Author(s)

Both regression model 1 (Table 6) and PLSSEM (Figure 1) indicates a significant positive relationship between innovation and customer satisfaction. The coefficients represent that service innovation has a greater influence on customer satisfaction as compared to technological innovation. The models suggest that more than 50% of the variance in customer satisfaction can be accounted for by the

innovative capabilities of the postal sector. This indicates a satisfactory fit of the regression model to the data. The structural model fit also indicates a well fit model, SRMR= 0.05, Chi-square/df= <0.5, NFI= 0.932. Hence, H1 is supported by this result.

Table 7

Regression Model 2

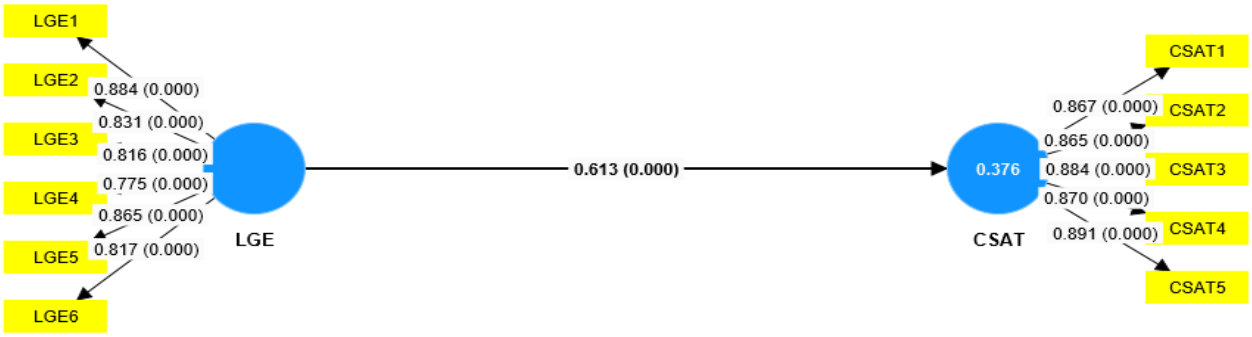
Dependent variable	Independent variable	Beta coefficients	Std. Error	t- value	R Square	Tolerance	VIF
Logistics efficiency	Customer Satisfaction	0.615***	0.041	14.87	0.352	1	1

Note: *** p < .001

Source: Author(s)

Figure 3

Relationship between logistics efficiency and customer satisfaction



Source: Author(s)

Table 7 and Figure 3 shows that there is a positive relationship between the predictor variable logistics efficiency and customer satisfaction. The model suggests more than 35% of the variance in CSAT may be attributed to changes in LGE. The structural model fit also indicates a well fit model, SRMR= 0.049, Chi-square/df= <0.5, NFI= 0.931. Hence, H2 is supported by this result.

Table 8

Regression Model 3

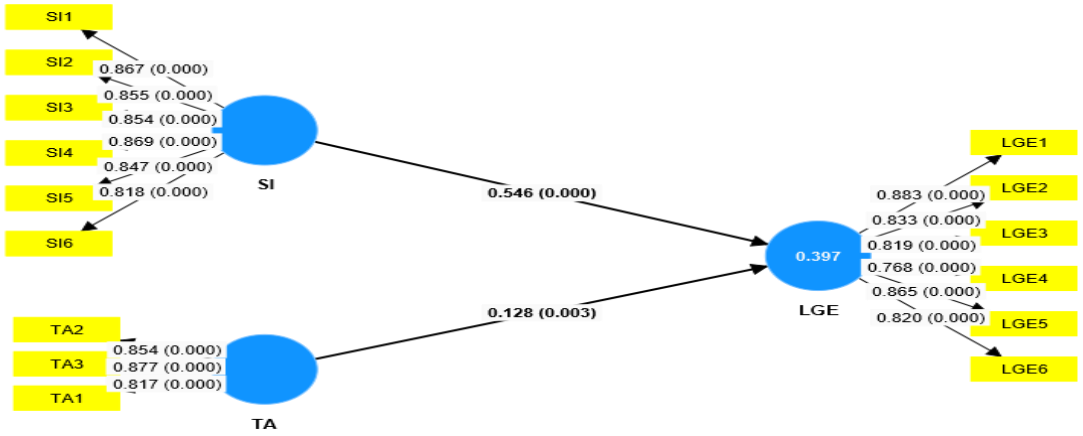
Dependent variable	Independent variable	Beta coefficients	Std. Error	t- value	R Square	Tolerance	VIF
Service innovation	Logistics efficiency	0.499***	0.040	10.979	0.380	0.654	1.530
Technology innovation		0.120***	0.040	2.691		0.654	1.530

