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Effects of successful adoption of information technology enabled services in proposed smart cities of India: From user experience perspective

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Abstract

Purpose – The purpose of this paper is to understand the effects of successful adoption of information technology (IT)-enabled services to be provided in the proposed smart cities of India from end-user-experience perspective.

Design/methodology/approach – This paper has taken a sincere endeavor to understand to what extent the success of the smart cities depends on the users' experience of the IT-enabled services, the backbone of smart cities, and how using IT-enabled services can improve the quality of the users' lifestyle. Initially, few hypotheses have been developed from literature review, followed by structured questionnaires. Once the data were collected, they were analyzed using different statistical tools. This paper will be useful for the policymakers, specifically those who are involved in technology and IT-governance-related areas, in policymaking for the proposed smart cities in India.

Findings – This study tries to find how the IT-enabled services would transform the lives of residents both socially and technologically; to what extent the prospective citizens will be engaged to use the modern services; to what extent the threat of privacy and security issues affects the overall performance of the proposed smart cities of India; and how gaining trust of the citizens could help in successful adoption of IT services. This paper tries to find out few of these questions from the city residents' perspective.

Research limitations/implications – This study is undertaken keeping Indian smart cities in perspective. However, in India, the proposed smart cities are in different states. In fact, the respondents selected by the authors are not the true representatives of the whole population, which is spread covering all parts of India. This paper could have implications for policymakers in drafting the smart city policy in India especially from IT-governance and user-experience perspective.

Practical implications – As this study discusses proposed smart cities of India from IT-enabled services and from the citizens' perspective, it will have a huge practical implication once these smart cities become operational in India.

Social implications – This study discusses the IT-enabled services expected to be provided to the citizens of the proposed smart cities of India. As the paper discusses about the citizens' perspective and the proposed smart cities of India, it definitely has social implications especially since the study is related to the citizens of proposed smart cities of India.

Originality/value – The research reported in this manuscript is the outcome of in-depth study on proposed Indian smart cities especially from IT adoption and from users' perspective. Very few studies have been carried out on proposed Indian smart cities from IT adoption perspective and how that could improve the lifestyle of the residents.

Keywords Innovation, Privacy, Security, User experience, Smart city, E-governance

Paper type Research paper

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Introduction

Few cities, mostly in developed countries, have already taken a new shape with updated and modern facilities where different information technology (IT)-based digital services are readily available to their citizens. These cities where all modern amenities and facilities are mostly based on IT platform are called "Smart Cities". Practically, urban settings have undergone thorough changes due to substantial and accelerated development of Information and Communication Technology (ICT). The cities are becoming smarter as a consequence of enhancement of e-governance-related services provided to their residents. This also improves the economy of those cities, which in turn eventually improves the economic health of the whole country. Hence, conversion of cities to smart cities would improve gross domestic product (GDP) of that country. Probably with this contemplation, the Government of India has decided to create or convert cities to make them what we may call "smart cities", where all the services available to the citizens would be IT-enabled. Government of India, through its "Ministry of Urban Development", has adopted an exhaustive, comprehensive and implementable detailed plan to develop and enhance the living standards of residents of cities and has taken an initiative to upgrade or to newly set up 100 cities having all the modern amenities and facilities, mostly based on IT platform, to create "smart cities". However, with the effort from Government and private enterprise, there are few smart cities in progress in India, which are in their advanced stages. Few of the smart cities which are in progress are Lavasa in Maharashtra, Gujarat International Finance Tec-City in Gujrat and Nano-city in Haryana. It is expected that digital services to be provided in the proposed smart cities of India would play a vital role because these services are expected to enhance the quality and performance of the services available to the users. With the help of internet and IT-enabled services in proposed smart cities of India, it is expected that it would reduce costs, increase efficiency and automate services and it would become an active channel to connect with the citizens in a more effective and pragmatic manner (Kai *et al.*, 2008; Cai *et al.*, 2009). Few of the services to be provided in the proposed smart cities of India include transportation, government services, health care, traffic, energy sector, housing, water supply system and waste management activities. This is the reason why sometimes "smart cities" are called "Digital Cities", "Intelligent Cities", "IT Cities", "Cyber Cities", etc., as the backbone of these cities is IT-enabled digital services. Thus, we can say a city can be converted to a smart city with the help of IT-enabled services if it has a balanced economy and overall development in social and environmental sectors (Caragliu *et al.*, 2011). To realize the vision of smart cities of India, the concerned authorities must be very much vigilant to see to it that the citizens are actively taking part and using the IT-enabled services provided to them. In other words, unless the citizens of the proposed smart cities of India use all the available facilities provided to them, the entire mission could be futile. The facilities could be underused. It could be the recipe of a total failure (Kickbusch and Gleicher, 2014). Technology adoption in modern cities could improve the economic health to a great extent, which eventually improves the GDP of the country as a whole (Beaudry and Green, 2002; Comin and Hobijn, 2004; Foster and Roseuzweig, 2010). Smart cities have been defined in several ways, which need to be conceptualized for dealing with its degree of performance in the light of the extent of usage by the concerned citizens. The UK department of Business, Innovation and Skills has defined "Smart Cities" as:

> It does not consider "Smart Cities" as a static outcome but on the contrary, considers it as a continuous process of improvement by the help of involvement of citizens, use of hard infrastructure, use of modern technologies which would ultimately make the cities livable, resilient and capable of combating challenges.(Smart Cities Background Paper; London, 2013)

