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Understanding the impact of digital service failure on users: Integrating Tan's failure and DeLone and McLean's success model

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ABSTRACT

Although information systems (IS) success has been given much attention in IS literature, failure has received lesser attention. This study empirically validates a model of digital service failure for consumers by integrating three dimensions from Tan's failure model and one dimension from DeLone and Mclean's Information Success model. The factors have been mapped to Expectation Disconfirmation Theory (EDT). Experiential survey approach has been used to collect primary data from information systems users who have experienced digital service failure. Structural equation modeling (SEM) has been used for model testing and validation to measure the impact of information, system, functional and service failure of digital service on end users. The findings suggests that information, functional, system and service failure has an impact on the consumers through the outcome, process, cost and user satisfaction of digital services.

1. Introduction

Numerous studies has been conducted using the DeLone and Mclean's information systems success model which highlights the importance of factors like information quality, system quality, use, security, privacy, user satisfaction on individuals and organizations of Information Systems (IS) (Bentler, 2007; Chatterjee & Kar, 2018; Chatterjee, Kar, & Gupta, 2018; Chen & Cheng, 2009; Chen, Yen, Pornpriphet, & Widjaja, 2015; Chen, Jubilado, Capistrano, & Yen, 2015; DeLone & McLean, 2002; Delone & McLean, 2003; Delone & Mclean, 2004; Dong, Cheng, & Wu, 2014; Dwivedi et al., 2015; Fang, Chiu, & Wang, 2011; Gable, Sedera, & Chan, 2008; Gao & Waechter, 2017; Hsu, Chang, Chu, & Lee, 2014; Chatterjee, Kar, & Gupta, 2017; Kim & Kishore, 2018; Petter & McLean, 2009; Lee & Kozar, 2006; Mohammadi, 2015; Petter, DeLone, & McLean, 2008; Petter, DeLone, & McLean, 2013; Petter, DeLone, & McLean, 2012; Rana, Dwivedi, Williams, & Weerakkody, 2015; Shin, 2003; Tam & Oliveira, 2016; Wang & Liao, 2008; Wani, Raghavan, Abraham, & Kleist, 2017). It has been documented that 44 percent of the users do not make the final transaction with the digital service provider because of problems faced by the users during the purchase of product or services (Tan, Benbasat, & Cenfetelli, 2016). This study extends the usage of Expectation Disconfirmation Theory (EDT), first introduced by Oliver (1980), where evaluation of post-purchase satisfaction plays a major role among the users using digital services, as is also indicated in recent reviews of the literature (Singhal & Kar, 2015). Since there is a gap between the expectation and actual delivery of service, EDT posits such services to be deemed as a failure from the perspective of the users.

Failure has been studied extensively in the field of projects (Lu, Liu, & Ye, 2010; Pinto & Mantel, 1990; Yeo, 2002), however, limited attention has been given to failure of digital services such as failure in online booking of tickets, playing online games (Huang, Cheng, Huang, & Teng, 2018), online banking services (Alalwan, Dwivedi, Rana, & Williams, 2016; Alalwan, Dwivedi, Rana, & Algharabat, 2018; Sharma & Sharma, 2019), online marketing (Aggrawal, Ahluwalia, Khurana, & Arora, 2017; Aggrawal, Arora, Jain, & Rathor, 2017; Mittal, Kaul, Gupta, & Arora, 2017) paying of taxes and utility bills online and mismatch of citizen data sanctity in and across government systems (Dwivedi, Kapoor, Williams, & Williams, 2013, 2017; Rana & Dwivedi, 2015; Rana et al., 2015; Rana, Dwivedi, Lal, Williams, & Clement, 2017). According to Buchanan and McMenemy (2012), digital services are "services or resources accessed and/or provided via digital transaction". Whatever may be the causes or drivers, failure might decline trust and may result in non-recurring users and in a bad reputation. Although numerous study has been done considering the success of digital services, Tan et al. (2016) were the first to introduce a failure model. Tan et al. (2016) extended the theoretical perspectives of the IS success model into a IS failure model since not much research has been

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conducted to address the failure faced by users. He identified three types of failure; functional, system and service. Functional failure has dimensions like need recognition, alternative identification, evaluation of alternatives, acquisition and post-purchase failure which affects the outcome. System failure has dimensions like inaccessibility, non-adaptability, non-navigability, delay and insecurity which affects the outcome. Service failure also has dimensions like unsurety of needs, lack of empathy, non-responsiveness, intangible and unreliability of service. Our work introduces a fourth failure dimension named service failure, which has been adapted from Delone and McLean (2003) Information Systems success model.

Delone and Mclean (2003) model has been in the paper as fourth dimensions as it reconciles the diverse perception of service failure which is built upon Delone and McLean (2003) model to derive a theoretically grounded classification systems which characterize the unique transactional problem related to digital services. Failure of digital services might also result in users switching to alternative services. Hence understanding the causes for the digital service failure and its impact on the users is imperative. What constitutes failure is another topic of discussion since it is not easy to measure, where one person might consider a failure; another one might think it is not. To analyze and investigate different failure classification, Tan's model (information, functional and system failure) and Delone and McLean (2003) model has been mapped to the Disconfirmed Expectancy with the impact on consumers, which has been captured through the outcome, process, cost, and user satisfaction.

Literature (e.g., Leong, Ang, & Low, 1997; Bitner, 1990; Maxham & Netemeyer, 2002) suggests that digital service failure reaction towards consumer is unfavorable because of high rate of occurrence. So, the literature also suggests that the reaction of the consumer is different in different situation with respect to its frequency and the type of digital service failure occurs. The time taken between the two successive failures. The theory in the literature also explains that the reaction of a consumer towards the digital service failure is different is different situation (Folkes, 1984). The literature also suggests that whenever the digital service fails, it triggers a cognitive behavior of the consumer (Bearden & Teel, 1983). EDT theory expresses the user's dissatisfaction as a function of expectancy disconfirmation which posits the expectation, disconfirmation, and performance of the digital service. In this study, we combine these theories to propose a novel Digital Service Failure Model (DSFM) by integrating theories borrowed from Delone and McLean (2003) and Tan et al. (2016) to establish the impact of information failure, functional failure, system failure and service failure on the consumers in terms of outcome, process, cost and user satisfaction.

The rest of this research paper has been divided into six sections. The second section elaborates the literature review, impact of digital service failures like information failure, functional failure, system failure, and service failure. Section three formulates the hypothesis. Section four discusses the research methodology. The fifth section gives the result in detail such as data collection procedure, the demographic profile of respondent, SEM analysis and hypothesis testing. The sixth section provides the discussions, contribution to theory, and implication for practices. The seventh section concludes the study with the limitations and future research directions.

