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Success of IoT in Smart Cities of India: An empirical analysis

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ABSTRACT

With Rapid progress of wireless technology, the daily life of the citizens has undergone drastic change. They are using sophisticated devices based on latest technology for their daily usage at homes. This lucrative facility is available especially to the citizens of modern cities of the world. India is also not lagging. Government of India has announced for creation of 100 Smart Cities where the citizens are expected to use Information and Communication Technology with the help of internet. More use of internet by the citizens would enhance more internet penetration and here Internet of Things (IoT) plays a crucial role. However, tapping into the IoT is mere a part of the story. It is necessary to combine IoT with Artificial Intelligence (AI) in 'Smart Machines' to simulate intelligent behavior to arrive at an accurate and reliable decision without human intervention. Now combining AI and IoT information systems has become an essential precondition for achieving information system success. For information system success, it is essential to identify the factors affecting it. The purpose of this study is to identify those factors affecting successful implementation of information system enabling IoT coupled with Artificial Intelligence in the proposed Smart Cities of India (SCI).

1. Introduction

During 2015, Government of India (GOI) through the Ministry of Urban Development (MoUD) has announced its policy of Smart City Mission (SCM) wherein it has been settled to create 100 Smart Cities in India (SCI). Smart Cities mean modern cities equipped with all modern facilities basically depending on Information and Communication Technology (ICT) (Tryfonas, Kiountouzis, & Poulymenakou, 2001). Concept of creation of SCI presumably comes from the concept of rapid trend of urbanization because with time India is becoming land of cities or towns abandoning the villages (Gupta, 2014). Smart Cities mean datafied cities thoroughly connected with internets (Gosgerove, 2011). Thus, Smart Cities are internet cities (Falconer & Mitcheli, 2012). Since Smart Cities would use frequently internets as expected, their citizens being smart citizens would also use the internets along with their extended use to reduce time and cost for their daily usual activities. As a result, it is very much expected that they would heavily relay on the advantages by using Internet of Things (IoT) which is nothing but where objects would communicate with each other using internet and antenna without human interference. It would in turn reduce time and cost of human activities. If the citizens of proposed SCI use the products operated through IoT, they will be able to get better result with less cost to achieve their desired target. Hence, they are needed to know this innovative technology so that they can adopt it. There are different adoption theories. However, the basic idea of adoption of a modern technology is covered by Technology Acceptance Model (TAM) (Davis, 1989). But this model has been modified by different researchers and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) is found to have been extensively utilized towards their attempts to explain Information System (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2017). Thus, use of IoT by the smart citizens of SCI would change the technological scenario rendering the Smart City smarter (Grover & Kar, 2017; Schlick, Ferber, & Hupp, 2013). However, in India, creation of Smart Cities (Chatterjee & Kar, 2015) is in infancy stage baring a few privately managed SCI like Lavasa in western India, GIFT city in the state of Gujrat etc. which do not project general picture of SCI. After creation of Smart Cities (Chatterjee, Kar, & Gupta, 2017), the citizens there are expected to adopt IoT which would change their lifestyle from legacy mode to digital mode. Naturally, primary question lies to induce the potential citizens of SCI to motivate to adopt IoT (Dwivedi, Shareef, Simintiras, Lal, & Weerakkody, 2016; Rana & Dwivedi, 2015; Shareef, Kumar, Kumar, & Dwivedi, 2011). Once the use of products utilizing IoT technology is increased, the citizens would feel ease to take help of application of IoT in other products operated through the help of IoT. At this point, government would take help of IoT because through the increased usage of IoT technology by the citizens of SCI, it is expected that more data would be generated by the IoT enabled devices. These data would be used by the government for quick decision making after those data are analyzed appropriately through application of Artificial

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Intelligence (AI). Thus, the success of usage of IoT would fetch benefit both to the citizens and government. Government of India (GOI) has already through Ministry of Electronics and Information Technology (MeitY) has announced its draft policy where it has been stated that IoT would open a new business paradigm pulling huge revenue and GOI would be expecting to invest around USD 15 billion by 2020 in IoT industries when the number of IoT devices in India would be around 2.7 billion as expected, which was around 200 million in 2015. So, how adoption motivation towards using IoT technology may be created for the prospective citizens of SCI is a crux of the question. For this, the potential users are needed to be informed regarding success of using this innovative concept like IoT and here lies the secret of IS Success (Rana, Dwivedi, Williams, & Weerakkody, 2015). Numerous studies have been conducted about usage of IoT, design of IoT, implementational hazard of IoT and so on. (Gubbi, Buyya, Marusic, & Palaniswami, 2013; Khan, Khan, Zaheer, & Khan, 2012; Rana, Dwivedi, Lal, Williams, & Clement, 2017; Sundmaeker, Guillemin, Friess, & Woelffle, 2010; Tau & Wang, 2010) though much studies have not been conducted regarding intention of acceptance of IoT by the users (Haller, Karnouskos, & Schroth, 2009; Peoples, Parr, Mcclean, Scotney, & Morrow, 2013; Yi, Jackson, Park, & Probst, 2006). However, it is always important to study acceptance behavior of users relating to IT based issues (Mathieson, 1991; Luarn & Lin, 2005; Bandyopadhyay & Bandyopadhyay, 2010; Venkatesh, Thong, & Xu, 2012; Kapoor et al., 2014a, b) for proper realization of ailments. Thus, creation of SCI is expected to induce more and more users of IoT enabled devices. Again, use of IoT enabled devices by the citizens of SCI (Kapoor et al., 2014a, b) would cause generate and exchange of information what we say Big Data. Thus, it is expected that this quick expansion of devices and sensors which are connected to the 'things' would continue. The billions of things coming under IoT would produce massive volume of data and here lies the greatest potential. These data might be analyzed in a rapid and accurate way. The unique way to get hidden insights of these Big Data (Chauhan et al., 2016; Chatterjee et al., 2017) are to use Artificial Intelligence (AI). The government can take help of these data after boiling them down to some meaningful information for appropriate decision making. It would then help build intelligent process automation and appropriate forecasting. These technologies would make the works of government more efficient in operation and it would be very effective in realizing the needs of the citizens of proposed SCI and would help the government to fulfil the needs of the citizens in a much better way. More the citizens would use the IoT enabled system, more data would be generated rendering more scope to the government to analyze more data through different AI tools for citizen's benefit as they will be provided with accurate and reliable information to the citizens. It is evident that information to be generated and exchanged to huge extent using IoT enabled devices as a culmination of expected more use of IoT enabled devices by the citizens and then government would get ample scope to analyze those data using AI to reach quick and reliable decisions. Thus, success of this information system derived from integration of IoT, Big Data and AI (Joseph, Kar, Ilavarasan, & Ganesh, 2017) is very essential to pull more and more users. Hence, factors which determine to bring information system success are required to be predicted. In doing so, we have taken help of Updated Information System Success Model (DeLone and McLean, 2002a, b; DeLone & McLean, 2003) and have developed a model after formulation of hypotheses which have been subsequently tested through different tools for confirming the reliabilities as well as validities of the predicted factors and the hypotheses to amend and reconcile the model after proper survey among the targeted respondents. This study has been ended with a discussion and implication followed by conclusion along with limitations mentioning directions for future studies.