The British Standard Institute (BSI) on the contrary has given the definition of "Smart Cities" as "The effective integration of physical, digital and human systems in the built environment to deliver sustainable prosperous and inclusive future for its citizens" (Smart Cities Framework; British Standard Institute, 2014). IBM has defined "Smart Cities" as "one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimized the use of limited resources". CISCO defines a "Smart City" as "scalable solutions that take advantage of ICT to increase efficiencies, reduce costs, and enhance quality of life" (Falconer Mitcheli, 2012). Manchester Digital Development Agency has defined "Smart City" as "smart city means smart citizens – where the citizens have all the information they need to make informed choices about their lifestyle work and travel options". Here it is evident that unless the digital facilities to be provided to the citizens in proposed smart cities of India are properly used by the citizens, the success of the smart cities will be severely lagged. So, there must be necessity of availability of ICT infrastructure for enhancing overall growth including appreciable and enhanced citizens' involvement in using the IT-enabled services, and government authority should try to reach out to the citizens to get the citizens actively engaged in using those digital services. It is a fact that these IT-based services would cover a wide range of services for the citizens compared to the contribution of solely e-government operations. However, to create a smart city, the e-government needs to be proactive. Practically, the proposed smart cities of India would be operating optimally if the concerned civic authorities provide all the services on a digital platform and if such services are consumed by citizens on a regular basis with their full potential. In this paper, in-depth studies have been undertaken to assess how the living standard of the citizens, by using IT-enabled services, would improve? How these IT enabled services, contemplated to be provided in smart cities of India, would transform the lives of residents both socially and technologically? How the extent of personal creativity and innovativeness (PCI) of the prospective citizens can influence the quality of lives toward improvement? To what extent the prospective citizens will be engaged to use the modern services? To what extent the threat of privacy and security issues negatively affect the overall performance of the proposed smart cities of India? How by gaining trust citizens could become more interested in using IT-enabled services? These issues have been discussed in this paper and have been assessed through conceptualization by the help of replies obtained from congenial resources by using card scoring procedure (Moore and Benbaset, 1991) which is a part of research methodology. To plug up menace of bias, the results are based on feedback obtained from structured and relevant questionnaires put to different respondents from multiple sectors. Measurement of items has been computed in a quantifiable manner through five-point Likert scale, ranging from 1 to 5, where necessary. The varied qualities of the respondents have been taken and their veracity has been tested to assess the extent of bias through Chi-square test; detailed analysis of the results has been made through different standard statistical approaches including *t*-test. For predicting some specific hypotheses, detailed background studies have been undertaken by the help of literature review, and the hypotheses have been duly validated after analyzing the data. The results so obtained have been discussed and a meaningful conclusion has been drawn. Some of the aspects in this paper could not be touched, which have been mentioned as limitations, leaving those as an unaccomplished task for future researchers.

Literature review and research hypotheses

Detailed background studies have been carried out keeping focus on the users' experience. There are only few effective, substantial, pragmatic works done in this area and are not to the desired level. However, we have gone through the available literature so that it could contribute

toward better conceptualization and understanding of the user aspects of smart cities in a comprehensive manner. Thus, study of the user experience (UE) aspect, as far as digital service usage is concerned, could help to assess how to improve the overall performance and success rate of these smart cities. Growth of economy of a country, in general, depends on the pace of growth of its cities; thus, cities could act as an effective source of economic growth in resource potential domain, consumption domain and also in production domain (Black and Henderson, 2003; Duranton and Puga, 2007; Pumain and Moriconi-Ebrard, 1997). Growth of cities affects economy of the country, and this idea has provoked many researchers to study on urban development issues (Friedman, 1986; Beaverstock *et al.*, 1999; Knox and Mc Carthy, 2005; Kourtit *et al.*, 2011; McCann, 2008; Sassen, 2006). The citizens of the smart cities are expected to keep their digital records for permanent preservation into the electronic devices or in cloud, and thus, they could become potential victims of privacy thefts. However, by frequent use of different digital mode of services, the response will be faster, paperless, flawless, etc., which would enhance the efficiency of the system and would likely improve the quality of life (QL) (Abdel-Rahaman and Fujita, 1990; Becker *et al.*, 2003; Duranton and Puga, 2007; Glaeser *et al.*, 1992; Quigley, 1998; Dendaal, 2003; Kulkki, 2014):

H1a. Frequent usage of IT-enabled services by the residents of smart cities will have positive impact on their living standards.

H1b. Frequent usage of IT-enabled services by the residents of smart cities would improve their perceived QL.

Since both hypotheses are referring to similar issues, we can merge them and make it a single hypothesis.

H1. Frequent usage of IT-enabled services by the residents of smart cities will have positive impact on their living standards, improving the perceived quality of lives.

There is a sharp distinction between service innovation and product innovation because food of service innovation also comes out from activities required to solve problems (Bygstad and Lanestedt, 2008; Mansury and Love, 2008). Improvement of technology also enhances appreciably level of social interaction. To realize the adoption of IT services, not only the technological aspects but also the social aspects should be considered. Using modern technology services, which are very interactive, is one of the essential factors for perceived enjoyment (Ratten, 2009; Brown and Brudney, 2003; Castells, 1996; Ebrahim and Irani, 2005; Eager *et al.*, 2000). Thus, with introduction of new IT-based services and functionalities, when brought in the proposed smart cities, it is required to assess how the users are accepting that, and for that, model demonstration among the prospective and potential users might be helpful. Thus, before introduction of new IT-based services in proposed smart cities of India, authorities are required to undertake some homework like examination of the extent of acceptance by the potential users and behavioral pattern of the potential users of that particular place. It has been ascertained that perceived characteristics concerning such innovation have a positive effect on the behavior of the adopters as to how they would accept such a new technology associated with e-government system (Carter and Belanger, 2005; Gilbert *et al.*, 2004; Shareef *et al.*, 2007; Harrison *et al.*, 2010; Hartley, 2005; Hollands, 2008):

H2a. Innovation in IT-enabled services will transform the lives of residents of proposed smart cities both socially and technologically.