2. Literature review

The initial IS success model developed by DeLone and McLean (1992) by taking information quality, system quality, use, user satisfaction, individual and organizational impact as the dependent variable. After ten years the model has been updated by Delone and McLean (2003) by adding intention to use, service quality as the independent variable and net benefits as a dependent variable. Petter et al. (2013) further suggested another update for the model and added net benefit as a variable by replacing the individual and organizational variable. Past studies have been done around Digital services and its innovation, disruption, success, transformation, empirical investigation, opportunities and challenges (Ciriello, Richter, & Schwabe, 2018; Skog, Wimelius, & Sandberg, 2018; Voigt & Hinz, 2016; Hauser, Günther, Flath, & Thiesse, 2018; Legner et al., 2017), but there is a lack of studies related to the digital services failure. Later on, Tan et al. (2016) has converted the IS success model into IS failure model since there are no studies has been done to address the failure faced by the users. They used 3 dimensions for this information, functional and system failure. Since there is a gap in research on the failure of IS and its impact on the system users, this study has integrated both Tan et al. (2016) failure model with Delone and McLean (2003) model and introduced the service dimension of failure.

EDT (Oliver, 1980) is used as a theoretical model, popular in marketing literature, to analyze digital service failure classification and its consequences. Some studies in information systems have highlighted the usage of EDT for analyzing behavior post-adoption (Lankton & McKnight, 2012; Venkatesh & Goyal, 2010) but the context of failures have never been explored. While not much of usage of EDT has happened in information systems literature, the context of digital services consumption and its determinants of failure becomes important to analyze using EDT given that its theoretical framework is based on post-purchase experience and subsequent satisfaction from the consumption. The failure classification model has its own further constituent dimensions which add new theoretical linkages worthy of exploration. Information failure has dimensions like an inaccurate, incomplete, irrelevant and untimely failure which has been extended to the EDT model in this study.

This study attempts to validate empirically the impact of digital services failure by integrating Tan et al. (2016) failure model with Delone and McLean (2003) Information Success model and is a first exploration of its kind in existing literature. Further, EDT is used to evaluate the disconfirmed expectancy in digital service concerning its impact of consumers.

2.1. Impact of a digital service failure on consumers

In a conceptual approach, the study starts with a theoritical and conceptual foundation which later derives a classification system of the digital service failure. The model development begins with the concetual approach which leads to deriving clasification systems by applying theoritically inspired grouping then evaluating it empirically to confirm the grouping. In the study by Holloway and Beatty (2003) which indetified the information failure as listing out-of-stock items incorrectly. The authors also idetified the functional failure as difficulties in ordering and payment during the transaction via e commerce website. Further authors identified system failure as difficulties in the navigation due to failure of core dimensions.

The failure of information, functional, system and service impacts the digital service on its output, process, cost and user experience of the consumers as shown in Fig. 1. The reasons for the digital service failure are information failure, functional failure, system failure, and service failure. These first three failure dimensions (i.e., informational failure, functional failure, system failure) have been adapted from Tan et al. (2016), and fourth failure dimension (service failure) has been adapted from the Delone and McLean (2003) Information Systems success model. The EDT is used to measure the consumers' dissatisfaction concerning outcome, process, cost, and user satisfaction.

2.1.1. Information failure

The constructs for measuring information failure has been adopted from the Information Systems success model by Delone and Mclean (2004), DeLone and McLean (1992), Holloway and Beatty (2003), Seddon (1997), Wixom and Todd (2005). The IS success factors are accuracy, completeness, correctness, relevance and timely. Hence, it can be said that the failure of digital services are caused by incomplete,

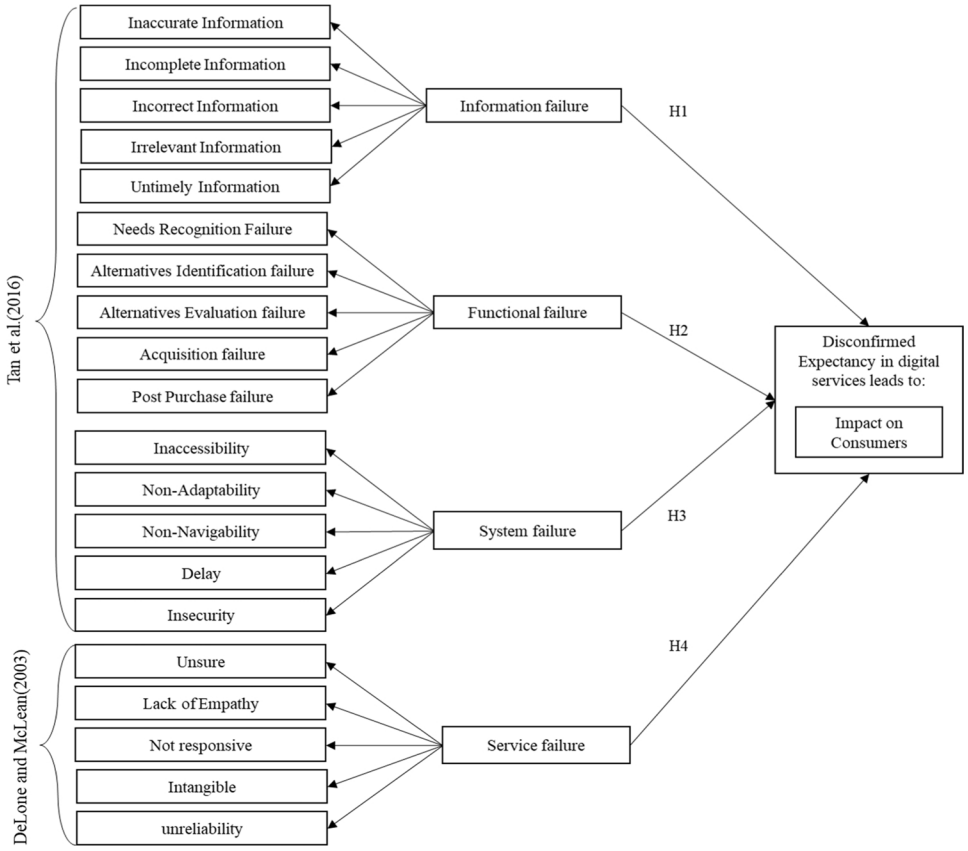

Fig. 1. Proposed DSFM: Integrating Delone and McLean (2003) andTan et al. (2016).

incorrect, inaccurate, untimely and irrelevant information.