2. Literature review and formulation of hypotheses

Internet of Things can be construed to be soothing combination of three ingredients; it is an interaction through internet between people to people; it is an interaction through internet between people to things; and it is an interaction through internet between things to things (Patel & Patel, 2016). IoT is nothing but an effective network of physical objects capable of interactions through internet without human intervention (Sintef & Friess, 2014). Again, it is a problem to define the notion of Artificial Intelligence (AI) and till now this basic issue remains unexplored. Turning, 1956 initially took a holistic attempt to elucidate the conception of AI. It was like the fact that 'something' speaks with us. If then it does not become possible to distinguish between that 'something' and a human being, that 'something' may be construed to be AI (Turning, 1956). This is not a formal definition of AI. Informally we can say that "AI will be such a program which in an arbitrary world we cope not worse than a human" (Dobrev, 2004). So far as definition of Smart City is concerned, it is to note that there does not exist any universally acceptable definition of Smart City. The conception of Smart City varies from city to city, country to country. It has a separate connotation in India compared to other countries, say, like Europe. It can be thought to be comprising of a compact area associated with inclusive and sustainable development creating a replicable model that would be acting like an ideal light house to other prospective aspiring cities (Chatterjee & Kar, 2017). The study is related with Updated Information System Success Model (DeLone and McLean, 2002a, b; DeLone & McLean, 2003). A user in making a choice usually traverses through different series of phases (Mowen, 1995) which are realization and recognition of problems, alternative options, and benefits to be derived. This is information-processing phase. Then comes the decision-making phase. The user tries to minimize the effect to decide but tries to maximize the quality of decision so reached (Bettman, Johnson, & Payne, 1990). The users use different aids for assessing quality of decision (Bharati & Chaudhury, 2004). Thus, if the user does not get proper information regarding choice, it is difficult for the user to adopt the issue and hence quality of information in this respect is a crucial factor. It is also opined by the researchers that, users also investigate regarding the service quality of the choice (Jiang, Klein, & Crampton, 2000; Kettinger & Lee, 1999; Van Dyke, Prybutok, & Kappelman, 1999). Also, a user relies on the system quality for which the user wants information regarding the system quality (Srinivasan, 1985). These three factors, that is, Information Quality, System Quality and Service Quality simultaneously impact on the use and on the satisfaction of the users. Here it is important to note that 'intention to use' is an attitudinal issue where 'use' is a behavioral issue. Again, 'use' in a process sense, precedes users' satisfaction whereas in a causal sense, 'use' leads to users' satisfaction. Similarly, increase of satisfaction of users to use IoT would lead to increase users' intentional attitude which in turn enhances the users' behavior to increase actual use of IoT. 'Net benefit' is very difficult to define without knowing the context (Seddon, Staples, Patnayakuni, & Bowtell, 1999). However, it may be said, net benefit may be construed as net gain or net loss too (Holsapple & Lee-Post, 2006). Net benefit may be associated to the individual or may be associated to the nation even. Hence, the context is important for interpreting net benefit (Shareef, Dwivedi, Kumar, & Kumar, 2016). All these issues have inputs over the use of information system enabling IoT by the users. This study is confined to identify the factors which might bring success in the information system enabling IoT technology and by achieving such, the users would use the IoT enabled devices in SCI.

Once the users are motivated to use IoT enabled services provided by the government, they will use IoT enabled devices where it will generate huge amount of data. Thus, use of IoT by the citizens of SCI opens a scope for generating huge data also known as big data using IoT enabled devices. The government would get scope then to analyze these data with the help of appropriate Artificial Intelligence tools. It would help arrive at quick and reliable decision- making and these meaningful and reliable decisions would benefit the users who would use these services. In this way, in SCI. for fetching ultimate benefits to the citizens, coupling of IoT with AI would be very much helpful. The entire

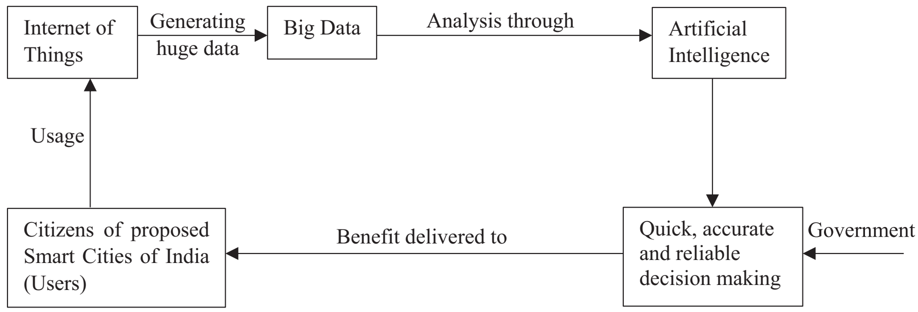

Fig. 1. Flow Chart.

cycle is shown in below Fig. 1.

3. Updated information system success model

The research model has been developed with the help of Updated Information System Success Model (DeLone and McLean, 2002a, b; DeLone & McLean, 2003). The model shows impact of Information, System and Service Qualities on Intension of use of IoT and Users' Satisfaction using IoT. Satisfaction impacts on Net Benefit. Positive intension improves actual use of IoT and Net Benefit impacts on Intension. Net Benefit also impacts on Users' Satisfaction as well as on Intension of Users to actual use IoT. Use of IoT also improves Net Benefit. The various constructs and the resulting hypotheses of the model are interpreted in this section.

3.1. Perceived information quality (PIQ)

Use of devices integrated with IoT is a new concept. The citizens of SCI are expected to take help of IoT technology to meet up their needs. The use of IoT technology by the citizens of SCI is perceived to be enhanced if the concerned citizens can have well organized transparent information regarding this innovative technology (Mowen, 1995). This information is required to be presented to the potential users in a well-organized way associated with updated information so that the users' satisfaction level is increased. The authorities of SCI are required to focus attention on these points (Petter, DeLone, & McLean, 2008). Moreover, quality of information provided by the system is assessed by the users (Gallagher, 1974). The Information Quality includes accuracy (Bailey & Pearson, 1983; Mahmood, 1987), extent of completeness (Miller & Doyle, 1987), extent of relevance (King & Epstein, 1983), need of the contents (Doll & Torkzadeh, 1988), whether in time (Miller & Doyle, 1987) which are also to be measured by the users to identify Information Quality. It has impact on intension of the users as well as on users' satisfaction because if the quality of information is transparent, accurate, comprehensive and explicit, it would motivate the intention of the potential users along with their improvement of satisfaction level (Mohammadi & Hossein, 2015). Thus, quality of information influences the intention of the potential users to use IoT in SCI and it also improves users' satisfaction in using IoT in SCI. In terms of the above discussions, the following hypotheses are provided.

H1. Perceived Information Quality (PIQ) positively affects Perceived Intention to Use (PIU) IoT in SCI.

H2. Perceived Information Quality (PIQ) positively impacts Perceived Users' Satisfaction (PUS) in using IoT in SCI.

3.2. Perceived system quality (PSQ)

System quality includes stability, user friendliness, good availability in terms of De Lone & Mc Leon model (Holsapple & Lee-Post, 2006). In this issue, the users' perception towards performance of the system counts. System Quality is measured by ease of use (Belardo, Karwan, & Wallace, 1982), reliability of the system and to what extent it is flexible (Srinivasan, 1985), convenience for access (Bailey & Pearson, 1983). Intension of Use and Satisfaction of Users to use IoT depends on this System Quality because if the quality of the system is good, accurate and easy to handle with reliability, this would pull the potential users to intent to use the system and it would also provide effective satisfaction of the potential users (Rana, Dwivedi, Williams, & Weerakkody, 2016; Sharma, Gaur, Saddikuti, & Rastogi, 2017). Besides, when a potential user thinks to use a system, the user usually tries to realize the quality of the system in all aspects. User expects that the quality of the system which focuses on performance characteristics should be such that by exerting less effort, maximum benefit may be obtained and in that case the users' satisfaction level is increased (Bettman et al., 1990). Judged from the above discussions, the following hypotheses are developed.

H3. Perceived System Quality (PSQ) positively impacts Perceived Intention to Use (PIU) IoT in SCI.

H4. Perceived System Quality (PSQ) positively affects Perceived Users' Satisfaction (PUS) in using IoT in SCI.

3.3. Perceived service quality (PESQ)

The Service Quality is measured by the users who focus on the weighing to what extent the software and hardware are up-to-date, whether the service can be relied upon, if there is quick response, if the employees can work well, if there exists empathy (Kettinger & Lee, 1995). Intension of Users to use IoT as well as satisfaction level of the users to use IoT depend on Service Quality. Potential users intending to use a modern technology always expect that the system must have good service quality. The service quality is assessed as to how well the service level so delivered to the potential users matches their expectations (Collier & Bienstock, 2006). If an user faces some problems while using a modern technology (such as IoT) based device in SCI, the user expects quick service to rectify the flaws and if that is met up promptly with fairness, and reliability, the users' satisfaction level is also enhanced (Van Dyke et al., 1999; Jiang et al., 2000).

If the quality of service regarding usage of IoT is not up to the expected satisfaction level of the users, they would be reluctant as well as will be hardly interested to be involved in using the device. With these inputs, the following hypotheses are formulated.

H5. Perceived Service Quality (PESQ) positively contributes Perceived Intention to Use (PIU) IoT in SCI.