H2b. Innovation in IT-enabled services will transform the lives of residents of proposed smart cities, and this will have a positive impact toward improving the perceived living standards.

Since both hypotheses are referring to similar issues, we can merge them and make it a single hypothesis.

H2. Innovation in IT-enabled services will transform the lives of residents of proposed smart cities both socially and technologically and this will have a positive impact.

The usage of IT-based services by the citizens also depends on the creative and innovative capabilities of the citizens. If they are open to innovation as well as willing to engage with creativity, naturally they will have an acceptance toward the modern IT-based systems. The digital services (Rogers, 1995; Gil-García and Pardo, 2005) are needed to be provided in the proposed smart cities of India. The knowledge of innovation and capability of modern services expected to be provided in the proposed smart cities of India (Agarwal and Prasad, 1998) would help citizens adopting new digital services much quicker. Also, by adopting the digital services, the quality of the lives of the citizens would be improved. Also, the political atmosphere, properly defined accountabilities among Government departments as well as availability and awareness of information would propel the adoption of digital services in proposed smart cities of India (Rocheleau, 2003; Coccoli *et al.*, 2014; Adorni *et al.*, 2012):

H3. The concept of personal creativity and innovativeness positively impacts the overall creativity and innovativeness.

Human nature and human behaviors are of peculiar nature because they mostly depend on the prevailing social atmosphere (Ratten, 2009). It is very natural and inevitable that citizens residing in a place would be highly influenced by the nature and environment of the place, they will be appreciably influenced by their neighbors, which eventually will have effective and appreciable impact over their own judgement as well as over their behavioral attitudes. Thus, citizens' behavior and standard of judgement are flexible and not rigid, depending on many external factors (Casakin *et al.*, 2015; Emeakaroha *et al.*, 2014). To what extent a citizen would be involved with the antecedents of the city depends on where he/she resides as well as his/her gathered experience derived from interaction with other citizens of that city. Interaction among the citizens has a colossal impact on the extent of engagement of citizens with the affairs of the city where they reside. Behavior of citizens is also influenced by the activities of the other citizens of that city and particularly depends on their neighbors. Thus, environmental perception counts very much regarding engagement and commitment of the citizens toward affinity to use IT-based services expected to be provided to them (Nfuka and Rusu, 2010; Belenche *et al.*, 2016; Hidalgo and Hernández, 2001; Stedman, 2002; Florek, 2011; Marceau, 2008). Citizens who naturally get involved in civic activities on their own without being provoked by any external influence are called active citizens. They raise their voices in the civic works, become loud in protest if anything goes wrong and create an ideal example in their community. These active citizens are found to sometimes act with political bias and sometimes, and sometimes without any political alignment. Both have contributed to the society, as their activities influence others toward actively using IT-enabled services (Sherrod *et al.*, 2002; Ehrlich, 2000; Colby *et al.*, 2003; Zhu, 2000, Johnson, 2008). It is contemplated that the IT services to be provided in proposed smart cities of India managed by the local civic authorities will be mainly for modernization of the city, and if the citizens are profoundly engaged in using these services, it will be beneficial for the city and if

they are committed, it would have an impact toward full utilization of digital services, enhancing overall improvement (King and Coterill, 2007; Lam, 2005):

H4. Proper engagement and commitment to use IT enabled services by residents of smart city increases the usage of IT-enabled services

It should to be kept in mind that, the civic authorities, for the proposed smart cities of India, only providing seamless, cashless facilities through IT-based services to the citizens would not totally help toward improvement of the efficiency of the smart city but, on the contrary, the civic authorities responsible for developing and launching of IT-enabled modern services to the citizens should initially make the citizens aware regarding the benefits of the services, which then would derive the use of the digital services, motivating citizens to accept and subsequently use the newly introduced IT-enabled services. It is also necessary that the civic authority be vigilant about the fact that such newly introduced services are available to the citizens without any abrupt interruption keeping the same standard of quality. The IT-enabled services scheduled to be available to the prospective citizens should be explicitly explained by the concerned civic authorities to the citizens, in terms of quality and software, to make the users realize that using the service can help them effectively reach their goals. Thus, quality of the IT services would play a very crucial role in terms of acceptance of a service in a regular manner (Kumar *et al.*, 2007; Merhi and Koong, 2013; Shareef *et al.*, 2011):

H5. The perceived good quality of IT-enabled services in smart cities of India would increase the usage of IT-enabled services, enhancing adoption of digital services by the citizens of proposed smart cities of India.

Another important aspect which may highly and adversely affect the citizens of the proposed smart cities of India regarding the usage of IT-enabled services is privacy and security issues. In proposed smart cities, definitely IT-related services would include digitalized transactions and transactions through smart cards. When the citizens will use these, they will be highly concerned regarding the menace of security threat and will be doubtful about their privacy being protected. Of course, the level of conception of privacy depends upon the extent of depth of knowledge of the citizens regarding IT-enabled services. Citizens having superficial knowledge about IT-enabled services will always suffer from concerns regarding their security and privacy, thinking their private data may not be protected and might be used in a wrong way, which would cost them adversely, incurring a great loss to them eventually (Casaló *et al.*, 2007; Gunawong and Gao, 2010; Okhubo, 2008; Bartol *et al.*, 2011; Hosmer, 1995). Those who are highly concerned about their security and privacy will definitely use IT-enabled services less often (Rothensee and Spiekermann, 2008; Teleghani *et al.*, 2010; Kerilis *et al.*, 2013):

H6. Lack of perceived privacy (PP) negatively affects the trust level (TL) of residents of smart cities.