- **Inaccurate Information:** Information provided during the digital service transaction contains some error which misleads the users who fail to do the transactions. Inaccurate information is the key determinant to check the failure of information. The inaccurate information reduces the quality of the information. When the information collected by the digital services are incorrect and biased then it leads to the failure of digital service.
- **Incomplete Information:** Information provided during the digital service transaction is incomplete for the users to make the transactional decision. The completeness of the information is justified by the fact that digital service provides all the necessary facts to do the transaction successfully. To gain the confidence of consumer transparency in the transaction is very crucial. The disclosure of information such as company's policies, hidden charges, process of the transaction and full information about digital services.
- **Incorrect Information:** Information provided during the digital service transaction is incorrect for the users to make a transactional decision. The incorrect information leads to the failure in the digital service transaction, incorrect information such as information collected from the incorrect and unauthentic sources.
- **Irrelevant Information:** Information provided during the digital service transaction is irrelevant for the users to make any transactional decision. Irrelevant information creates a burden on the consumer and complicates the system unnecessarily. This leads to the additional search by the consumer to find the relevant information from the pool of irrelevant information.
- **Untimely Information:** Information provided during the digital service transaction is not updated on the real-time basis for the users to make a transactional decision. Untimely information is that information which are not up-to-date. So, the untimely information creates a burden on the consumer to find up-to-date information.

2.1.2. Functional failure

Functional failure has been adapted from Information System success model as described by Delone and McLean (2003), Delone and Mclean (2004), Holloway and Beatty (2003). Hence, it can be said that the failure of digital services are impacted by the functionality provided on digital services when they are not enabling users to accomplish their desired transactional activity.

- **Needs Recognition failure:** The functionalities of digital services which are not able to assist the users in making their needs and preferences for the products and/or services offered. When the digital service is not able to provide the need and preferences of the consumer. The need such as helping the consumer in selecting the best services as per the requirement of the consumer.
- **Alternatives Identification Failure:** The functionalities of the digital services which are not able to assist the users in identifying the alternatives to the products and/or service offered. Since the consumer can narrow down the services in which the consumer is interested in but still the consumer willing to search to other alternatives available.
- **Alternatives Evaluation failure:** The functionalities of the digital services which are not able to assist the users in evaluating the alternatives to the product and/or services offered. The consumer generally evaluates digital services using two-stage process. The first step is to refine and transform the consumer preferences into a subset of alternatives and the second step is to compare the subset of alternatives to finalize the digital services.
- **Acquisition Failure:** The functionalities of the digital service which are not able to assist the users in acquiring the product and/or services offered. Acquisition completes the digital service transaction. The occurrence of a problem during the final step of the digital service transaction leads to the acquisition failure.
- **Post-Purchase Failure:** The functionalities of the digital services

which are not able to assist the users to: (1) track the product and/or services purchased; (2) provide suggestion on how to use the purchased product and/or services in order to get the maximum gain, and; (3) destroy the products and/or services which are not needed.

2.1.3. System failure

The factors for system failure has been adopted from the IS success factor model as described by Alter (2002), Alter and Sherer (2004), Chen and Cheng (2009), Delone and McLean (2003),; Delone and Mclean (2004), DeLone and McLean (1992), Duane, O'Reilly, and Andreev (2014), Dwivedi et al. (2015), Petter et al. (2013), Seddon (1997), Shaikh and Karjaluoto (2015), Sohail and Al-Jabri (2014), Singh, Kar, and Ilavarasan (2017), Wixom and Todd (2005). It can be defined the system failure as the failure due to not being able to accomplish the user's transactional activities. So, it can be said that the system failure of digital services are caused by inaccessibility, non-adaptability, non-navigability, delay, and security.

- **Inaccessibility:** The digital service which is not accessible to the users. Accessibility is one of the main criteria for the success of digital service. Accessibility means the ability to deliver digital service by overcoming the physical limits. When digital service is not able to deliver, then the system fails due to inaccessibility.
- **Non-Adaptability:** The digital services which are not able to adapt by the need of the users. The digital service provider can adapt to the requirement of the consumers. The adaptation to provide multi-language digital service content. The inter-country variation in the digital service content also leads to adaptability. The lack of adaptability in the digital service failure leads to system failure.
- **Non-Navigability:** The digital services which are not able to navigate in accordance with the user's needs. When the digital services are being navigable by the inexperienced users. The ease with which the new user can be able to traverse easily. When the inexperienced users are not able to navigate the digital services then there is system failure due to non-navigability.
- **Delay:** The digital service which is not able to match the speed of the users. Response time is an essential parameter for the success of the system. Studies in the past have suggested that the delay in the digital services leads to system failure. The delay also creates frustration among consumers. Past studies have also suggested that the instant response as the key to the success of digital services.
- **Insecurity:** The components of the digital service which are not secure against the attacks from the hackers. The success of the also depends on the security of digital services. The security safe gourd intrusion of the third parties, misuse of the confidential information. Past studies also highlighted the failure to provide security to the digital services will fail the system.

2.1.4. Service failure

The factors for service failure have been taken from the Information Systems success factor model as described by Delone and Mclean (2004), Holloway and Beatty (2003), Lee and Kozar (2006), Petter et al. (2008, 2013), Seddon (1997), and Wang and Liao (2008). The service failure of digital service are the failures which are not able to do a transaction in accordance with the user's requirement.

- **Unsure:** The digital service providers are not sure about the delivery of its services. The surety in the delivery of digital services leads to the success of digital services. The lack of the surety of the delivery of digital services leads to failure.
- **Lack of Empathy:** The digital service providers lack empathy towards their users. The empathy of the service provider towards the consumer while providing digitals services evaluates the success of digital services. The lack of empathy in the delivery of digital services leads to the failure of digital services.
- **Not Responsive:** The digital service providers are not able to provide prompt response to their users. The response time taken by the service provider to provide digital services to the consumer evaluates the success of the digital services. The lack of responsiveness during the delivery of digital services leads to the failure of digital services.
- **Intangible:** The digital services providers are not able to provide the touch and feel service to their users. The amount of touch and feel needed by the consumer is not been provided by the digital service provider also leads to the failure of digital services.
- **Unreliability:** The digital service providers are not able to provide the trust and reliability to their users. The trust and reliability are one of the criteria for the success of digital services. The lack of trust and reliability leads to the failure of digital services.