Note: *** p < .001

Source: Author(s)

Figure 4

Relationship between service and technological innovation and logistics efficiency

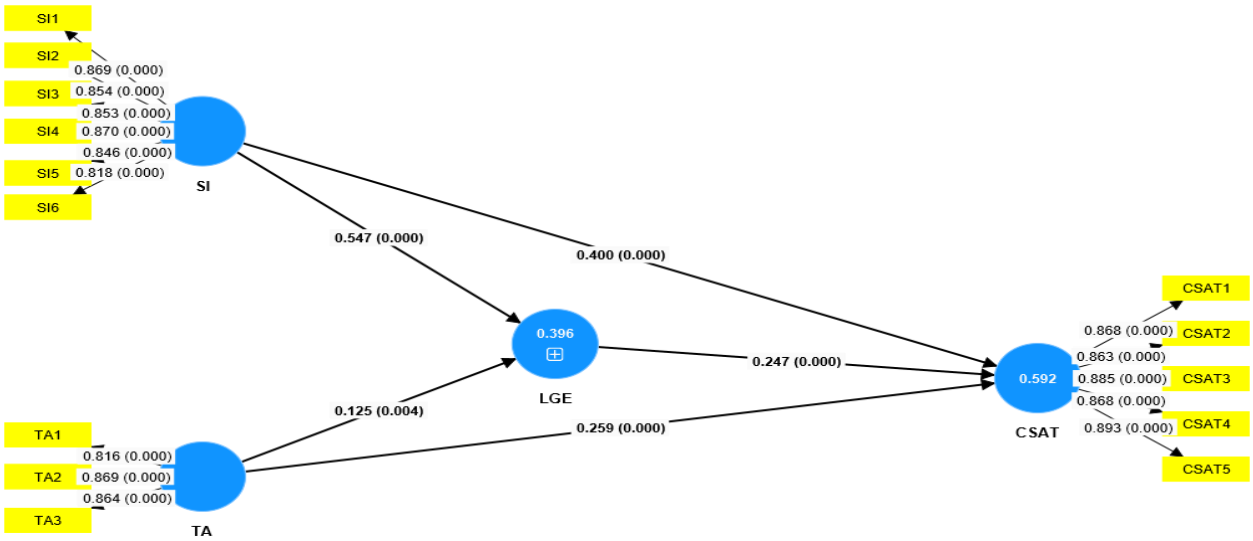


Source: Author(s)

Table 8 and Figure 4 show that there is a positive relationship between the predictor variable innovation and logistics efficiency. However, service innovation has a greater impact on improving logistics efficiency. The model suggests more than 38% of the variance in logistics efficiency may be attributed to changes in innovation level. The structural model fit also indicates a well fit model, SRMR= 0.053, Chi-square/df= <0.5, NFI= 0.902. Hence, H3 is supported by this result.

Figure 5

Relationship of service, technological innovation, logistics efficiency and customer satisfaction



Source: Research framework developed by author(s)

Table 9

Model 4

Paths	Beta coefficient	SE	T-value	P value
LGE -> CSAT	0.247	0.049	5.097	0.000
SI -> CSAT	0.400	0.049	8.240	0.000
SI -> LGE	0.547	0.044	12.512	0.000
TA -> CSAT	0.259	0.043	6.006	0.000
TA -> LGE	0.125	0.044	2.854	0.004
SI -> LGE -> CSAT	0.135	0.030	4.561	0.000
TA -> LGE -> CSAT	0.031	0.013	2.448	0.014

Source: Author(s)

Table 10

Model fit

Constructs	f- square	R-square	Q-square
CSAT		0.592	0.550
LGE	0.091	0.396	0.389
SI	0.192		
TA	0.104		

Source: Author(s)