H6. Perceived Service Quality (PESQ) positively influences Perceived Users' Satisfaction (PUS) in using IoT in SCI.

3.4. Perceived intension to use IoT (PIU)

It explains the attitude, since intension is a behavioral issue. This personal behavioral attitude can reshape one's tendency to actual usage

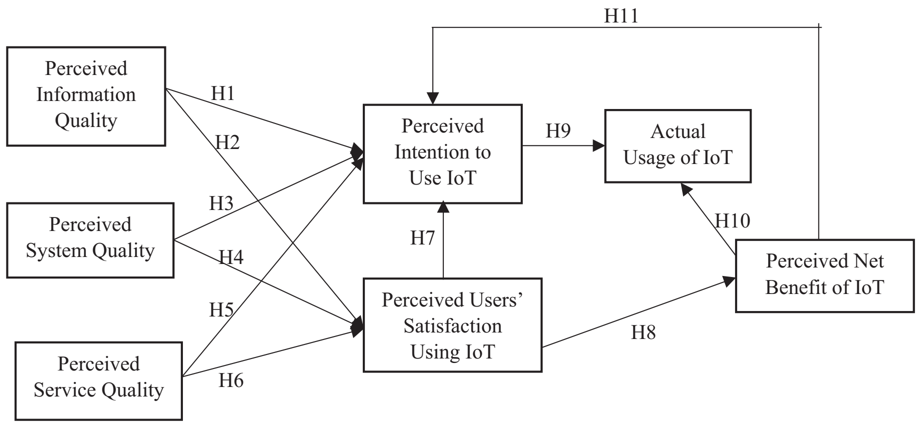

Fig. 2. Theoretical model.

of the innovative technology and this intention would, as such, eventually motivate the potential users to be involved in actual usage of the technology (Dwivedi et al., 2017). If anything is found in order in the context of perception of users, it is said that the users are intended to do so. It also signifies if information, system and service quality are to the thinking of the user, the user would intend to use IoT. Perceived users' satisfaction explains and impacts this factor, that is, Perceived Intension to Use (Chang & Cheung, 2001; Rai, Lang, & Welker, 2002).

3.5. Perceived Users' satisfaction using IoT (PUS)

Satisfaction may be construed as a meaningful response concerning to perceived difference between expectations already possessed by potential users and perceived performances after using the technology (Grigoroudis, Litos, Moustakis, Politis, & Tsironis, 2008). It is concerned with users' opinion measurement for the system. It covers the entire experience cycle of the users in using IoT. If the users do not feel the system to be working in order, the users will remain unsatisfied. The users would be reluctant then to repeat the use (Palmer, 2002; Sanders, 1984). The users' satisfaction is necessary, and this satisfaction would help the users to intend to use IoT-based devices (Holsapple & Lee-Post, 2006). With discussions in Sections 3.4 and 3.5, the following hypothesis is developed.

H7. Perceived Users' Satisfaction (PUS) to use IoT in Smart Cities of India positively impacts the Perceived Intention to Use (PIU) IoT in SCI.

3.6. Actual usage of IoT (AUI)

It is associated with conception of personal relevance which a potential user attaches to the specific system with proper involvement (Sorebo, Sorebo, & Sein, 2007). If the user realizes that information system and service quality are satisfactory, the users would intend to be involved to be using IoT in SCI and once the users intend to use IoT, the users eventually definitely be involved in actual use of the IoT devices in the SCI. The Perceived Intension to Use IoT impacts positively and significantly on the actual usage of IoT. With these considerations, the following hypothesis is developed.

H9. Perceived Intension to Use (PIU) IoT in Smart Cities of India positively influences Actual Usage of IoT (AUI) in Smart Cities of India.

3.7. Perceived net benefit of IoT (PNB)

'Net Benefit' is a difficult proposition to explain. Précised definition is tough to derive. It is because whenever anyone says about Net Benefit, one must mention the context. Since, Net Benefit may cover the user (individual) and even the nation. So, context is required to be mentioned while defining Net Benefit. It has an extremely high amplitude of interpretation. There may be positive benefit as well as negative benefit. Net Benefit for learning web-technology is positive, which is important to consider in the present study (Holsapple & Lee-Post, 2006). If the user becomes satisfied or in other words we can say if Perceived Users' Satisfaction (PUS) is increased, the user will be motivated with a perception that in that case Perceived Net Benefit (PNB) of the user will also be increased (Piccoli, Brohman, Watson, & Parasuraman, 2004). Judged from this stand point, the following hypothesis is prescribed.

H8. Perceived Users' Satisfaction (PUS) to use IoT in Smart Cities of India positively affects Perceived Net Benefit (PNB) of using IoT in Smart Cities of India.

Moreover, it is also evident that Perceived Net Benefit (PNB) will also have a significant impact positively on Actual Use of IoT (AUI) by the potential users (Holsapple & Lee-Post, 2006) because benefits derived are helpful to the potential users in all aspects (Peoples et al., 2013). Following the above discussion, the following hypothesis is developed.

H10. Perceived net benefit (PNB) would have positive impact on Actual Use of IoT (AUI).

Again, when Perceived Net Benefit (PNB) is increased it will have positive impact on Perceived Intention to Use (PIU) (Rust & Kannan, 2003). In terms of the above discussion, the following hypothesis is developed.

H11. Perceived Net Benefit (PNB) of using IoT in Smart Cities positively influences Perceived Intention to Use (PIU) IoT in Smart Cities of India.

The theoretical model based on the eleven hypotheses derived from the conception of studies of different literatures available and from the conception derived from Updated Information System Success Model is shown in Fig. 2.

4. Research methodology

4.1. Development of items or indicators or statements

From the constructs which have been developed from the inputs of the literature review as well as from the updated Information System Success Model prescribed by (DeLone and McLean, 2002a, b; DeLone & McLean, 2003), we have extracted the statements numbering 32 initially. In framing the questionnaires, help of "Two Statement Method" (Arenda-Toth & Van de Vijver, 2007) has been taken which assists to ascertain and assess the cultural dispositions of the targeted respondents. It helps to structure the question formats accordingly. Moreover, the structure of the questions concerning to their reliabilities and understandabilities has been shaped lending idea from the Coyle and Thorsen (2001) model. The initial questions were prepared easy to realize and to respond. Gradually, it became stiffer and stiffer. In this way the questionaries' were formed. Again, with these 32 statements, we have consulted the experts in this area as well as we have also put these 32 statements to some selected knowledgeable respondents numbering 19 who are supposed to be conversant with IoT as well as with AI. Inputs from the experts as well as from the responses from 19 respondents, it is found that out of 32 statements 8 statements suffer from vice of understandabilities as well as of complex wordings. We have eliminated these 8 statements, and we have used the remaining 24 statements.

4.2. Selection of demographic profile of respondents

Since we have 24 statements to be dealt with, we are required to select effective responses from respondents ranging from 96 to 240 because we know item: response bears acceptable values from 1:4 to 1:10 (Hinkin, 1996). We have selected metropolitan cities of India like Mumbai, Kolkata, Bangalore and Delhi where it is expected that there IoT knowing respondents are expected to be available. It has been experienced by attending in different IoT and AI related conferences concerning to discuss and update citizens of SCI that the citizens of these four metropolitan cities are mostly aware of this technological concept of IoT. Through contact in those conferences with the people attending, it has been possible to list out potential respondents from these cities. We have initially chosen 100 tentative participants from each city and with this, to begin with we have contacted 400 respondents-participants through email and through serving hard copies of list of statements to get their meaningful responses. Out of 400, we got only response of 272 participants. The responses have been scrutinized and it was found that out of 272 responses, 28 responses were incomplete, and those were not considered and eliminated. As a result, we dealt with 244 effective responses. The entire survey works were undertaken for a period of three months during October to December 2017. Now, to quantify these 244 replies, we used Likert scale making strongly agree 01 to strongly disagree 05 taking the range of consideration from 01 to 05. The demographic profile of these 244 respondents are given in Table 1.

As we have already stated that the responses of the respondents should be > 96 and < 240, here in this study, we find that we have received 244 effective responses which is very close to 240 and hence we can conclude that our consideration of number of responses is fair to derive pragmatic result.