2.1.5. Disconfirmed expectancy

A cognitive model to decide the satisfaction level in the users has been introduced by Oliver (1980). Later the theory has been applied in numerous studies to study the phenomena of pre-purchase and post-purchase behavior of the users in marketing literature. This theory is later extended as EDT (Steelman, Hammer, & Limayem, 2014). The digital service failure can be measured through disconfirmation among the users concerning its impact on consumers with respect to its outcome, process, cost, and user satisfaction. In our study, an attempt has been made to establish the impact on the consumers by borrowing the lens of the disconfirmed expectancy theory.

- **Outcome:** Disconfirmed outcome expectancy refers to the transactional outcome which is obtained from the digital services is not as per the desired of the consumers. The mismatch in the outcome concerning the expectation as perceived by the consumer towards the digital service provider leads to the failure of digital services.
- **Process:** Disconfirmed process expectancy refers to the transactional process outcome which is not processed as per the desired by the consumers. The mismatch in the process with respect the expectation as perceived by the consumer towards the digital service provider leads to the failure of digital services.
- **Cost:** Disconfirmed cost expectancy refers to the expenses of more resources during digital service transaction than the consumers desire it. The mismatch in the cost with respect to the expectation as perceived by the consumer towards the digital service provider leads to the failure of digital services.
- **User satisfaction:** Disconfirmed user satisfaction refers to the less satisfaction of the users during digital service transaction than the consumers desire it. The user satisfaction in the process with respect the expectation as perceived by the consumer towards the digital service provider leads to the failure of digital services.

The theoretical lens of EDT has been used to evaluate the failure of the digital services concerning its impact on consumers with respect to its output, process, cost and user experience. This study evaluates the different failure classification taken from Tan et al. (2016). The failure classifications are information failure, functional failure, system failure. However, the service failure construct has been taken from the Delone and McLean (2003) model. These EDT theory measures the disconfirmation in the expectation of the consumer while using digital services. By using EDT in the theoretical model, it maps the digital service failure to the impact on consumers with respect to its outcome, process, cost and user experience.

3. Hypothesis development

The information has become pivotal in the case of consumer make decision to purchase. As per the existing literature related to consumer satisfaction and service quality, the information has become very important criteria to make purchasing decisions (Oliver, 1980). The information available on the online sometimes influences the consumer

the purchase something which they have not planned or intended to purchase it during the browsing of online website. So in this the case of inaccurate or incomplete information available on the website leads to the purchase of the product or services which the consumer was originally not desired to purchase which does not match their actual requirement.

Information failure is an essential type of digital service failure. The reasons attributed to information failure varies across the studies. For example, as per Holloway and Beatty (2003), it can occur because of insufficient, incorrect and lack of personalized information. The information failure has a negative impact on its consumers with respect to its user, process, cost and user satisfaction. However, the significant effect of information failure is high for outcome than its process, cost and user satisfaction. So, it can be hypothesized that the information failure in digital services will have a significant negative impact on its consumers.

H1. Information failure in digital services will have a negative impact on its consumers.

Functional failure leads to the dissonance among the consumer towards the digital service providers. The failure of function sometimes leads to the transaction failure as well which irritates the consumer. During the empirical findings it has been seen that the failure of service functionalities no matter how it has been designed seems to be meaningless if it does not satisfy the consumer requirement (Tan et al., 2016; Cenfetelli, Benbasat, & Al-Natour, 2008). In other words, the authors says that one should think how the technology should be intertwined with the product to satisfy the needs of the consumers. If the consumer is not satisfied because of the functional failure then the consumer will not purchase the digital services.

Functional failure plays a vital role in the failure of digital services. Digital service failure depends on the factor like acquisition failure, alternative evaluation failure, alternative identification failure, need recognition failure and post-purchase failure. The functional failure has a negative impact on the user, process, cost and user satisfaction. However, the significant effect of functional failure is high for the process than its outcome, cost and user satisfaction. So, it can be hypothesized that functional failure in digital services will have a negative impact on its consumers.

H2. Functional failure in digital services will have a negative impact on its consumers

As soon as the consumer visits any online website then the consumer starts experience the system, be it time spent on the browsing and exploring the product or services. A little time spent on the website also counts on the access to the system. The attribute of the systems effects the efficiency with which the consumer accesses the content an e-commerce website (Delone and McLean, 2003; Wixom & Todd, 2005). It is evident that the system failure lowers the satisfaction of the customer and eventually the consumer leave the website without doing the final transaction. It has also been justified empirically as well. Studies in the literature also justifies that as the response time of the website decrease the consumer doing final transaction also decreases (Venkatesh & Goyal, 2010).

There have been numerous studies on how to make IS success by Delone and McLean (2003), Delone and Mclean (2004), DeLone and McLean (1992, 2002), Petter et al. (2008), 2013, Petter and McLean (2009). However, the literature suggests that Tan et al. (2016) has first used the Information Systems success model in the service failure context. The system failure has a negative impact on the user, process, cost and user satisfaction. However, the significant effect of system failure is high for cost than its outcome, process and user satisfaction. So, it can be hypothesized that the system failure in the digital services will have a negative impact on its consumer.

H3. System failure in digital services will have a negative impact on its consumers

The service offered by the website during the online transaction to the consumer decrease with the failure of the website offering service. The response time of the website also plays a critical role for the final transaction done by the consumer during online shopping. The digital product or service success and failure also depends on the services offered by the digital service provider to the consumer. Past studies in the literature shows that failure of e-commerce website induce a sense of loss in the minds of the consumer as the time as got wasted during the browsing and selecting the product or services.

Failure of service especially digital services is one of the crucial parameters to consider for examining outcome. There can be various reasons for the failure of digital services. The service failure has a negative impact on the user, process, cost and user satisfaction. However, the significant effect of service failure is high for user satisfaction than its outcome, process and cost. Further, it can be hypothesized that the service failure in digital services will have a negative impact on its consumers.

H4. Service failure in digital services will have a negative impact on its consumers

The Expectation Disconfirmation Theory (EDT) is most suited for our current focus of the study because it is derived from cognitive theory which is needed in the cases of evaluating post-adoption or post-purchase satisfaction as a function of expectation, perceived performance, and disconfirmation of beliefs. This lens has been borrowed in our study to explore the impact of service failure on the consumers. In particular, in this study, we have attempted to model the impact through outcome, process, cost and user satisfaction.

