# 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