H7. Lack of perceived security (PS) negatively affect the TL of residents of smart cities.

If a citizen uses an IT-enabled service several times and finds that he/she is not deceived nor has his/her private data been hijacked or security snatched, a sense of trust would grow in the citizen's mind and the citizen would be encouraged to be engaged in using those services further. Frequent use thus helps develop trust (Agarwal and Prasad, 1998). If a citizen watches that another citizen is using one particular IT-enabled service with ease and is not cheated, a trust would develop in the citizen's mind and the citizen would not hesitate to be

engaged using the same IT-enabled service. Thus, to get the citizens more and more engaged in using IT-enabled services, civic authorities of the concerned proposed smart city would need to arrange programs and campaigns enhancing the awareness and trust in the mind of the users so that they can get themselves engaged using these IT-enabled services without any fear (Shih and Venkatesh, 2004; Venkatesh *et al.*, 2008; Compeau *et al.*, 2007):

H8. As the TL of the citizen increases toward IT-enabled services, it positively impacts and increases the usage of IT-enabled services.

From the background studies, process of measurement has been developed by framing relevant questionnaires to the context of the discussion after being modified ae per the opinion of experts. The respondents selected were of varying age groups, had different affinities to be engaged in using the IT-enabled services, were of both the genders and were from varied educational backgrounds to avoid unwanted bias. After obtaining results, different tests have been conducted to analyze the results, and the results also have been validated with the hypotheses derived from the background studies. Based on all these procedures, including background studies as well as assessing frequency of usage of IT-enabled services, a framework of study has been developed and shown in Figure 1.

Research methodology

The background studies so far undertaken gave much food for reflection toward ascertaining the process of measurement. For avoiding any flaw in the measurement system, we have adopted card scoring procedure, which is comparatively simple to handle (Moore and Benbaset, 1991). It was necessary to prepare a questionnaire that is specific, pragmatic, defectless, unambiguous and very much relevant to the target. To ensure these, we have duly consulted six experts from the fields of information systems, researchers of smart cities in India, Central Government officials who are engaged in smart cities policy formulation as well as experts from the industries on security and privacy fields to develop the questionnaire. The questionnaires covered constructs fitting with measurement items as shown in Table I.

All measurements concerning construct variables have been done using the Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Majority of the respondents were from northern [mostly Delhi or National Capital Region] and eastern (mostly Kolkata and surrounding areas) part of India, as we have few conferences and other seminars scheduled there in those parts of India; thus, convenience and random sampling technique was used in this case. Apart from that, we have distributed online questionnaires too for few of the participants who were scattered across India. Also, the duration of the data collected was

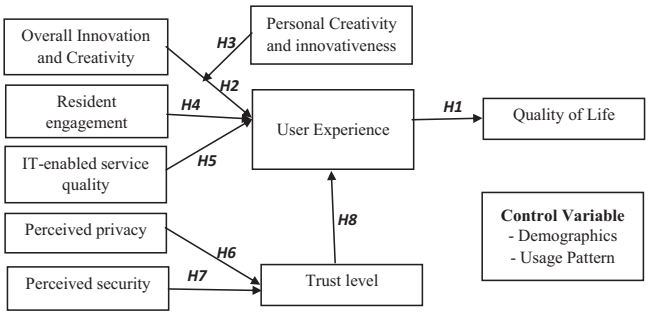

Figure 1.
Research framework

Constructs	Items: Measurements
Innovation and creativity (IC)	IC1: System is creatively designed so that it can be used by different kinds of people having different socioeconomic background, different educational level, different cultural sensitivity, etc.
	IC2: The services provided to the residents are visible and the residents are aware
	IC3: The IT services provided to the residents are compatible, i.e. the services are being consistent with the residents' values, needs, prior experience, etc.
	IC4: The digital services are available from different platforms, i.e. mobile, personal computer, etc.
	IC5: The services can be tested with limited resource as and when required to be tested
	IC6: Usage of IT-enabled services enhances the status of the residence than those using the older manual/paper-based processes
Personal creativity and innovativeness (PCI)	PCI1: Residents understand the system well with limited knowledge of IT
	PCI2: The functionalities of the services are well used by the residents
	PCI3: The systems are being personalized by the residents, i.e. use the IT-enabled services as per the requirements
	PCI4: The residents can use the IT-enabled services creatively while saving time and effort
	PCI5: The acceptance rate of new services to one resident can be different from the other resident
Resident engagement (RE)	RE1: Residents are well connected with the civil authorities via different e-governance services
	RE2: The government uses the e-governance mode to deliver different services to the residence
	RE3: Residents are participating in different community services using IT-enabled services
	RE4: Residents of smart city are socially engaged with different IT-enabled services
	RE5: Government provides different sorts of information to the residents using digital media
	RE6: Community participation of residents are well established using different digital modes of services
	RE7: Residents' usage of digital IT-enabled services in every sphere of life enhancing the life style
	RE8: Civic involvement using different IT-enabled services is well established
	RE9: Residents are well advised and trained to use IT-enabled services
IT-enabled service quality (SQ)	SQ1: The IT-enabled services are efficient and user friendly to the residents of smart city
	SQ2: The functionalities are adequately designed to meet the needs of the residents with full satisfaction
	SQ3: The systems are well maintained providing good-quality services to the residents
	SQ4: The information is continuously updated with latest information in place
	SQ5: The system is reliable and it maintains the performance as per the requirements
User experience (UE)	UE1: Residents having ease of use of IT-enabled services in the smart city
	UE2: The users feel good using IT-enabled services
	UE3: The residents having positive attitude to use the IT-enabled services