4.3. Test of multicollinearity

If there exists high correlation among the predictors it would create problem in regression analysis. As such, it is required to compute the Variance Inflation Factor (VIF) of each of the predictors (Gujarati, 1995; Tau & Teo, 2000). If it is found that the value of each VIF for each predictor is below 10, it is considered that multicollinearity does not exist (Kleinbaum, Kupper, & Muller, 1988). The VIF can quantify the severity of multicollinearity in a least square regression analysis. It gives the feedback as to how much the variance being square root of Standard Division of an estimated regression analysis is enhanced due to collinearity. Square of VIF indicates how the standard error is larger compared to what it would be had the variables not correlated with the other predictors in the concerned model. More clearly, if VIF of a predictor is x and if square root of x is y, then we can say that standard error of the coefficient of that predictor is y times larger compared to what it would be had the predictors not correlated with other predictors. In the present study, we have computed VIF of each variable predictor and have found that the value of each VIF of each predictor is much below 10 which is the acceptable value (Kleinbaum et al., 1988) and there is no problem of multicollinearity among the predictor variables in this study.

4.4. Reliability test of observed variables

To assess how much observed variables are reliable, we have computed Cronbach's alpha and Spearman Brown Prediction (Prophecy) values. Values of Cronbach's alpha are acceptable if it is > 0.7 (Robinson, Shaver, & Wrightsman, 1991) though for an exploratory research its lower limit may be acceptable as 0.6 (Hair, Anderson, Tatham, & Black, 1998; Robinson et al., 1991). Another researcher also opined that lower limit of Cronbach's alpha may be accepted as 0.6 (Nunnally, 1978). Spearman Brown Prediction (Prophecy) test is normally used by psychometricians for predicting reliability (Maira, Egils, & Riccardo, 2013). It's lower permissible value is considered as 0.7. The entire estimates are shown in the Table 2. From the Table 2, it appears that values of Cronbach's alpha lie between 0.697 and 0.872 and so, it confirms that variables are reliable since we have already stated that the lowest value of Cronbach alpha should be not < 0.6. Also, it appears from the Table 2 that the values of Spearman Brown Prediction test lie between 0.763 and 0.911 and so, it also is acceptable since we know that the lowest value of this constant should not be < 0.7. Hence, from these estimates we can say that variables are reliable.

4.5. Measurement model (loading factor, CR, AVE and MSV)

It is to note that eventually we have considered 24 statements or items from 7 variables. But assessing the loading factors of the items concerning to their own construct, it appears that 4 items assumed loading factors well below 0.3 and hence they have not been considered and as such, we have considered 20 loadings which have also been shown in the concerned table of estimation of Cronbach's alpha and Spearman Brown Prediction test (Table 2).

Here we have computed loading factors of items for each construct. It is accepted that the indicators concerning to each construct which has been developed are reliable if their least value is > 0.707 (Barroso, Carrion, & Roldan, 2010; Chin, 1998; Hulland, 1999).

We have also assessed the values of Average Variance Extracted (AVE) for each construct. This is necessary to assess convergent validity of items of each construct with reference to their own construct (Fornell & Larcker, 1981). The AVE provides a measure to the effect as to how much the item can explain their own construct. The accepted lower limit of AVE is 0.5 (Gefen & Straub, 2005; Hair, Black, Babin, Anderson,

Table 1
Demographic profile of respondents.

	Gender		Age (Years)					Highest Education					Current Profile			
	M	F	< 20	21–29	30–39	40–49	> 50	PE	SE	Gr	PG	Above PG	A	P	B	C
No	192	52	14	106	90	20	14	0	46	63	91	44	30	24	96	93
%	78.7	21.3	5.7	43.4	36.9	8.2	5.8	0	18.9	25.8	37.3	18.0	12.3	9.8	39.3	38.6

PE ≡ Primary Education; SE ≡ Secondary Education; Gr ≡ Graduate; PG ≡ Post Graduate; Above PG ≡ Above Post Graduate; A ≡ Academician; P ≡ Professional; B ≡ Businessman; C ≡ Corporate.

Table 2
Reliability test for observed variables.

Parameters	Cronbach's alpha	Spearman Brown Prediction	No. of items
Perceived Information Quality (PIQ)	0.806	0.841	3
Perceived System Quality (PSQ)	0.799	0.810	3
Perceived Service Quality (PESQ)	0.812	0.892	2
Perceived Intention of Use (PIU)	0.697	0.763	4
Perceived User's Satisfaction (PUS)	0.872	0.911	3
Actual Usage of IoT (AUI)	0.811	0.872	2
Perceived Net Benefit (PNB)	0.790	0.854	3

& Tatham, 2006). We have computed construct reliability which is also called Composite Reliability (CR). It is very like that what is inferred through the value of Cronbach's alpha as well as through the Spearman Brown Prediction test. As much close the value of CR to 1, we say more the constructs are reliable and more the value of CR becomes close to 0, we say the constructs are unreliable. However, normally lowest acceptable value of CR is 0.6 (Bagozzi & Yi, 1988; Urbach & Ahlemann, 2010). The computation of loadings, CR and AVE is shown in Table 3. We have computed Maximum Shared Variance (MSV) of each construct and has found that each value of MSV is less than corresponding value of AVE which confirms the reliability of the concerned result.

From the Table 3, it appears that the values of loadings of items concerning to their own constructs lie between 0.850 and 0.991. The lowest value of loading here is 0.850 which is greater than the lowest permissible value of 0.707 and hence, the items are reliable to the extent of their corresponding constructs. Again, the range of values of CR lie between 0.870 and 0.959, the lowest permissible value being 0.870 which is more than the lowest acceptable vale of CR which is 0.6. Hence the constructs developed are reliable. Again, the values of AVE lie between 0.842 and 0.936, the lowest value is 0.842 which is more than permissible lowest value of AVE which is 0.5 and hence the items are reliable to explain their own constructs.

4.6. Convergent and divergent validity of items

The items or the statements for each construct should be correlated and the items of one construct should not be correlated with the items of other constructs. In other words, convergence among the items of each construct should be there and divergence of items of a construct with other items of other constructs should be there. To ensure this, the loading factors among items of one construct must have high values close to 1 and loading factors of items of one construct with other items of other constructs must have very much low value. If this is ensured, it can be construed that the items of one construct are convergent with each other and items of one construct are divergent with other items of other constructs which lead to the fact that we have been able to develop the items correctly and for this we are required to find out the cross-loading factors. The following Table 4 highlights the results.

From the results shown in the Table 4, it appears that PIQ1, PIQ2, PIQ3 have loadings with each other which are very high and PIQ1, PIQ2, PIQ3 possess very low loading with PSQ1, PSQ2, PSQ3, PESQ1, PESQ2, PIU1, PIU2, PIU3, PIU4, PUS1, PUS2, PUS3, AUI1, AUI2, PNB1, PNB2, and PNB3 and so on. Things will be clear if we consider the results depicted in Table 4. It is seen that loadings of PIQ1 with PIQ2 and PIQ3 are 0.92 and 0.91 respectively whereas loadings of PIQ1 with PSQ1, PSQ2 and PSQ3 are 0.02, 0.02 and 0.04 respectively, which are very low. It is said loading factors are high whereas cross-loading factors are very low which is expected. So, this helps us to conclude that we have been able to develop the items in respect of the different constructs very correctly. It is pertinent to mention here that initially during our survey, we received 2972 responses out of 400 respondents targeted. We scrutinized the responses and eliminated 28 responses as those responses were incomplete. Had we initially not done this screening process, the values of cross loading factors might have been higher and in that case, we would have failed to establish divergence validity.

4.7. EFA factor loadings

If the items of one construct have very much considerable values of loadings concerning to their own constructs, we say, those items have confirmed their convergent validity test. It has already been done in this study. It is also essential to assess to what extent the items of one construct are related with other constructs. If the values of loading factors of items of one construct have very insignificant values of

Table 3
Measurement table.