4. Research methodology

This study aims to evaluate the users' expectation disconfirmation concerning its impact on consumer with respect to its outcome, process, cost, and user satisfaction. The user's failure experience is evaluated concerning its failure in information, functional, system and service. The main contribution while attempting to meet this objective is the integration of two theoretical models along with validation of the model through empirical research. In order to evaluate the failures experienced by the users, the experiential survey has been done to collect the empirical data from the users who have prior failure experience while using digital services (Rowley, 2014). The questionnaire in the survey is based on the failure experienced by the users during digital service consumption. The measurement instrument to find the latent variable has been designed with the support of literature as shown in Table 1. The table highlights the sources from literature which has been used to build upon the constructs and their measurement items. These measurement items were used in the survey whereby the proposed integrated model has been validated empirically through a survey. The survey was in the context of impact of digital service failure by the experienced users residing in the smart cities of India. First of all, a pilot study has been done on 30 users who have experienced failure of digital services in the past to test the reliability and validity of the survey instrument. After the feedback received from the users, the questionnaire has been modified accordingly. In the survey instrument, the first seven questions capture the demographics information of the respondent. The demographics are employment status, employment type, gender, age, highest academic qualification, duration and how frequently the respondent uses the digital services. The respondents are the users who have experienced the failure of digital service in the past. Now the respondents were asked to fill the questionnaire based on the five-point Likert scale with '1' being strongly disagree, '2' being disagree, '3' being neutral, '4' being agree and '5' being strongly agree.

Cronbach's alpha test has been conducted to check the reliability of the responses received and is found to be 0.871 which is acceptable

Table 1
Latent variable with its measurement items.

Construct	Measurement Items
Information Failure (Tan et al., 2016)	IF1: Digital service provides accurate information to you. IF2: Digital service provides more comprehensive information to you. IF3: Digital service provides correct information to you. IF4: Digital service provides relevant information to you. IF5: Digital service provides consistent information to you
Functional Failure (Tan et al., 2016)	FF1: Digital services are capable of assisting your needs and preferences FF2: Digital services are capable of assisting you to search for information. FF3: Digital services allows you to make comparisons of different product. FF4: Digital services allows you to purchase the product you want. FF5: Digital services allows you to track the product you purchased.
System Failure (Tan et al., 2016)	SyF1: You are able to access the services you want to access. SyF2: You feel flexible while using digital services SyF3: You require lots of effort to use the digital service SyF4: You require more time to use the digital services. SyF5: You feel secure while using digital service
Service Failure (Delone & McLean, 2003)	SeF1: Digital service makes you feel safe and provide confidence during transaction. SeF2: Digital services understand your need and gives individual attention. SeF3: The digital services are prompt to respond to your interest. SeF4: Digital services provides visually appealing facilities. SeF5: Digital services started performing from first time
Impact on Consumers (integrating DeLone & Mc Lean, 2003; Tan et al., 2016)	IC1: Failure in information of digital services affects your outcome. IC2: Failure in function of digital services affects your process. IC3: Failure in system of digital services affects your cost. IC4: Failure in services affects your satisfaction towards digital service.

according to Gefen, Straub, and Boudreau (2000). Cronbach's alpha test is used to measure the reliability test. Cronbach's alpha is a function of number of items in a test which measure the average co-variance between item-pairs and the variance of the total score. Further Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy has been done and found to be 0.859. Kaiser-Meyer-Olkin (KMO) test is used to measure how the collected data is suitable for factor analysis. It measures the proportion of variance among variables that might be common variance. The lower the proportion, the more suitable collected data is for factor analysis. KMO value ranges between 0 and 1.

During the data collection, the users who have experienced failure while using digital services were selected as respondents. The study has been done in the four metro smart cities of India (that is New Delhi Municipal Corporation (NDMC); Navi Mumbai; Chennai; and New Town, Kolkata). The difference among these four metro smart cities are the diversity in culture and social ecosystem which collectively reflects the cultural diversity of India. These four metro cities are in the northern, western, southern and eastern parts of India respectively and therefore has a decent representation of the geographic diversity of the country. However, the residents typically have a higher population from the northern, western, southern and eastern parts of India in these cities.

The reason for choosing these smart cities for the validation of our model is because of the greater possibility of these residents to use such digital services (Mustafa & Kar, 2019), which subsequently make them prone to a possible service failure experience. Users were approached in top 3 different shopping malls which have representative users from different affluence level of the society due to the brands the shops in the malls cater to. These malls also had the highest footfalls within these cities, and the identified users were provided the choice of participating in the survey either in the online or in the offline mode. The questionnaire has been filled through both offline as well as online mode. The experienced users get the online survey form individually via personal email while during the offline mode the hard copy of the survey form has been given personally. The respondent of the survey was on a voluntary basis during the online as well as offline mode. During the offline survey, 1000 hard copies of the survey instrument have been administered to the respondent, and 185 responses have been received. While during the online mode 500 emails have been sent personally to experienced users, and 65 responses have been received. A total of 230 usable responses have been considered for the study out of 250 responses received. The reason for the rejection of these 20 responses were the incompleteness. The responses rate of the offline, as well as online modes, were 18.5 percent and 13 percent respectively. The responses were divided evenly over the four smart cities. Table 1 shows the list of constructs with its measurement items.

5. Results

5.1. Demographics profile of respondents

The demographics of the data set represent the four smart cities of India concerning its cultural and geographical diversity. There are total 230 respondent of the survey done in the four major smart cities of India. There are total 161 male comprising of 70 percent of the respondent whereas the number of female respondents were 69 comprising 30 percent of the total respondent. 46 percent of the respondent belongs to the 19–24 years of age bracket whereas 30 percent of the respondents belongs to the 25–29 years of age bracket and rest belongs to the below 19 years and above 30 years of age bracket. The highest academic qualification obtained by the respondent belongs to the have bachelor degree which is 42.17 percent. The master degree holder were 38.69 percent and PhD holder were 11.30 percent and rest belongs to high schools qualification category. 73.47 percent of the respondents were student whereas 14.34 percent were employed. Some of the respondents were unemployed, self-employed, retired and home maker. Among the employed respondent 25.65 percent were in government organization, 10 percent were in private organizations and remaining were having their own business or working with NGO (Non-Government Organization). The main characteristics of the data was the association with the usage of digital services and it has been found that the 38.69 percent of the respondent were using digital services for more than 6 years, 32.17 percent of the respondents were using digital services from 4 to 6 years, 23.04 percent of the respondents were using digital services from 1 to 3 years, and rest 5.21 percent of the respondents were using digital services from past 1 years. The second main characteristics of the data was the frequency of using digital services and it has been found that 55.65 percent of the respondent were using at least 1 times a day, 33.47 percent of the respondent were using at least 1 times a week and 8.26 percent of the respondents were

using at least 1 times a month. Care was taken while identifying participants that they has faced service failure at least once while attempting to use any digital services.