Table I. The constructs and indicators of the framework

(*continued*)

Constructs	Items: Measurements
	UE4: The design of the IT-enabled user interface satisfies the user needs and meets the criteria
	UE5: The residents would well adopt the IT-enabled services with maximum functionalities
	UE6: The training or learning time requirement to use the IT-enabled services is low
Perceived privacy (PP)	PP1: Information of the residents is not disclosed to unwanted authorities or personals
	PP2: Citizens' image, voice, etc. are not distributed without the consent of that citizen to some other unwanted person or authority
	PP3: Perceived propensity of threat to lose personal information submitted to get different services
	PP4: Confidentialities of information of the residents remains protected
	PP5: Information is not linked to any department without the proper approval from the concerned resident
Perceived security (PS)	PS1: The security aspect of the IT-enabled system is not compromised under any circumstances
	PS2: The perceived threat of data stolen from the IT system
	PS3: The people working to secure the IT-enabled services of the smart city are adequately trained
	PS4: Residents are adequately trained and aware of how to use the IT-enabled services safely and securely
	PS5: Residents are well protected from any security threat
	PS6: IT-enabled services provided to the residents of smart city are having a high degree of security features which can keep the digital services fully secured
Trust level (TL)	TL1: Perceived integrity of the system remains intact
	TL2: Perception of residents about the government's ability to protect them from security and privacy threats
	TL3: Smart city residents trust IT-enabled system and believe in it
	TL4: Resident's perception on ability to provide trusted IT-enabled government's services
	TL5: Provide reliable services to the residents of smart city
Quality of life (QL)	QL1: Perceived physical well-being, safety, security, healthy life style, good avenues will improve
	QL2: Perceived ability to do things by citizens themselves enhancing self-reliance
	QL3: Would improve quality of social activities, more participation in community work, better social security as well as good relationship with others in society
	QL4: Would enable personal achievement, self-actualization, success of achievement, good environment

Table I.

June 2015 to December 2016, mostly from northern and eastern part of India. The questionnaire captured the demographic information of the respondents. Age of all participants was more than 18 years. In selecting the respondents, we have contacted both male and female participants having varied educational qualifications to avoid any bias in the results. Of the 346 questionnaires distributed, we received 290 responses (70.4 per cent male and 29.6 per cent female), making the rate of response 84 per cent. Among the male respondents (204), 11.4 per cent had qualification higher secondary, 65.3 per cent were graduates and 23.3 per cent were postgraduates with age ranging 18 to 30 years 21.2 per

cent, 31 to 40 years 30.3 per cent, 41 to 50 years 11.4 per cent, 51 to 60 years 17.1 per cent and above 60 years 20 per cent. Again, among the female respondents (86), 4.5 per cent had qualification higher secondary, 77.2 per cent were graduates and 18.3 per cent postgraduates with age covering the range 18 to 30 years 23 per cent, 31 to 40 years 44.2 per cent, 41 to 50 years 6.6 per cent, 51 to 60 years 14.2 per cent and above 60 years 12 per cent. The entire scenario is shown in Table II.

In our study, we did contact different people who would be/are willing to live in proposed smart cities of India, and these respondents, irrespective of their genders and age range, did hold different posts in their respective fields including implementation and deployment of IT-enabled services. This has been done to ensure that the generality is not lost in the conclusion (Podsakoff *et al.*, 2003).

Results

Here we have used the Exploratory Factor Analysis (EFA) to uncover the underlying structure of the relatively large set of variables in this study. Here we should mention that EFA is a technique which tries to identify the underlying relationships between different measured variables. Table III shows the results obtained from EFA, and we can see the different factor loading and the corresponding composite reliability (CR) is also provided for each construct. We have used SPSS and AMOS v18 tool for calculating loadings and other statistical calculations. EFA results are developed in Table III where standard factor loading and CR are given.

It appears with reference to own construct that each of the loading factors is greater than 0.70, for example, for construct "Innovation and Creativity (IC)", the loading factors are 0.72, 0.91, 0.75, 0.82, 0.81 and 0.79. Besides, from this result, it also appears that the cross-loading factors are all below 0.4 (Bollen, 1989). It also appears from Table III that composite reliabilities are 0.84, 0.83, 0.88, 0.89, 0.88, 0.92, 0.91, 0.92 and 0.82. It appears that each of the composite reliabilities is greater than 0.70, which is accepted as cut-off point. From Table IV, it is seen that all the Pearson Correlation Coefficients in reference to the constructs (IC, PCI, resident engagement [RE], IT-enabled service quality [SQ], UE, PP, PS, TL and QL) lie in the range 0.11 to 0.69, and that average variances computed are 0.92, 0.78, 0.75, 0.81, 0.77, 0.81, 0.82, 0.91 and 0.78, each being greater than 0.50, and the square roots of these averages shown in the diagonals also are found to be more than 0.50 each. Now in the below table we will find out the Average Variance Extracted (AVE) of this study. The AVE is a classical test theory where the average variance is extracted and it is a measure of the amount of the variance which is being captured successfully by the constructs of this study with relation to the amount of variance due to the measurement errors.

