Factors impinge on the development of a smart city: a field study

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Abstract
Smart city aims at amassed connectivity at various levels in the midst of citizens, as well as amid the administration and the daily growing population. India is one of the developing countries where population growth is one of the significant areas to be noted seriously. A city is a large and permanent human environment that provides its citizens with many services and opportunities. The rapid economic growth and population growth have put a huge amount of strain on urban infrastructure and service provision. India is an under developing nation to modernize urban life; the current urbanization needs good tactics and creative planning. India's government has launched 100 smart cities where it is expected that citizens will use new innovations and resolve the issues. Smart cities are intended for finest usage of space and resources along with an effective and optimum dissemination of benefits. This study aims to investigate and analyse Chennai smart city mission (SCM) development. This work has been undertaken to learn about the aspects of smart development and the factors governing smart city. The analysis has been split up into 4 portions as questionnaires’ survey in Chennai city, frequency and percentage analysis, descriptive analysis and using structural equation modelling (SCM). Using the Statistical Package for Social Sciences (SPSS) version 21.0, conversational interviewing and questionnaire survey and also journal study are conducted to find factors influencing the implementation of smart city and reviewed. Using the structural equation model (SEM) AMOS 21.0 software, confirmatory factor assessment had been done. This study gives in-depth knowledge in the implementation of the smart city scheme aspects and also suggests solution for the most affecting factor in a city.

Keywords Smart city · Environmental impact · Statistical analysis · Urban analytics · SEM modelling

Introduction
The increase in population growth leads humanity to face various difficulties in daily life. Particularly in urban areas, poor urban infrastructure, higher unemployment, traffic congestion, energy shortage, high power loss in transmission, power theft, health issue, inadequate housing, education challenges, rising crime rates, supply connection issue, inadequate power generation capacity and frequently power failures are most common hitches, mostly in developing countries such as India in an existing city. There comes smart city scheme to give a better life to every common man to lead it with ease.

Overpopulation is one of the predicaments face by most of the cities in the world which leads to scarcity of resources. It creates problems among people by turnout of a social and economic discrepancy. The objective of smart city is to provide enough resources and space for citizens without any inequality along with effective distribution of welfares. Also, the system aims at improvising the connectivity among all colours of people at various levels. Since technology is speedily evolving, every individual would admit it, and to adapt to today’s trend and demands, one has to change their way of life accordingly. The system also improves public properties like hospitals, roads and schools, and it meant to be eco-friendly. Based on the smart city index, to determine a city is smart, one of the metrics to be considered is to validate the mobility and transport criterion.
The Indian government launched the flagship promotion “100 smart cities mission” by June 25th 2015 by the Prime Minister of India in the name of “Atal Mission for Rejuvenation and Urban Transformation (AMRUT)”. Each of the city comes under the mission will be a key factor to raise the country’s GDP rate via multiple ways like growth in employment openings. This can be attained around 2030 by 75% in terms of assumption. The vision of the present Indian government on smart cities is ought to have services like automated traffic signal, speedy accident aid, enhanced public transport facility, smart traffic system, data centre, automated smart face identification system to identify criminals easily, smart control and so on. To make the above said vision practically possible, information and communication technology (ICT) should go hand-in-hand with the smart city mission. The emerging technologies such as the Internet of Things (IoT) and artificial intelligence (AI) would help it out. Nowadays, sensors play a vital role in all upcoming technologies. The word “smart” meant for automation with the help of sensors from end-to-end of a system incorporated with real-time applications. The overall process can be split up into 4 steps: collection, analysis, communication of information in the form of sensor data and acting accordingly. In the near future, this smart city mission in India will endow a better infrastructure, housing for all, delivers adequate resources with smart solutions and creates employment opportunities and so on. Apart from these services, it also provides facilities for safety measures, for instance, early warning in terms of messages or alarm for incidents such as landslides, droughts, floods, hurricanes and other natural disasters. And to identify crimes, the integration of technologies like AI and the IoT with smart city vision would be supported.

Though advantages are high, building a smart city needs huge investments by the government. In addition, the pillar of the smart city is “data”. The system is going to involve hundreds of IoT devices which communicate information via wireless in an open platform between the users’ leads to connectivity issues, data theft and other associated issues. Hence, smart city data needs to be anonymized. And it also affects the present way of people’s daily life in terms of few factors which are described in the forthcoming sessions of this study. Nevertheless, this is one of the finest changes in the way of living if it is done with determined and wilful implementation.