5.2. Structural equation model (SEM) analysis

Structural equation modelling (SEM) has been used to validate the integrated conceptual model. SEM is a second-generation data analysis methodology which is used to test the relationships within constructs and variables with high-quality statistical analysis to meet the standards recognized by the IS researcher. SEM enables the researcher to find out the relationship among the multiple dependent and independent construct simultaneously, as well as accounting for moderating and mediating variables. AMOS 20 software has been used for this purpose of data analysis in the current study.

5.3. Confirmatory factor analysis

The Confirmatory Factor Analysis (CFA) confirms the factor extracted in the Exploratory Factor Analysis (EFA). During the confirmatory factor analysis, the convergent validity must establish. To establish the convergent validity three criteria must be satisfied. First is adequacy of model fit second is significant lambda value (factor loading) preferably greater than 0.3 and third is the value of Average Variance Extracted (AVE) should be higher than 0.5. Hair, Ringle, and Sarstedt (2011) recommends that the value of Comparative Fit Index (CFI) should be higher than 0.95 and the value of Root Mean Square Error of Approximation (RMSEA) should be less than 0.06 to achieve model fit. The recommended value depends on the sample size taken for the analysis as well. Most of the authors agree to the consensus that the cmin/df value should be less than 5.0 (Hair et al., 2011; Malaquias & Hwang, 2019), Goodness of Fit Index (GF) should be higher than 0.8 (Allam, Bliemel, Spiteri, Blustein, & Ali-Hassan, 2019; Hair et al., 2011), Adjusted Goodness of Fit Index should be higher than 0.7. CFA has been shown in Table 2.

5.4. Structural model

The value of fit index cmin/df is 1.678 which is less than 3.0, Goodness of Fit Index (GFI) is 0.88 which is higher than 0.80, Adjusted Goodness of Fit Index (AGFI) is 0.839 which is higher than 0.70, Root Mean Square Error of Approximation (RMSEA) is 0.06. All the fit indexes are in the acceptable range as per Hair et al. (2011).

5.5. Validity and reliability

The convergent validity, discriminant validity, and reliability are necessary to establish while doing Confirmatory Factor Analysis (CFA). The value of Average Variance Extracted (AVE) should be higher than 0.5 to test the convergent validity, and the value of Maximum Shared Variance (MSV) should be less than Average Variance Extracted (AVE). To test the reliability of construct the value of Composite Reliability (CR) should be higher than 0.7. Table 3 explains the correlation and reliabilities of the construct and Fig. 2 illustrates the model.

5.6. Common method Bias

Common method bias has been checked using Harmen's single factor test and is found to be 30.30 % which is less than 50 % variance explained by a single factor (Baabdullah, Alalwan, Rana, Kizgin, & Patil, 2019; Kim & Hall, 2019; Li et al., 2019; Wang, Wang, & Lin, 2018). Harmen's single factor test is a technique to identify the common method variance. During the Harmen's single factor test if one factor accounts for more than 50 % of the variance then it concludes that the substantial amount of common method bias is present. So, it has been assumed that the bias is not significant in the application of the method and from the survey data collected and analyzed.

Table 2
Results of the Confirmatory Factor Analysis.

Construct	Measurement Item	Factor Loading	Cronbach's Alpha
Information Failure (IF)	IF 1	0.47	0.793
	IF 2	0.47	
	IF 3	0.76	
	IF 4	0.72	
	IF 5	0.80	
Functional Failure (FF)	FF 1	0.67	0.913
	FF 2	0.74	
	FF 3	0.82	
	FF 4	0.92	
	FF 5	0.90	
System Failure (SyF)	SyF 1	(negative value) dropped	0.509
	SyF 2	(negative value) dropped	
	SyF 3	0.71	
	SyF 4	0.48	
	SyF 5	(negative value) dropped	
Service Failure (SeF)	SeF 1	0.55	0.760
	SeF 2	0.75	
	SeF 3	0.63	
	SeF 4	0.55	
	SeF 5	0.52	
Impact on Consumers (IC)	IC 1	0.79	0.852
	IC 2	0.90	
	IC 3	0.67	
	IC 4	0.69	
	CMIN/DF	1.678	
	GFI	0.880	
	AGFI	0.839	
	CFI	0.938	
	RMSEA	0.060	

Note: all the factor loadings are at $p < 0.001$.

5.7. Hypothesis testing

The result of the hypothesis testing has been shown in Table 4. The hypothesized path, estimates, Standardized Estimates (SE), z-value, p-value, and significance has been shown in Table 4. All the hypothesized path IF → IC, FF → IC, SyF → IC and SeF → IC are found to be statistically significant, so Hypothesis H1, H2, H3, and H4 has been accepted. It has been concluded that the information failure, functional failure, system failure, and service failure has directly affects on the outcome, process, cost, and user experience.

6. Discussion

Although numerous studies has been done for the success of information system using DeLone and McLean (1992) and Delone and McLean (2003) along with the research pertaining to the online transaction, but there is comparatively very less study has been done related to the failure of digital services. As per the literature, it has been found that there is need to address the problem related to the failure of digital services. The study has tried to address the problem faced by the consumer by joining Tan et al. (2016) model with Delone and McLean (2003) model. The step taken to address the failure of digital service is small but concrete towards the development of research agenda by constructing a theoretical model and verifying and validating it through Structural Equation Modelling (SEM).

The study provides a Digital Service Failure Model (DSFM) which highlights the impact of digital service failures (information failure, functional failure, system failure, service failure) on the users while using digital services. Moreover, the proposed DSFM provides an insight into the digital service providers on what needs to be done to

Table 3
Correlations and Reliabilities of the proposed model.

	M	SD	CR	AVE	MSV	IF	FF	SyF	SeF	IC
IF	3.53	0.543	0.785	0.434	0.771	**0.659**				
FF	3.82	0.600	0.907	0.665	0.404	0.493	**0.815**			
SyF	0.52	0.360	0.529	0.368	0.245	−0.131	−0.495	**0.606**		
SeF	2.76	0.377	0.741	0.369	0.771	0.878	0.636	−0.229	**0.607**	
IC	3.19	0.461	0.850	0.590	0.119	0.264	0.446	−0.082	0.433	**0.768**

Note: Square-root of the AVE on diagonal.
M: Means, SD: Standard Deviation, CR: Composite Reliability, AVE: Average Variance Extracted; MSV: Maximum Shared Variance.