Table II.
Demographics of the respondents/ participants of the survey

Gender (%)	Education level (%)	Age (%)
Male: 70.4	HS: 11.4	18-30: 21.2
	Graduate: 65.3	31-40: 30.3
	PG: 23.3	41-50: 11.4
		51-60: 17.1
		>60: 20
Female: 29.6	HS: 4.5	18-30: 23
	Graduate: 77.2	31-40: 44.2
	PG: 18.3	41-50: 6.6
		51-60: 14.2
		>60: 12

Construct	Indicator	Loading	Composite reliability
Innovation and creativity (IC)	IC1	0.72	0.84
	IC2	0.91	
	IC3	0.75	
	IC4	0.82	
	IC5	0.81	
	IC6	0.79	
Personal creativity and innovativeness (PCI)	PCI1	0.88	0.83
	PCI2	0.87	
	PCI3	0.77	
	PCI4	0.79	
	PCI5	0.82	
Resident engagement (RE)	RE1	0.88	0.88
	RE2	0.87	
	RE3	0.91	
	RE4	0.86	
	RE5	0.92	
	RE6	0.77	
	RE7	0.80	
	RE8	0.85	
	RE9	0.79	
IT-enabled service quality (SQ)	SQ1	0.81	0.89
	SQ2	0.77	
	SQ3	0.78	
	SQ4	0.72	
	SQ5	0.85	
User experience (UE)	UE1	0.82	0.88
	UE2	0.85	
	UE3	0.79	
	UE4	0.78	
	UE5	0.81	
	UE6	0.84	
Perceived privacy (PP)	PP1	0.91	0.92
	PP2	0.87	
	PP3	0.92	
	PP4	0.88	
	PP5	0.93	
Perceived security (PS)	PS1	0.87	0.91
	PS2	0.88	
	PS3	0.91	
	PS4	0.83	
	PS5	0.81	
	PS6	0.86	
Trust level (TL)	TL1	0.93	0.92
	TL2	0.89	
	TL3	0.96	
	TL4	0.92	
	TL5	0.95	
Quality of life (QL)	QL1	0.77	0.82
	QL2	0.85	
	QL3	0.81	
	QL4	0.89	

Table III.
Standardized factor loading and composite reliability

The path analysis for the model of the research has been shown in Figure 2. It illustrates the results derived using Structural Equation Modeling (SEM) as shown in Table VI. From Figure 2 it is noticed that among the path coefficient of interaction in between innovation, creativity and personal creativity, innovativeness appears to be very much significant having level of confidence 95 per cent.

In Table V in respect of gender, education and age, with regard to control variables, results of Chi-square tests have been shown. This control variable does not change throughout the experiment, and in this case, the control variables are demographics consisting of gender, education and age for this experiment. Now, in Table V, we will show the Chi-square tests on control variables of demographics. This test is used to understand if there is a significant relationship between the categorical variable which in this case are gender and educational qualification. Here we should mention that we have more than one categorical variables to test the independence for each of these variables. The below table explains the details of Chi-square tests on control variables of demographics.

In Table VI SEM fit indices are shown. In SEM, the fit indices establish whether the overall model is acceptable or not. Structural Equation Modeling helps to understand the acceptability of the overall model and helps to identify the significance of the specific paths in the proposed model. The acceptable fit indices do not essentially indicate whether the path relationships are strong or not. Here, in our case, many of the fit indices are derived from the Chi-square value as shown in Table VI. Basically, the Chi-square value in this case represents the difference between observed covariance and the model covariance matrix. The fit indices are classified into different classes such as discrepancy functions (Chi-square

Table IV.
Correlation matrix and reliability analysis by AVE*

Construct	1	2	3	4	5	6	7	8	9	AVE
IC	0.96									0.92
PCI	0.63	0.88								0.78
RE	0.28	0.34	0.87							0.75
SQ	0.52	0.28	0.58	0.90						0.81
UE	0.56	0.61	0.32	0.61	0.88					0.77
PP	0.26	0.17	0.15	0.16	−0.18	0.90				0.81
PS	0.25	0.16	0.17	0.15	−0.19	0.91	0.91			0.82
TL	0.29	0.15	0.18	0.20	0.61	−0.68	−0.67	0.95		0.91
QL	0.33	0.35	0.30	0.66	0.58	−0.12	−0.11	0.48	0.88	0.78

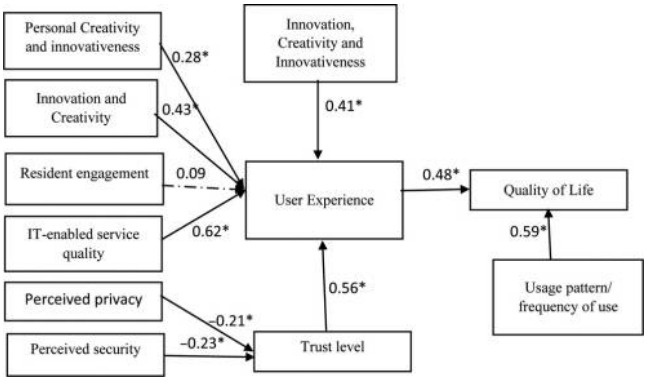

Figure 2.
The path analysis for the research model

test, Root Mean Square residual, etc.); tests which compare the target model with the null model such as Comparative fit index (CFI), Normed fit index (NFI), Tucker fit index, Incremental fit index; information theory goodness-of-fit tests such as Akaike Information Criterion (AIC), Bayesian Information Criterion, Consistent AIC (CAIC) as well as non-centrality fit measures such as non-centrality parameter. The following Table VI shows different fit indices using SEM technique.