Finally, we come up with research framework in Model 4 (Table 9 and Figure 5) indicating a significant positive relationship when considering innovation, logistics efficiency and customer satisfaction. Logistics efficiency partially mediates the relationship between innovation and customer satisfaction. The variation in the model's logistics management service innovation and technology innovation can account for 59% of the variance in customer satisfaction. This indicates an improved relationship. The model fit indicates a well fit model, SRMR= 0.047, Chi-square/df= <0.5, NFI= 0.910. Hence, H4 is supported by this result. An improvement in R-squared value indicates that the collaboration of innovation and logistics efficiency will force the customer to use postal services more. We analyzed the predictive relevance strategy and found that the Q-square values above 0, as indicated in Table 9 (Hair et al., 2017). This study analyzed the variation of endogenous components and assessed the effect size. The f-square statistic quantifies the influence of independent variable on dependent variable by assessing variations in the R-square value (Hair et al., 2019). The effect size calculation based on Cohen's (1988) method, as referenced in Gignac and Szodorai (2016), resulted in f-square values of 0.02, 0.15, and 0.35, representing weak, moderate, and strong effects, respectively. We also checked for goodness of fit (GoF) index to check the robustness of model and suggest a well fitted model (Hoffmann and Birnbrich, 2012). Equation 1 is about the GoF calculation and

$$GoF = \sqrt{AVE * R^2} = 0.36 \quad (1)$$

Discussion and Conclusion

Table 11

Summary of hypotheses testing

Hypotheses	Statement	Decision
H1	Innovation positively influences customer satisfaction during disruptions	Accepted
H2	Logistics efficiency positively influences customer satisfaction during disruptions	Accepted
H3	The introduction of innovation positively influences logistics efficiency during disruptions	Accepted
H4	Logistics efficiency mediates the relationship between innovation and consumer satisfaction during disruptions	Partial Mediation

The investigation shows that service innovation (β = 0.400) is the primary factor with a significant impact on customer satisfaction, with technological innovation (β = 0.259) coming in second and logistical efficiency (β = 0.247) coming in third. The findings are similar to Awuku et al. (2023), who found that innovative service delivery methods in the telecommunications industry have a greater impact on customer satisfaction. Technological innovations and service innovations have the potential to greatly enhance efficiency and trustworthiness. The results of the analysis reveal that the postal department needs to focus not only on logistics arrangements but also on the technologically innovative strategies adopted by competitors to sustain itself in the market. Postal delivery service was able to tolerate the COVID-19 pandemic and adopted a few innovations to tackle the disruptive environment (see Table 1). With more people staying at home and relying on online shopping, the demand for package deliveries has increased significantly. To meet this surge in demand and maintain their relevance, postal departments were able to manage their operations by implementing contactless delivery options, mobile or web applications, digital payments, improving tracking systems, digital communication, introducing alternative delivery options, and so on. The pandemic has highlighted the need for postal delivery services to continuously innovate

and find new ways to serve customers, ensuring their survival and success even during times of crisis. However, the postal sector's ability to withstand the challenging environment may be attributed to government support and the limited services provided by private operators. But this has paved the way towards its potential to improve the quality of services and sustainability in a competitive market.

Service innovation is one of the key areas that has had a significant impact on postal services. The relationship between innovation and customer satisfaction is undeniable (H1). By embracing new technologies and finding innovative solutions, postal services can streamline their operations and provide faster and more convenient services to customers. This can lead to increased customer satisfaction, as individuals value efficiency and convenience in their mail delivery experience. Furthermore, innovative features such as real-time tracking and digital notifications improve transparency and communication between postal services and their customers, increasing satisfaction levels. Overall, innovation is critical to ensuring customer satisfaction and retaining an edge over competitors in the logistics industry (Busse & Wallbenburg, 2011).

Implementation of innovative solutions has a profound impact on the effectiveness of logistics operations, allowing them to effectively cope with interruptions (H3). But when organizations focus on innovative capability combined with logistics efficiency, it enhances customer satisfaction. Logistics efficiency partially mediates the relationship between innovation and customer satisfaction (H4). By continually adopting innovations and improving processes, postal services can stay competitive and offer customers a more personalized and efficient experience. In conclusion, the marriage of innovation and logistics efficiency is essential to meeting the evolving needs and expectations of customers in the logistics sector (Cui et al., 2012). Different managerial skills can actively foster innovation, unlike ordinary management (Busse & Wallbenburg, 2013). Additionally, offering a wide range of customizable delivery options, such as time slots or pick-up locations, further enhances customer satisfaction by giving them more control over their deliveries, which requires more advanced technology.