Factors	Items	Loadings	CR	AVE	MSV
PIQ	PIQ1: Data generated by IoT will be accurate	0.965	0.917	0.906	0.624
	PIQ2: Information processed by the system will be secured	0.917			
	PIQ3: Information available through the system will be relevant for me	0.972			
PSQ	PSQ1: The IoT enabled devices will be easy to use	0.967	0.951	0.933	0.626
	PSQ2: The IoT enabled information system in smart cities of India will have global standard	0.963			
	PSQ3: The system will ensure privacy of the citizens	0.967			
PESQ	PESQ1: The service quality of IoT enabled system will be reliable	0.850	0.870	0.842	0.627
	PESQ2: The support staff of IoT enabled system will be competent	0.981			
PIU	PIU1: I would prefer to use IoT enabled devices than non-IoT devices	0.921	0.891	0.865	0.604
	PIU2: I think IoT enabled services in smart cities will be preferred mode of communication	0.936			
	PIU3: I think most of the citizens in smart city will be using IoT enabled devices	0.952			
	PIU4: I need some IoT related training to use IoT enabled devices	0.911			
PUS	PUS1: Govt. will use data generated by IoT enabled devices for quick and accurate decision making which would ultimately help citizens in proposed smart cities in India	0.960	0.929	0.919	0.511
	PUS2: IoT technology will make my life easy	0.923			
	PUS3: I would truly enjoy using IoT enabled devices	0.991			
AUI	AUI1: I will be using IoT enabled devices daily	0.963	0.959	0.936	0.610
	AUI2: Citizens of the smart cities will be using IoT enabled devices for their daily requirements	0.972			
PNB	PNB1: Using IoT technology will help me doing things quicker	0.910	0.899	0.879	0.626
	PNB2: The IoT will help me to improve the quality of life	0.927			
	PNB3: I think the overall cost of the IoT enabled devices is going to reduce in future once the smart cities in India are fully operational	0.974			

Table 4
Convergence and Divergence validity among items.

	PIQ1	PIQ2	PIQ3	PSQ1	PSQ2	PSQ3	PESQ1	PESQ2	PIU1	PIU2	PIU3	PIU4	PUS1	PUS2	PUS3	AUI1	AUI2	PNB1	PNB2	PNB3
PIQ1	**1**																			
PIQ2	**0.92**	**1**																		
PIQ3	**0.91**	**0.89**	**1**																	
PSQ1	0.02	0.03	0.02	**1**																
PSQ2	0.02	0.01	0.01	**0.96**	**1**															
PSQ3	0.04	0.03	0.01	**0.91**	**0.86**	**1**														
PESQ1	0.03	0.04	0.05	0.01	0.03	0.05	**1**													
PESQ2	0.06	0.07	0.01	0.09	0.04	0.05	**0.91**	**1**												
PIU1	0.06	0.01	0.08	0.02	0.04	0.06	0.06	0.05	**1**											
PIU2	0.05	0.02	0.04	0.09	0.03	0.01	0.06	0.01	**0.94**	**1**										
PIU3	0.02	0.02	0.04	0.09	0.06	0.07	0.05	0.02	**0.93**	**0.86**	**1**									
PIU4	0.01	0.01	0.05	0.04	0.07	0.07	0.03	0.04	**0.89**	**0.81**	**0.92**	**1**								
PUS1	0.03	0.09	0.06	0.04	0.08	0.09	0.01	0.05	0.02	0.04	0.02	0.01	**1**							
PUS2	0.04	0.01	0.03	0.02	0.09	0.08	0.02	0.07	0.02	0.07	0.01	0.02	**0.92**	**1**						
PUS3	0.01	0.08	0.02	0.08	0.01	0.03	0.07	0.09	0.01	0.09	0.03	0.04	**0.91**	**0.89**	**1**					
AUI1	0.02	0.07	0.01	0.01	0.02	0.03	0.07	0.01	0.03	0.01	0.05	0.04	0.02	0.01	0.02	**1**				
AUI2	0.03	0.06	0.07	0.01	0.01	0.04	0.08	0.03	0.03	0.03	0.07	0.07	0.08	0.01	0.06	**0.96**	**1**			
PNB1	0.05	0.02	0.07	0.02	0.01	0.01	0.09	0.05	0.04	0.05	0.06	0.07	0.08	0.07	0.07	0.05	0.04	**1**		
PNB2	0.01	0.05	0.08	0.04	0.02	0.02	0.02	0.07	0.06	0.07	0.01	0.06	0.07	0.03	0.07	0.01	0.06	**0.92**	**1**	
PNB3	0.01	0.01	0.01	0.08	0.04	0.01	0.03	0.08	0.07	0.09	0.02	0.06	0.06	0.03	0.02	0.02	0.02	**0.91**	**0.90**	**1**

The bold indicates convergent validity among the items.

Table 5
Exploratory factor loading.

	PIQ	PSQ	PESQ	PIU	PUS	AUI	PNB
PIQ1	**0.965**	0.021	0.031	0.031	0.061	0.071	0.012
PIQ2	**0.917**	0.011	0.111	0.033	0.021	0.062	0.072
PIQ3	**0.972**	0.063	0.032	0.041	0.031	0.073	0.013
PSQ1	0.061	**0.967**	0.041	0.061	0.043	0.063	0.061
PSQ2	0.023	**0.963**	0.092	0.071	0.056	0.071	0.016
PSQ3	0.041	**0.967**	0.096	0.081	0.066	0.051	0.059
PESQ1	0.051	0.081	**0.850**	0.011	0.067	0.043	0.011
PESQ2	0.062	0.081	**0.981**	0.021	0.021	0.053	0.057
PIU1	0.071	0.073	0.021	**0.921**	0.011	0.012	0.012
PIU2	0.082	0.112	0.121	**0.936**	0.013	0.072	0.031
PIU3	0.011	0.021	0.023	**0.952**	0.121	0.073	0.032
PIU4	0.010	0.061	0.094	**0.911**	0.023	0.071	0.056
PUS1	0.023	0.073	0.081	0.061	**0.960**	0.031	0.033
PUS2	0.041	0.082	0.061	0.051	**0.923**	0.042	0.034
PUS3	0.031	0.091	0.071	0.052	**0.991**	0.041	0.036
AUI1	0.032	0.121	0.012	0.041	0.061	**0.963**	0.037
AUI2	0.051	0.021	0.019	0.061	0.021	**0.972**	0.021
PNB1	0.063	0.011	0.018	0.071	0.061	0.037	**0.910**
PNB2	0.041	0.061	0.023	0.021	0.123	0.025	**0.927**
PNB3	0.063	0.072	0.031	0.031	0.111	0.021	**0.974**

The bold indicates loading of items with their own construct.

loadings in relation to other constructs, it confirms the divergent validity of the items which is expected in this study. The loading factors of the items in relation to own construct and other constructs have been computed and are shown in Table 5. It appears from the Table 5 that, as expected, the statements or items are bearing close relation to explain their own constructs, e.g. PSQ1, PSQ2 and PSQ3 have loading factors relating to their own construct PSQ are 0.967, 0.963 and 0.967 respectively, but these three indicators bear loadings with other constructs, say, PIQ as 0.061, 0.023 and 0.041 respectively which are very low and as such insignificant. Thus, the statements, indicators, or items are found to have closely related to their own construct and do not have close relation with other constructs which is expected and confirms that we have been able to develop items properly in this study.

4.8. Discriminant validity test

Discriminant validity test is almost identical with multicollinearity test. To ensure discriminant validity among the constructs which states that the constructs are not related to each other, it is to confirm that square roots of AVEs known aa Average Variance (AV) are greater than the correlation coefficients between two composite constructs (Fornell & Larcker, 1981). The results are shown in the Table 6.

Table 6
Discriminant validity table.

	PIQ	PSQ	PESQ	PIU	PUS	AUI	PNB	AVE
PIQ	**0.952**							0.906
PSQ	0.717	**0.966**						0.933
PESQ	0.790	0.690	**0.918**					0.842
PIU	0.611	0.723	0.792	**0.930**				0.865
PUS	0.745	0.767	0.760	0.765	**0.959**			0.919
AUI	0.681	0.657	0.620	0.718	0.611	**0.967**		0.936
PNB	0.692	0.791	0.692	0.777	0.715	0.781	**0.938**	0.879

The bold indicates Average Variances being square roots of corresponding AVEs.

It appears from the above table that the values of Average Variances which are square roots of AVEs shown in diagonals (0.952, 0.966, 0.918, 0.930, 0.959, 0.967 and 0.938) are greater than the corresponding correlation coefficients of the two composite constructs. Hence, it is confirmed that discriminant validity has been achieved.