All the results so obtained shown in different tables and Figure 3 illustrate many important issues and indicate, besides other inferences, to what extent the eight hypotheses already developed are accepted or dropped. The loosely connected constructs are shown by the dotted line where its value is shown. It is 0.07 between the constructs innovation and creativity and QL. It is 0.08 between resident's engagement and QL. The value is 0.11 between the constructs IT-enabled service quality and QL, and 0.09 between the constructs resident's engagement and users' experience in using IT-enabled services along with the adoption of IT-enabled services in the proposed smart cities of India. All the above relationships are shown in Figure 3 using path analysis where dotted line is used.

Discussion

Results show that each of the values of loading factors (Table III) is more than 0.70 and cross-loading factor of each is below 0.40; hence, it is evident that all the items loaded are closer to their own construct compared to their closeness to other constructs. This result responds positively discriminant validity and convergent validity of the constructs (Brown and Chin, 2004). Here we should mention that convergent and discriminant validity both are the subcategory of construct validity and they both together help to validate the construct

Control variable →	Gender			Education			Age		
Overall model ↓	x^2	*df*	*p-value*	x^2	*df*	*p-value*	x^2	*df*	*p-value*
Unconstrained	740.55	522		872.33	781		1076.67	1042	
Fully constrained	762.64	531	0.003	896.76	790	0.012	1094.56	1051	0.033
Difference	22.09	9		24.43	9		17.89	9	

Table V. Chi-square tests on control variables of demographics

Fit index	Judgment	Research model	Competitive model
x^2		632.35	615.76
p-value		0.019	0.033
df		262	259
x^2/df	$1 < NC < 3$	2.41	2.38
GFI	>0.92	0.95	0.86
AGFI	>0.86	0.88	0.82
CFI	>0.93	0.92	0.88
RMSEA	<0.08	0.06	0.08
NFI	>0.94	0.96	0.85
TLI	>0.91	0.97	0.87
AIC	As small as possible	102.33	198.97
CAIC	As small as possible	203.43	440.78

Notes: GFI = goodness of fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean square error of approximation; TLI = Tucker Lewis index

Table VI. SEM fit indices

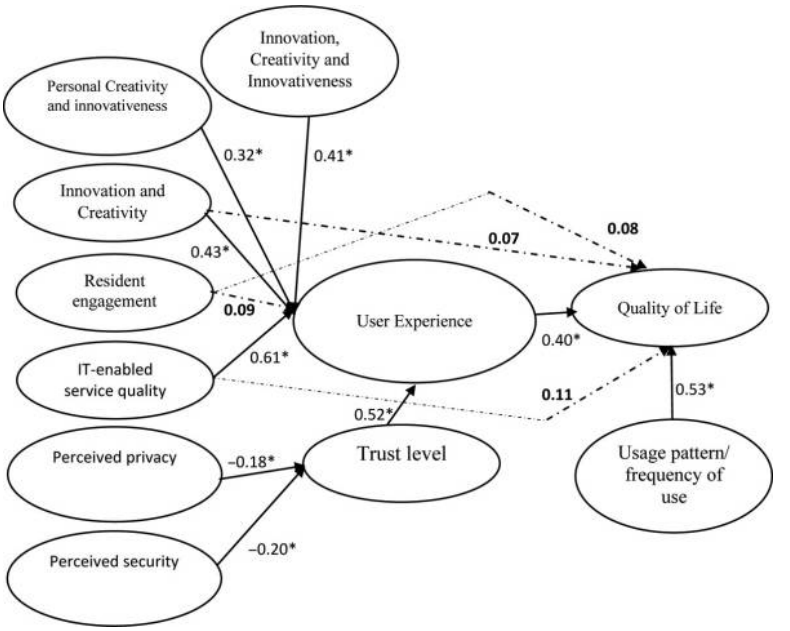

Figure 3.
The path analysis for the competitive model

validity. Here in this study we can see the evidence of both convergent and discriminant validity, which demonstrate together for construct validity. Here we should also mention that convergent validity or discriminant validity alone is sufficient for establishing the construct validity. Now to establish the degree to which the constructs are related to each other, we have used the correlation coefficient which helps to understand the patterns of intercorrelations among the construct. Here we should mention that the correlations between similar measures theoretically should be high and in this case, it is 0.69, and the dissimilar measures should be very low and in this case, it is 0.11. Thus, in this study, all the Pearson Coefficients lie between 0.11 and 0.69 as shown in Table IV, which helps to infer that there does not exist any problem of multicollinearity in matters relating with SEM analysis. Again, from Table IV, it is seen that each value of AVE is greater than 0.50 and each square root of AVE also exceeds 0.50, which gives an indication that each item has a very close relation and as such aligned with its own construct than the others. It also indicates that all the indicators relating to the corresponding construct are very much reliable and valid (Fornell and Lareker, 1981). To test the research model, SEM results used have been highlighted in Figure 2. From the knowledge of the indices of model fit available in Table VI, it can be inferred that the proposed research model is absolutely valid (Schumacker and Lomax, 2004). Hence, except *H4* shown through dotted line in Figure 2, all the hypotheses are valid and echo the results so obtained. Result also indicates that extent of acceptance and usage by the citizens relating with IT-enabled services will be considerably influenced by the innovativeness of the prospective citizens expected to be residing in proposed smart cities of India. Also, with the increase of automation, there will be applications helping e-informational services; also the citizens are supposed to get e-consultation services from the smart city management authorities and advisors, and with the improvement of digital services platform, we will have more and mare e-transactional services. It also appears that,

the IT enabled services to be provided in proposed smart cities of India, to be designed in an innovative way which must be easier to use and then those services would be accepted by the citizens and the adoption rate would increase. The Chi-square test result indexed in Table V when analyzed ventilates that citizens' age, gender, educational qualifications do not considerably influence the whole conceptual model. However, citizens' perceived QL would be influenced appreciably with the extent of frequency of use of IT-enabled services. The Figure 3 also shows a possible mediating effect with regard to acceptance and usage of IT services by the citizens. The conception of values of path coefficients as shown in Figure 3 indicates that acceptance and usage of IT-enabled services by the prospective citizens would have a positive effect over the improvement of QL.