However, persistent structural problems, disparities in technology, and changing market forces have all played a role in its continued difficulties. The primary internal obstacles pertain to sluggish

decision-making, excessive bureaucracy, and a company culture that lacks a conducive environment for fostering creativity. Another significant obstacle that was also noted is the lack of ability to attract highly skilled and creative individuals (Sund, 2008). The external obstacles are government regulations and the constrained growth prospects of domestic markets (Sund, 2008). However, these obstacles only fueled their determination to fulfill their duty and deliver important correspondence to its intended recipients, no matter the circumstances. In order to effectively compete with the private sector, the public sector must prioritize continuous innovation, modernization, and a proactive approach to meeting customer expectations. But in a public sector organization, this will only happen if high-level management is ready to take the initiative and design and implement such structural changes with the help of government support (Lin, 2007). It must be mentioned that the logistics sector has difficulties with innovation due to ineffective development methods and a lack of patent protection for new ideas (Oke, 2004). The available resources should be utilized in a way that fosters the growth of creative capacities and methods for managing operations (Richey et al., 2005).

Based on the findings of this investigation, the researcher presented the strategies that managers might take into consideration on a priority basis for the innovative capability of the postal sector and remaining competitive in the market.

- Consistently allocate resources towards the adoption of advanced technologies to shape the modern postal system. Embrace digital transformation by allocating resources to implement cutting-edge tracking systems, online platforms, and mobile applications. This will result in an improved user experience and operational efficiency.
- Enhancing Operational Efficiency: Deploy streamlined operational frameworks and automated systems to maximize process efficiency and minimize expenses. By automating repetitive tasks, postal services can free up resources and focus on more value-added services.
- Last-Mile Innovation: Investigate cutting-edge alternative delivery methods such as parcel lockers or self-service pickup points in collaboration with partners.

- Customer Engagement: Improve customer engagement by implementing individualized communication, proactive updates, responsive customer assistance, and understanding the importance of customers' feedback.
- Emphasize the importance of cultivating a culture that values flexibility and adaptation in order to maintain competitiveness. Giving employee training programs top priority will help to achieve this by ensuring that the staff is still skilled and able to adapt to changes.
- Foster collaboration with private logistics, couriers, and e-commerce enterprises to capitalize on synergies and mutually beneficial capabilities. The traditional way of focusing on the mail delivery process would not serve the purpose; they need to enhance the efficiency level to meet the needs of e-commerce.
- Regulatory Advocacy: Promote changes in regulations that encourage innovation and enhance competitiveness.

Managerial Implications

The findings have several managerial implications. The practical consequences discussed here are important for effectively managing service innovation initiatives in order to minimize customer dissatisfaction, which in turn will impact the overall profitability of the firm. The research findings indicate that service improvements have the potential to enhance customer satisfaction, particularly when customers view these innovations as having a significant impact.

Growth in the postal sector necessitates investment in technology for improved operational efficiency and regulatory advocacy. It has become important for the postal services to upgrade their infrastructure and management systems to meet the increasing demands of e-commerce and ensure timely and reliable delivery. The impact of innovation on logistical efficiency and consumer perception could be better understood with the help of this study. This can be used to formulate or adjust strategies aimed at boosting the business's revenues and productivity. The rise in competitors' market share serves as a catalyst for investment in innovation, but only up to a specific threshold (Felisberto, 2012). On the other hand, those that failed to innovate faced challenges in keeping up with customer expectations and may

have lost business as a result. Therefore, postal reforms must consider this aspect when formulating policies.

Limitations and Future Scope

Innovation and logistics efficiency in relation to customer satisfaction were the primary foci of this study. In future research, other factors, such as government restrictions and management capability can be included in the present model. India Post, with its vast network and constant backing from the government, is still the backbone of the country's postal services. On the flip side, private courier services meet the dynamic needs of a rapidly expanding economy by offering something new to the market—speed, efficiency, and a competitive edge. The true nature of the rivalry can be better understood by comparing the performance of private courier services with that of the postal department.

Author's Contribution

Contribution	Saha, J.	Sarma, T. R.
Contextualization	X	X
Methodology	X	X
Software	X	-
Validation	X	X
Formal Analysis	X	-
Investigation	X	X
Resources	X	-
Data Curation	X	-
Original	X	X
Revision and editing	X	X
Viewing	X	X
Supervision	-	X
Project management	X	X
Obtaining funding	-	-

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