5. Structural equation modeling

To assess the model so provided, we have taken the help of Structural Equation Modeling (SEM). It includes essential estimations of some salient indices like Chi-Square ($\chi 2$)/Degree of Freedom (*df*), Comparative Fit Index (CFI), Normal Fit Index (NFI), Tucker Lewis Index (TLI) and Root Mean Square Error (RMSE). The values of these Fit Indices if lie within the permissible range, it can be said that the model so provided is in order.

The SEM also justifies if the specific paths shown are justified or not. The results of Fit Indices and RMSE which all are, as stated above, within the permissible range are shown in the annexed Table 7. This highlights that the proposed model is acceptable within the permissible range. It appears that all the parameters lie within the permissible limit and hence the model provided is fit and specific paths shown in the model are in order.

5.1. Path analysis including summary of structural model

The results of Structural Model are shown in Fig. 3 wherefrom it

Table 7
SEM Fit Indices results.

Fit Indices	Standard	Estimate	Remarks
χ^2/df	$1 < \chi^2/df < 3$	2.001	It appears that value of χ^2/df is 2.001 which is within permissible range and hence acceptable.
Comparative Fit Index (CFI)	> 0.93 (Byrne, 1994)	0.968	It appears that the value of CFI is 0.968 which is > 0.93 and hence acceptable.
Normal Fit Index (NFI)	> 0.95 (Schumacker & Lomax, 2004)	0.991	The value of NFI is 0.991 which is > 0.95 and hence acceptable.
Tucker Lewis Index (TLI)	> 0.91 (Byrne, 1994)	0.956	The value of TLI is 0.956 which is > 0.91 and hence acceptable.
Root Mean Square Error (RMSE)	< 0.08 (Hu & Bentler, 1998)	0.009	RMSE is 0.009 which is close to 0. And < 0.08 and hence it is acceptable. This RMSE signifies to what extent the derived model has been shifted from the standard model. More its value close to 0, we can say that resultant derived model is more accurate.

appears that R^2 is 0.72 for the construct (variable) Perceived Intention to Use (PIU) IoT in SCI which clarifies that PIQ, PSQ, PESQ, and PUS constructs can explain this variable, that is, PIU to the extent of 72%. Similarly, R^2 is 0.61 for the construct Perceived Users' Satisfaction (PUS) to use IoT in SCI. It interprets that PIQ, PSQ, PESQ and PNB can explain the variance PUS to the tune of 61%. The R^2 is 0.53 for the variance Perceived Net Benefit (PNB) which explains that this variance (PNB) can be 53% explained by PUS. Regression analysis further shows that paths between PIQ and PIU ($\beta = 0.56$, $p < 0.05$); between PIQ and PUS ($\beta = 0.71$, $p < 0.001$); between PSQ and PIU ($\beta = 0.62$, $p < 0.001$); between PESQ and PIU ($\beta = 0.62$, $p < 0.001$) are significant and hence these results support the hypothesis 1, hypothesis 2, hypothesis 3 and hypothesis 5.

[$p < 0.05$(*); $p < 0.01$(**); $p < 0.001$(***)].

On the contrary, paths between PSQ and PUS ($\beta = 0.040$, $p > 0.05$, ns) and between PESQ and PUS ($\beta = 0.042$, $p > 0.05$, ns) are insignificant and as such the hypothesis 4 and hypothesis 6 are not supported. Other paths between PUS and PIU ($\beta = 0.42$, $p < 0.05$); between PUS and PNB ($\beta = 0.59$, $p < 0.01$); between PIU and AUI ($\beta = 0.66$, $p < 0.01$); between PNB and AUI ($\beta = 0.61$, $p < 0.01$) are found to be significant and as such the relevant hypotheses like hypothesis 7, hypothesis 8, hypothesis 9, hypothesis 10 and hypothesis 11 are supported by this result. As such, the hypothesis 1, hypothesis 2, hypothesis 3, hypothesis 5, hypothesis 7, hypothesis 8, hypothesis 9, hypothesis 10 and hypothesis 11 have been supported. The entire results are shown in Table 8, Table 9 and Table 10.

Thus, out of 11 hypotheses already developed based on conceptualization derived from literature review as well as from the concerned model namely Updated Information System Success Model (DeLone and McLean, 2002a, b; DeLone & McLean, 2003), it appears that results of regression analysis do not support hypothesis 4 as well as hypothesis 6 whereas rest of the hypotheses, that is, hypothesis 1, hypothesis 2, hypothesis 3, hypothesis 5, hypothesis 7, hypothesis 8, hypothesis 9, hypothesis 10 and hypothesis 11 are being supported. The entire results in summary are shown in Tables 9 and 10. In Table 9, we have shown in detail the values of R^2, estimated path coefficients and significance levels etc. and in Table 10, we have mentioned the recital of the hypotheses and have mentioned the state of supporting and not-supporting the hypotheses showing that out of 12 hypotheses, save hypothesis 4 and hypothesis 6, all other hypotheses are supported through regression analysis. Thus, the hypotheses 4 as well as hypotheses 6 having low values of path coefficients which are 0.040 and 0.042 respectively have not been supported and the remaining 10 hypotheses having high values of path coefficients have been supported.

Table 8
Results of Path analysis at a glance.

Path	Hypothesis	β-value	p-value	Result
PIQ → PIU	H1	0.56	$p < 0.05$	Supported
PIQ → PUS	H2	0.71	$p < 0.001$	Supported
PSQ → PIU	H3	0.62	$p < 0.001$	Supported
PSQ → PUS	H4	0.040	$p > 0.05$ (ns)	Not-Supported
PESQ → PIU	H5	0.62	$p < 0.001$	Supported
PESQ → PUS	H6	0.042	$p > 0.05$ (ns)	Not-Supported
PUS → PIU	H7	0.42	$p < 0.05$	Supported
PUS → PNB	H8	0.59	$p < 0.01$	Supported
PIU → AUI	H9	0.66	$p < 0.01$	Supported
PNB → AUI	H10	0.61	$p < 0.01$	Supported
PNB → PIU	H11	0.72	$p < 0.01$	Supported

6. Results

It appears that though Perceived Information Quality (PIQ), Perceived System Quality (PSQ) and Perceived Service Quality (PESQ) have impacts on Perceived Intention to Use (PIU) IoT in SCI but out of these three variables PIQ, PSQ and PESQ, the PIQ has less influence

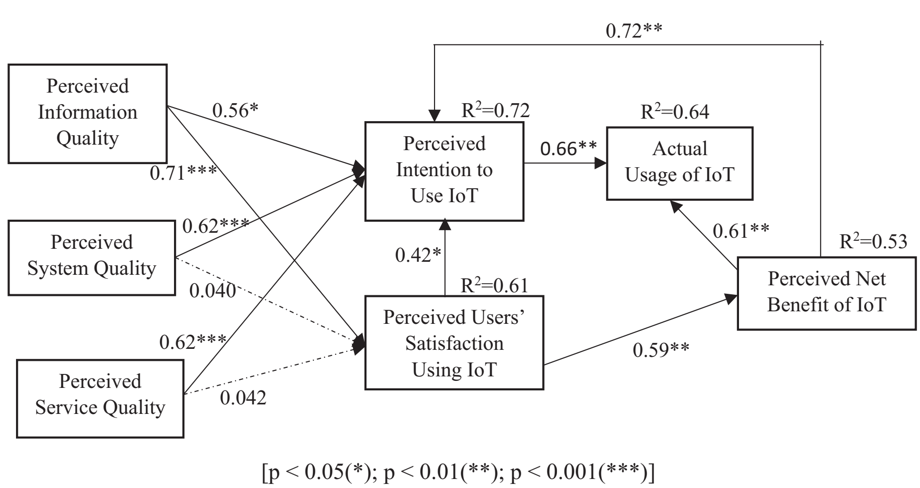

Fig. 3. Path analysis.

Table 9
Results from structural model.