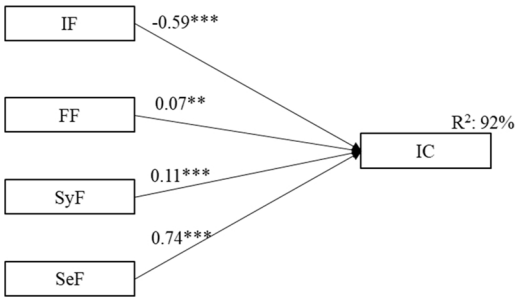

Fig. 2. Structural Model Result (**p < 0.01, ***p < 0.001).

Table 4
Result of the hypothesis test.

Hypothesized path	Estimates (Beta)	SE	z-value	p-value	Significant
H1: IF → IC	−0.59	0.044	−27.807	***	Significant
H2: FF → IC	0.067	0.040	3.152	0.002	Significant
H3: SyF → IC	0.108	0.067	5.103	***	Significant
H4: SeF → IC	0.742	0.064	34.932	***	Significant

Note: **p < 0.01, ***p < 0.001.

minimize these types of failure in the future. The DSFM is also validated empirically in the context of smart cities in an emerging economy, where the diffusion of digital services is higher. The four failure dimensions affect the outcome, process, cost and user experience of the users. This theory explains how much users are satisfied or dissatisfied with the use of product and/or services post-purchase. The expectation of the users from product/services before purchase and real experience after purchase is not the same. So, there is disconfirmation between the perceived and reality of using the product or services by the users. Later it depends on the users whether he/she is satisfied or dissatisfied with the purchased product or services. Information failure is majorly due to the disconfirmed outcome expectancy in digital services due to the process, cost and user satisfaction. Similarly, functional failure is also majorly due to the disconfirmed process expectancy and less due to the outcome, cost and user satisfaction. Again, system failure is impacted more by disconfirmed cost expectancy and less by the outcome, process and user satisfaction. Most of the time, prior researchers have used the DeLone and McLean (1992) model to evaluate the success parameters in the field of IS. Tan et al. (2016) have done an exploratory study to identify the impact of electronic commerce service failure. This DSFM is extended and integrated with DeLone and McLean (1992) model in our study.

As per the Bitner (1990) which applies attribution theory for the offline service failure using field experiment by taking survey from 145 respondents finds that consumers are very likely to be dissatisfied with the service provider when the service provider try to exercise more control over the reason for the offline service failure. The study also finds out that consumers likely to attribute service failure because of the lack of control from the service providers side when the service provider explains the reason for the failure because of external factor. Most of the time consumer see the offline service failure as a rare event when it happens in the very well-organized environment.

However, in a study by Hess, Ganesan, and Klein (2007) which use the stereotyping theory on the offline service failure to find out the dissatisfaction among the consumers using two experimental studies which includes 288 and 304 participants. The authors stressed that the failure of offline service failure is related to the dissatisfaction with the service provider which van be lowered by analysing and making excellent past service. Once the employee encounter offline service failure then the employee gets offended since they were habitual to getting excellent services in the past. With excessive control to influence consumers generalization of service failure to the service provider also leads to the failure of service. Generally, consumer attribute the reason for service failure to the service provider rather than the employees which serve the consumer. The attribution of service failure to the serving employee generally offends the employee.

DeWitt and Brady (2003) have not used any theoretical frame of reference for the offline service failure. The study evaluates the post-failure customer satisfaction and word-of-mouth of the consumer. The study has used four survey with 291, 146, 40 ad 126 responses from the consumer. The authors explain that the rapport between the consumer and the service provider increases with post-failure consumer satisfaction and decreases negative word-of-mouth. The study also explained that the rapport between the consumer and service provider leads to less complain from the consumer despite experiencing the failure of service.

Another study by Holloway and Beatty (2003) also have not used any theoretical frame of reference to evaluate the failure in online retail. The important dimensions which is covered by the study were problem in delivery, website design, customer service, payment, security, etc. The study has been conducted by interviewing 30 consumers with having experienced the e-commerce service failure before the actual survey of 295 consumer who shop through online.

McColl-Kennedy and Sparks (2003) study has used Fairness Theory as theoretical frame of reference in the offline service failure. It uses the 32 participants as a focus group study. The study finds that the whenever there is a service failure then it triggers an emotional response in the consumer which prompts them to commence an assessment of the situation by taking into account of procedural justice, interactional justice, and distributive justice.

6.1. Contribution to theory

It is interesting to note that not much of past literature has borrowed the lens of service failure and impact of such failures. Most of the research in information systems attempts to document the impact of successful adoption of new information systems to have positive impacts on the organization or user. We feel our exploration is unique in contributing to this lacuna whereby we not only analyze and investigate different failure classification, but we also integrate Tan's model (information, functional and system failure) with Delone and McLean (2003) model. Further we take on a very less explored lens of the expectations disconfirmation theory to establish the impact on consumers, which has been captured through the outcome, process, cost, and user

satisfaction.

The failure classification (information failure, functional failure, and system failure) which has been explored by Tan et al. (2016) does not capture all the different types of digital service failures. A digital service consumption like booking a hotel or a ticket often is an enabler for more interaction between the consumer and the service provider. Tan's study focuses on the e-commerce service failure in general is more focused on the buying and selling or goods and services via electronically over the internet but not specifically on digital service failure which is delivering services and not goods. Also, the specific determinants of informational, functional and system failure are not detailed out in Tan et al. (2016). Further, there was a lack of empirical validation of the model proposed by Tan et al. (2016), and this study attempts to fill the gap to do an empirical validation of the DSFM after integrating it with DeLone and Mclean Information Success Model (1992). This research paper thus advances the knowledge around service failure in general and digital service failure in particular. The classification system is based on the Cenfetelli et al. (2008) and Xu, Benbasat, and Cenfetelli (2013) for e-service quality. Since Cenfetelli et al. (2008) and Xu et al. (2013) emphasized on the attributes which are necessary for the success of digital service, it has been used to derive the parameter for the digital service failure.

It has been observed that the digital service failure depends on the non-technological failure as well like problems in the delivery of product, overcharging and not responding to the users' queries (Guriting & Oly Ndubisi, 2006; Oly Ndubisi & Sinti, 2006). Since it is not noted that the impact of the failure appears to be small, but in actuality, it becomes significantly large by accumulating of each and every type of users' failure experiences. The consequences of the failure (information, functional, system and service) have been taken into consideration to know the impact and make suitable action to correct it for the future. It has been found that the service failure is the most important and dominating factor against the information, functional and system failure.