Conclusion and implication

This study has tried to ascertain the main factors which would appreciably affect the extent of adoption of the digital services by the citizens of proposed smart cities. In the first portion of this study, the hypothesis has been developed through related past works and background studies, and later those hypotheses have been validated with the results so obtained after quantifying the responses from the respondent-participants against structured and relevant questionnaires prepared with the help of experts' consultations. Participants of different age groups with varied educational qualifications involving both genders female and male having different level of experience of using different digital services have been contacted so that by having participants from all the experience levels, the results so obtained do not suffer from the vice of bias. However, interestingly, the results found from this study reveals that these are not heavily dependent on those varied demographics as reveled from the Chi-square tests. It appears from the study that proper utilization of the IT-enabled services, expected to be implemented in the smart cities of India, by the potential users will have substantial and effective impact on their living standard and it would also help ameliorating their perceived QL. It is also concluded that innovative and novel digital services, if provided by the authorities for the usage of the citizens, would transform their lives not only from behavioral and technological perspective but also from social perspective. It is also seen that citizens who are expected to live in the proposed smart cities of India will be able to enjoy better QL, who would possess their own capability of creativity and innovativeness. It has been noticed from the users' perspective that they would be more interested in using the IT-enabled services if such services have good functionalities and quality. Practically, the secret of success of adoption of IT services and its utilization in proposed smart cities of India would lie heavily on the extent of active participation of the citizens, and to peruse those users, user-centric focused attention is required to be given by the civic authorities so that the users feel interested to get themselves involved in using those digital services without fear of any threat concerning to their security and privacy. Proper measures are required to be taken by the civic authorities because even the slightest incident of security jeopardization or of data theft of any user may spread very quickly and the extent of harm so occurred would be spread in a very magnified manner through rumors. The users would become, unreasonably, overcautious and, being otherwise conservative, it would be very difficult to bring them back in the main stream of flow of using IT-enabled services. Increase of level of trust in using IT-enabled services, supposed to be provided to the citizens, would have positive impact over the usage of IT-enabled services which in turn would eventually improve the overall utilization, performances and users' experience of the smart cities in India. To increase the number of users using digital services, better performance of systems needs to be ensured, meeting the security and privacy challenges. Efforts need to be taken so that the citizens do not face

difficulties of getting information about the facilities and guidance of using the digital services to be provided in the smart cities of India. They should be entitled to enjoy using the services and they should not come across difficulties to get the government data for their necessity and personal usage, so that they are tempted to have their involvement in using those IT-enabled services and to achieve such functionalities. It will be helpful if "open data echo system" is there (Zuiderwijk *et al.*, 2014).

Limitations and direction for future studies

In this study, we have selected the respondent participants from different levels of IT knowledge and expertise with varied avocations, varied educational qualifications and varied range of age. We have also considered the demography involving both female and male respondents. All these have been done for getting varied responses from the participants, having different behavior of usage, against few structured questionnaires. However, although the study is undertaken keeping Indian smart cities in perspective, the proposed smart cities are in different states which are in northern, southern, eastern and western parts of India. It is a fact that while we selected the respondents, they were not the true representative of the whole population which is spread covering all parts of India. The respondents are mostly from northern and eastern parts of India. India is a vast country having many diversities. It has people from different cultures and different lifestyles. Since the results have been obtained by involving respondents not representing the whole population from all the proposed 100 smart cities spread over different states of India, the results cannot be construed to have been obtained by a general representation of the respondents covering all parts of India but mostly focused on northern and eastern part of India from where we have maximum respondents. Besides, same set of questionnaires was given to all the respondent-participants. Same set of questionnaires cannot be befitting to all the respondents from different culture, inherent belief and different standards of living. While considering the users' behavior, to assess their extent of willingness to use the modern IT-enabled services, we did not consider the multipurpose political environments prevailing in different parts of India. In other words, we did not focus on the varied political commitments of different political parties ruling in different states which also might have potential influence over the behavioral pattern of the prospective beneficiaries of the proposed smart cities of India, deviating the results from reality. Thus, these are few of the limitations which we did not cover in this article. However, for attaining more generic results which could throw more light on the topic, it is expected that the future researchers would plug up these types of weakness and would be able to arrive at a more acceptable generic result befitting with ground reality covering all parts of India highlighting the potential issues in general and that prescription is expected to fetch a more comprehensive result.

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Sheshadri is also a certified project management professional, from Project Management Institute (PMI), USA and also completed PRINCE2, OGC, UK. He also holds ITIL v3 UK certification in IT infrastructure management area. He has experience in Retail, Oil and Gas Industry and has worked as advisor and partner with Royal Dutch Shell, StatOil Corporation, etc. Sheshadri has acted as a visiting faculty and guest lecturer in several Management and Engineering institutes. He has participated as industry speaker in some of the industry body forum and presented papers at CII, FICCI conferences, PMI US Conferences, IBM Global Conferences, Microsoft Partner Conferences, etc. Sheshadri's current interests are in the areas of smart cities, security, trust and privacy issues in IT governance, culture and its influence in IT industry, IT consultancy, customer relationship management, project and program management, IT architecture, cyber security and assurance, end user experience, etc. Sheshadri Chatterjee is the corresponding author can be contacted at: sheshadri.academic@gmail.com

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