Measure	Effect	Path coefficient	Significance
Effect on Perceived Intention to Use (PIU) IoT in Smart Cities of India	$R^2 = 0.72$		
by PIQ	+	0.56	$p < 0.05$ (*)
by PSQ	+	0.62	$p < 0.001$ (***)
by PESQ	+	0.62	$p < 0.001$ (***)
by PUS	+	0.42	$p < 0.05$ (*)
by PNB	+	0.72	$p < 0.01$ (**)
Effect on Perceived Users' Satisfaction (PUS) in using IoT in Smart Cities of India	$R^2 = 0.61$		
by PIQ	+	0.71	$p < 0.001$ (***)
by PSQ		0.040	$p > 0.05$ (ns)
by PESQ		0.042	$p > 0.05$ (ns)
Effect on Actual Usage of IoT (AUI) in Smart Cities of India	$R^2 = 0.64$		
by PIU	+	0.66	$p < 0.01$ (**)
by PNB	+	0.61	$p < 0.01$ (**)
Effect on Perceived Net Benefit (PNB) of IoT in Smart Cities of India	$R^2 = 0.53$		
by PUS	+	0.59	$p < 0.01$ (**)

over PIU and PSQ & PESQ both equally influence PIU since both these variables possess same β-value 0.62 having equal significance level. Again, Perceived Information Quality (PIQ), Perceived System Quality (PSQ) and Perceived Service Quality (PESQ) had been hypothesized to have impacts over Perceived Users' Satisfaction (PUS) from this study and as such H2, H4 and H6 were developed, but, regression analysis shows that PSQ and PESQ have insignificant influence over Perceived Users Satisfaction (PUS) as β-values are very low (0.040 and 0.042) having no significant level ($p > 0.5$). As such H4 and H6 were not supported. It further appears that PIQ, PSQ, PESQ, PNB and PUS have positive effect on PIU and out of these five constructs influencing over PIU, the construct PNB has maximum effect on PIU since the concerned path coefficient is 0.72 which is the highest with significant level $p < 0.01$ (**). It also appears that PIQ, PSQ, and PESQ have positive impact on PUS, though the effect of PSQ on PUS is very low ($\beta = 0.04$) with significance level $p > 0.05$ and the effect of PESQ on PUS is also very low ($\beta = 0.042$) with significance level $p > 0.05$ which resulted in not supporting the hypotheses H4 and hypothesis H6 respectively. It is a fact that AI would help much to the appropriate authority for decision making in a comprehensive manner, but it would be an exaggeration to construe that it would surpass the contribution of human intelligence though AI would complement it. Moreover, authority is required to be vigilant to structure proper algorithm related to AI in a most calibrated manner to yield best results and since result is obtained by application of AI on available data, it is natural that authority should put best effort on the accuracy of data to be obtained.

7. Discussions

We have already discussed the results derived from statistical analysis in Section 5.1 (Path analysis including summery of structural model). It is not repeated here. The results of empirical analysis highlight that information quality positively impacts on intention and satisfaction of potential users and service quality impacts on the intention of the users. Hence, the system designers, to increase the behavior intention and satisfaction of potential users, should be sincere and honest towards accuracy, understandability, completeness and security of information. The proposed model along with its elements highlights that these can be used as an effective and beneficial tool for decision makers of organizations and enterprises towards assessing the execution of information system. We have taken help of Information System Success Model proposed by De Lone & Mc Lean for IoT policy implementation for SCI. In doing so, we have taken help of constructs provided in the Information System Success Model. However, we have, in addition, extended the theory of Information System Success Model with inclusion of constructs like Perceived Intention to Use IoT (PIU), Perceived Users' Satisfaction Using IoT (PUS), Actual Usage of IoT (AUI) and Perceived Net Benefit of IoT (PNB) through intuition which are IoT specific for the SCI. It appears that these constructs also contribute towards use of IoT by the users and they are interlinked with each other as is transpired from the statistical analysis. Though, with development of hypotheses through data mining and otherwise, we prescribed the hypothesis that Perceived System Quality (PSQ) has impact on Perceived Users' Satisfaction Using IoT (PUS) which is H4 and that Perceived Service Quality (PESQ) has impact on Perceived Users' Satisfaction Using IoT (PUS) which is H6, but subsequently through statistical analysis, it appears that these two hypotheses H4 and H6 are not supported.

8. Implication

Now, we shall discuss the implication of this research study from theoretical perspective and from practical as well as policy perspective so far as success of implementation of IoT in proposed SCI is concerned.

8.1. Theoretical implication

For ensuring success of IoT implementation in SCI, we have taken help of Information System Success Model provided by De Lone & Mc Lean. We have also extended the model by adding another four IoT-specific constructs which are, Perceived Intention to Use IoT (PIU), Perceived Users' Satisfaction Using IoT (PUS), Actual Use of IoT (AUI) and Perceived Net Benefit of IoT (PNB). The model so provided would,

Table 10
Summary of results of hypotheses testing.

Hypothesis	Research proposition	Results
Hypothesis 1	Perceived Information Quality (PIQ) positively affects Perceived Intention to Use (PIU) IoT in Smart Cities of India	Supported
Hypothesis 2	Perceived Information Quality (PIQ) positively impacts Perceived Users' Satisfaction (PUS) in using IoT in Smart Cities of India	Supported
Hypothesis 3	Perceived System Quality (PSQ) positively impacts Perceived Intention to Use (PIU) IoT in Smart Cities of India	Supported
Hypothesis 4	Perceived System Quality (PSQ) positively affects Perceived Users' Satisfaction (PUS) in using IoT in Smart Cities of India	Not-Supported
Hypothesis 5	Perceived Service Quality (PESQ) positively contributes Perceived Intention to Use (PIU) IoT in Smart Cities of India	Supported
Hypothesis 6	Perceived Service Quality (PESQ) positively influences Perceived Users' Satisfaction (PUS) in using IoT in Smart Cities of India	Not-Supported
Hypothesis 7	Perceived Users' Satisfaction (PUS) to use IoT in Smart Cities of India positively impacts the Perceived Intention to Use (PIU) IoT in Smart Cities of India	Supported
Hypothesis 8	Perceived Users' Satisfaction (PUS) to use IoT in Smart Cities of India positively affects Perceived Net Benefit (PNB) of using IoT in Smart Cities of India	Supported
Hypothesis 9	Perceived Intension to Use (PIU) IoT in Smart Cities of India positively influences Actual Usage of IoT (AUI) in Smart Cities of India	Supported
Hypothesis 10	Perceived Net Benefit (PNB) in Smart Cities of India positively contributes to Actual Usage of IoT (AUI) to use IoT in Smart Cities of India	Supported
Hypothesis 11	Perceived Net Benefit (PNB) of using IoT in Smart Cities of India positively influences Perceived Intention to Use (PIU) IoT in Smart Cities of India	Supported

it is expected, enrich the understanding of Information System Success so far as IoT implementation in SCI is concerned. It is expected that future researchers would get an idea to improve this model considering it to be the plinth by addition or by elimination or by modification of some constructs if needed and update the model by such amendment befitting with the context which is expected to throw light to the Smart City authorities for successfully and effectively implementing other kinds of Information System in proposed SCI. In framing the constructs, we had used the idea lent from UTAUT and TAM along with much dependence on De Lone & Mc Lean model. We have also taken help of the idea derived from combination of meta-analysis and Structural Equation Modeling (SEM) (Dwivedi, Rana, Jeyaraj, et al., 2017) to shape the model in an implicit manner. However, the model provided mainly depends on the IS Success Model provided by De Lone & Mc Leon as already mentioned. Moreover, to make the representation of the model in the present context more exhaustive, explicit and comprehensive, we have included some ingredients of PIQ like accuracy (Bailey & Pearson, 1983; Mahmood, 1987), extent of completeness of information (Miller & Doyle, 1987), extent of relevance (King & Epstein, 1983) and need of contents (Doll & Torkzadeh, 1988) in addition. Like this, we have also considered some additional ingredients of PSQ over and above De Lone & Mc Leon model like reliability and flexibility of the system (Srinivasan, 1985), access easiness (Bailey & Pearson, 1983) and so on. Similarly, to enrich the acceptability of the proposed model; we have, over and above ingredients of different constructs provided by De Lone and Mc Leon, considered additional elements of the concerned other constructs, for example, in the construct PESQ, we have considered one ingredient like 'empathy' (Kettinger & Lee, 1995) in addition. All these have been duly mentioned and discussed in the relevant earlier sections of this study. Slight glimpse over the De Lone & Mc Lean model, it would be seen that we have separated one construct like 'Actual Use of IoT' to enrich the theoretical aspect of this study. Besides, in some of the constructs, we have used the word "perceived" prefixing in those constructs. This has been done because we have in this study nurtured use of IoT technology in proposed SCI and the Smart Cities in India have yet not been operational in the real sense of the term. In this way, by consideration of other relevant elements to elucidate the constructs, we have been presumably able to more theorize our model befitting with the ground reality in the context of use of IoT technology in various products by the citizens of proposed SCI.