The research implication of this DSFM is that it can be used by the future researchers to enhance the model in the field of digital service failure in different contexts of other economies and with varying levels of awareness and usage of digital services. The managerial implications of the study is that it provides managers a way to reduce service failure. The managers can identify the reasons for the failure of digital service using DSFM. The DSFM also provides a way to the manager to reduce the failure of digital service in future. The reduction in the failure of digital service will enhance the digital service success. The instances of service failure will be reduced when the manger will use the DSFM. As soon as the satisfaction of the customer improves the increase in the digital services will increase accordingly.

6.2. Implication for practice

The study will be useful to digital service providers in multiple ways. First, it extends the classification of the digital service failures (Mustafa & Kar, 2019). It has identified possible four areas of improving service delivery and service reassurance in case of failures. This is likely to help the digital service provider to address the critical reasons for its digital service failure. So, this DSFM will be of great help to explore and identify the actual reasons for such failures of the digital services in future. Moreover, the DSFM provides a way to improve their existing system to reduce the failure rates. Since the reason for the failure incident will keep on changing in the future, digital service provider will adapt accordingly to the change. By classifying the information, functional, system and service failure into outcome, process, cost, and user experience, it provides a useful insight to the digital service provider the find out the actual reasons for the digital service failure. This identification will potentially improve the future success of digital services. So, this DSFM will help to analyze those independent instances of service failure and hence will improve the users' satisfaction. The criticality of failure which is experienced by the users can be reduced by using the model.

The study will be interesting to the digital service provider since the DSFM can be useful for digital service providers since it serves as a toolkit to benchmark studies on the digital service failure classification. The DSFM can be used to evaluate weather users face difficulties while using the digital services applications. It can be noted that the digital service failure incidents can be validated and categorized as per the dimensions of DSFM. The model can be used to ascertain the digital service provider failure as well. It has been observed that the faulty digital service hamper the e-commerce more than the provider can imagine. A study by Oneupweb claims that the 45 % of the digital service fails solely because of failure in transaction. Our study highlights that the organization should focus more on the failure of service as compare to the failure of information, functional and system. Thus this failure may even be critical after the online transaction is actually completed. The service failure could comprise of activities such as delivery failure, webpage loading failure, payment service failure of online e-commerce company such as Flipkart and Amazon. Similarly, for digital services like booking of tickets or hotels online, the service providers need to bring in mechanisms of empowering consumers about their service encounters and post service consumption experience. Even if such platform may facilitate the initial booking, without mechanisms for intervention after service encounters happen, such digital services may not be considered as having presented a pleasant service experience.

Further the DSFM provides an actionable model to digital service provider to improve the quality of the digital services to the consumer. However, the model does not provide a detailed technical specification but it provides a direction as to what needs to be done to improve the quality of the digital services. Since the design of digital service is dynamic in nature and changing over the period. The DSFM provides a handy check list to find out the flaws in the digital services which is obstructing the consumer to use the digital services. It will be better from the digital service providers perspective to take necessary measure prior to the launch of the digital service rather than checking it after the lots of complain from the consumers side. It has been observed that the consumer retention in high when the digital service failure does not occur during its consumption as it increases the consumer satisfaction.

Finally, by identifying the consequences of digital service failure into disconfirmation outcome, process, cost and user experience, the model provides a clear way to the consequences of the digital service failure. This model can be useful to the digital service provider to know the high priority digital service and make most of the resources available to it. For example, it has been identified that the outcome of the transaction failure is because of the information failure then the inaccurate, incomplete, incorrect, irrelevant and untimely information needs to be checked in order to reduce the failure. Similarly, it can be understood by the analysis that the transactional failure can be compromised because of missing functionalities of the digital service such as need recognition, alternative identification, alternative evaluation, acquisition and post-purchase failure. Likewise, disconformity in the cost of digital service is because of system failure which in turn because of inaccessibility, non-adaptability, non-navigability, delay and insecurity. Conversely, the irrelevant information may not be pronounced from the consumers point of view because it does not affect the functional or system failure of the digital services and in turn it does not affects the process and cost expectancy. It has also been pointed out that the consumers dissatisfied with the digital service because of transaction activities associated with the digital services while it acquisitions. So it will be good from the digital service provides point of view to invest more on the technologies for making smooth transaction process during the digital service acquisition.

7. Conclusion

The DSFM was developed by taking Tan's failure model as a starting point and integrating this with DeLone and McLean's success model. Informational failure, functional failure, system failure) has been adapted from Tan et al. (2016), whereas service failure has been adapted from the Delone and McLean (2003) IS success model. Validation of the model shows that information failure depends on the inaccurate, incomplete, incorrect, irrelevant and untimely information experienced by the users. Functional failure largely depends on the need recognition, alternative identification, alternative evaluation, acquisition and post-purchase failure. System failure majorly depends on the inaccessibility, non-adaptability, and insecurity and since the factor loading of non-navigability and delay is in negative, so it has been dropped. Similarly, service failure depends on the unsurety, lack of empathy, non-responsiveness, intangibleness and unreliability of outcome. The expectation disconfirmation theory (EDT) has been applied in various studies like Liu and Khalifa (2003), Lankton and McKnight (2012), O'Neill, Wright, and Palmer (2003), Wang and Li (2012), Zhang, Lu, Gupta, and Gao (2015). This study used EDT to explain how digital service failure depends on the failure to meet the expectation of the users. The disconfirmation expectancies are in the form of outcome, process, cost and user satisfaction. The current study is limited to four types of failures but it can further be extended by taking different types of failure in future research undertaken in this domain.

The managerial implications of the study is that it provides managers an way to reduce service failure. The managers can identify the reasons for the failure of digital service using DSFM. The DSFM also provides a way to the manager to reduce the failure of digital service in future. The reduction in the failure of digital service will enhance the digital service success. The instances of service failure will be reduced when the manger will use the DSFM. As soon as the satisfaction of the customer improves the increase in the digital services will increase accordingly. The examples of managerial implication.

7.1. Limitation and future research directions

The main limitation of this study is that data collection has been done on only four major smart cities of India. While that is representative of the needs of residents in these metro cities, this DSFM model can be further validated with the other smaller smart cities as identified by the Govt. of India. Further, a cross-cultural validation of this model with other developed, emerging and developing economy would also be an interesting study. The four types of a digital service failure (information failure, functional failure, system failure, and service failure) can be further added with more new variables identified from the literature or as per the need over the period. The model can be further enhanced by taking specific variables from the users' as well as the provider's perspective. This study has been developed by analyzing the responses from the users who have experienced the failure of digital service in the past. So, in the future, this model may be further validated with the responses taken from the service provider's perspective and from the perspectives of domain experts in digital service who have experienced the failure in the recent past.

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Ethical approval

The study is exempted from the approval of ethics committee.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

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