8.2. Implication for practice and policy

The Government of India (GOI) has already decided to create 100 smart cities in India and in those 100 smart cities, the citizens are expected to enjoy high speed internet connectivity along with use of internet enabled devices such as IoT. For this, in every smart city, it is expected that proper IT infrastructures will be provided. Besides, during 2015, the GOI has published draft policy for IoT. GOI has assessed that use of IoT technology will improve the financial health of the country. Consequently, the use of IoT technology in SCI will fetch much benefit to the citizens of SCI as well as to the government. In this context we have taken a holistic attempt to identify the salient issues for successful and effective implementation of IoT policy relating benefits to be extended to the citizens of proposed SCI. This study has given scope to analyze how Perceived Information Quality (PIQ), Perceived System Quality (PSQ) and Perceived Service Quality (PESQ) influence different impacts of IoT policy implementation in proposed SCI. This article is expected to provide meaningful and comprehensive inputs to the Smart City authorities, that is, authorities in Ministry of Electronics and Information Technology (MeitY), Government of India regarding achieving success of IoT policy which would benefit the end users who would be citizens of proposed SCI. The concerned authorities to accomplish the objectives are required to improve the information, service and system quality which can motivate the users' intention to actual use the innovative technology like IoT. This confirms the findings of the study undertaken by other researchers (Zuiderwijk, Janssen, & Dwivedi, 2015). It is also expected that this study would help increase the adoption rate of IoT by the citizens of proposed SCI and by such increased use of IoT, the overall financial health of the SCI would improve along with sustainable growth. Thus, improvement of financial health of India will be effectively achieved if, with others, the full benefits of the IoT technology can be extracted and this depends in framing appropriate policy. Also, success of IoT in SCI depends on the combination of success of IoT policy in India which is in 'draft' stage as well as success of operations of these smart cities. Comprehensive policy is to be framed for ensuring success of IoT in SCI. It is suggested that policy in this context may be improved by taking appropriate inputs from different developing countries and those may be included in our policy after necessary reconciliation befitting with Indian context. Success may be achieved in this context if instead of fragmented policy framing, for example, policy for smart city, policy for IoT and so on, the GOI focuses attention to frame integrated comprehensive policy. In this context, this study is expected to provide effective and meaningful inputs to the policy makers to frame successful integrated policy for ensuring success of IoT in SCI. This research study will provide substantial inputs to the policy makers for framing integrated policy which would focus on the perspective of citizens of SCI. This study would also act as a thought-provoking ingredient to the policy makers to frame comprehensive policy which could include the citizens' centric perspectives to ensure success of IoT in SCI.

9. Conclusion

This study has aimed to predict salient factors which influence the information system success through usage of IoT in SCI. While questing the factors, the help of Updated Information System Success Model (DeLone & McLean, 2003) has been taken with some congenial modifications along with the help of inputs from relevant literature review. The study reveals that Perceived Information Quality (PIQ) and Perceived System Quality (PSQ) affect the use of IoT by the Smart Citizens of proposed SCI. Hence, authorities of SCI should focus on the cultivation of better information quality and of better system quality to enhance information system success which would improve the intention of the users to use IoT in SCI to fetch desired success. It appears from the study that Perceived Net Benefit (PNB) derived from satisfaction of usage of IoT by the citizens of proposed SCI plays a crucial role to induce more users to use IoT in proposed SCI. By such induction of increased number of users to use IoT enabled services in SCI, it is evident that, in that case influx of data would be generated and then it would be possible by the government to take help of these big data analytics tools which would ultimately help government for accurate and reliable decision making. Such being the scenario, the concerned authorities of proposed SCI should brush-up information quality, system quality and service quality to ensure Information System Success. This will be achieved by the concerned authorities if they are properly trained well ahead. The potential users should be made aware regarding the advantages of using products associated with the use of IoT technology. They should be made aware that use of this technology would facilitate generate huge data. From this huge data, Government will be able to analyze those data with the help of AI and will be able to arrive at a flawless decision. This would bring benefits to the citizens of SCI eventually. Thus, generation of data using IoT enabled devices is important. And the factors affecting usage of such IoT technology by the citizens of SCI has been, as such, studied. All these would motivate the users to be involved in using IoT technology in SCI and it would help the citizens to be smarter. The regression analysis conducted in this study highlights that Perceived Service Quality (PSQ) has insignificant effect over the Perceived Users' Satisfaction (PUS) of using IoT technology. Also, Perceived System Quality (PSQ) has insignificant effect over Perceived User Satisfaction (PUS) using IoT enabled information system. This is presumably because the smart citizens have an unfortunate experience regarding standard of system quality as well as of service quality of the information system provided by the government. With a preset mind, probably they have already presumed that system quality and service qualities provided by the government would not be at all up to the standard as experienced by the citizens and they have not attached much importance to these two factors (PSQ and PESQ) and that is why these two factors have become incapable of projecting much of influence over the users' satisfaction to use IoT in SCI. To restore the goodwill, the government should brush-up their technology development activities focusing sincere attention to the citizens' various needs in terms of improved lifestyle, good quality workstyle, high expectation, better benefits etc. It would then be appropriate to induce confidence of the citizens using IoT in proposed SCI to have confidence over the system quality and service quality provided by the government to citizens. It also appears that Perceived Information Quality (PIQ) significantly affects Perceived Users' Intention as well as Perceived Users' Satisfaction (PUS) to use IoT in SCI, to bring success, the authorities of SCI are expected to provide the users through IoT-rich information and hi-tech platform with a special attention as to what the citizens perceived as useful and easy and also the authorities of SCI should try to simplify users' web-interface which would create user-friendly informative environment (Celic, 2008). To make the citizens of SCI more IoT user-friendly to fetch respectable success, video conferencing with the users may be done to induce more users to use IoT based services which might eventually bring more confidence to the users' intention to use IoT as they would see the Smart City authorities on their computer screen (Raman, Stephenaus, Alam, & Kuppusamy, 2008). The model after analysis of data eliminated two hypotheses and has been able to explain users' attitudinal constructs affecting perceived intention to use IoT. The model has been able to identify the factors perceived to interpret the users' intention to accept IoT technology in proposed SCI and to investigate impacts on individual's differences on these factors. The model would provide, as expected, a scope to the authorities of proposed SCI to think to provide a better strategy for better development of IoT based services with a target for promotional planning for development of IoT service activities and system activities which would help accelerate more acceptance and usage of IoT based service by the citizens in the proposed SCI.

10. Limitations and scope for future research

We have confined our studies to identify and predict the factors with their relations relating to use of IoT by the users and authorities of SCI. But it is a fact that neither SCI have still become operational in the real sense of the term though the Government of India is continuously trying to shape the 100 SCI as quickly as possible, nor the usage of IoT in India is frequent though it is an emerging issue. Naturally, the factors predicted to influence usage of IoT by the citizens and authorities of SCI could not get scope to be validated with ground realities. Hence, in this respect nurturing is essential and it is as such left for the future researchers to modify the model and factors if needed after proper validation as and when the SCI will be operational and when the scope of products utilizing IoT will be frequent. In this study, we have focused our attention to identify and predict the factors affecting the success of usage of IoT technology by the users and have not discussed on the technology related complexities and issues towards implementation of IoT in SCI. Therefore, it is left for the future researchers to study the technological aspects of implementation of IoT in proposed SCI. Here in this study we have conducted our survey on four metropolitan cities of India (Bangalore, Kolkata, Mumbai and Delhi), but the proposed 100 Smart Cities are spread over different parts of India. We have mainly used the convenience sampling method in this study. As such it is a question if this survey would be able to ensure general representation of the overall population. It is left for the future researchers to study so that it ensures general representation of population. Since the IoT initiative is related with generation, storing and exchange of huge data, naturally it is not free from security and privacy vulnerabilities. But in this study, we have not touched this area. So, it is left for the future researchers to study on the security and privacy aspects related to IoT in SCI. Here it is to note that we have used mostly linear relationship among decision variables. In terms of the research works (Chong, Liu, Luo, & Keng-Boon, 2015; Sharma, 2017), things would have been much comprehensive had we explored non-linear relationships among the decision variables with the help of machine learning tool like artificial neural network model and so on.

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