Altogether, a smart city can be put in a simple words as it’s an urban area that uses various kinds of electronic systems and sensors to gather data. Insights gained from the gained data were used to bring about properties, resources and facilities resourcefully; in return, the same data is used to expand the manoeuvres across the city. In general, a smart city is a city that practices technology to provide public amenities and solve city problems. Smart cities fix things like get better transportation and ease of access, improve social services, endorse sustainability and give its residents a voice.

The main contribution of this study is to analyse the most affecting factors, i.e. elements which is most hindering the development of Chennai city in becoming a smart city. And also how the various problems should be solved sequentially such that least time will be taken by Chennai city to become smart city can be known. We hope this study will help readers to have a detailed knowledge about smart city.

In this paper, analysis is about the vulnerabilities of over-implementation of the smart city scheme aspects and also suggests solution for the most affecting factor in a city. This paper gets organized as follows. First, it’s a review about the existing smart city development plans and suggestions. Second, it comes about the analytical survey in Chennai city. In addition, a comparative analysis is framed on the aforesaid content. Finally, the summarization of this paper has been noted.

**Literature review**

One hundred cities were nominated for the smart city mission by each state in India. Tamil Nadu nominates 12 cities which includes Chennai as the first one in the midst. Since Chennai is the capital of the state as well as a metropolitan city and has been the first city to implement the smart city in Tamil Nadu, we authors considered Chennai city for this study. Particularly in Chennai, T. Nagar is considered for the analysis because T. Nagar is the busiest city in Chennai. The total area of the city is 6.95 km², and it has various combinations of residential, educational institutions and entertainment zones. In T. Nagar, important land marks are Panagal Park, Nadesan Park, Mambalam Railway Station, Kodambakkam Station and bus stand. The key components under smart city include pedestrian, retrofitting of open spaces, footpath widening along the main road, cycle sharing network, multilevel car parking, integrating all public network, robust IT connectivity and digitalization, smart buses, solid waste management, water supply management, sewer management, e-governance and storm water management including flooding warning and monitoring.

The city transformed to smart city, and the study examines transformation and framework of smart city and discussed four key elements: (1.) planning, (2.) infrastructure, (3.) ICT and (4.) solution for smart city (Kumar et al. 2020). The key to solve these urban problems is the development and implementation of advanced technologies designed to expand the eminence of a city life and
reducing the running costs of the city while in view of the objectives of a sustainable development (Ahvenniemi et al. 2017).

The huge problems are developed by urban developments in transportation, water management, solid waste management and electricity demand (Caragliu et al. 2015) and population which are exploring Chennai city the last 50 years (Census of India 2011). The need of smart city is described by the authors in a paper (Giffinger 2010). Smart governance, smart people, smart environment, smart mobility and smart living have been defined as six major smart city dimensions. Factors affecting smart city are detailed in a research article (Myeong et al. 2018) for further clarifications on the same.

**Smart city mission (SCM)**

In urban development’s planning, the conception of smart city has been vital because technological evolution is rapid, and also the local authorities are dealing with increasing challenges in solving climate, energy and urban difficulties. Developing and implementing advanced technology of smart city are the key in solving these problems in cities (Ahvenniemi et al. 2017). In June 2015, the MoUD (ministry of urban development) propelled the scheme called mission of “smart city” for 100 cities together with the announcement of the “AMRUT” (Atal mission for rejuvenation and urban transformation) for infrastructure rejuvenation across 500 cities in India. To attain economic progression and to improve the standard of citizens’ life, the mission smart city helps in infrastructure development and its services with the help of emerging technologies the so-called IoT (Kumar et al. 2020). The Indian government is trying to explore solutions for this problem among urban people; the method is change in the standard of life, stability and sustainability of city by the implementation of smart city. In general, a city is the one that assimilates information and communication techniques (ICT) that enhances the quality and performance of city services like transportation, energy and services to trim down the resource consumption and all-inclusive cost. (Kramers et al. 2014).

In Chennai, smart city developments are further classified into two division based on the economic and quality of common man’s life. They are pan city and area-based development. Area-based development is the key component for the smart city proposal. Based on research and analysis about an area of the city and frequent meetings with the corresponding representatives, pan city solution is that modifies an entire city in all at once (Smart city mission 2015). A smart city can also respond directly, more rapidly and in a very responsive fashion to any urban recession because it has a high level of urban effective resistance. (Ferrara 2015).

**Smart city implementation aspects**

Few new rules and regulations are mandatory to promote the smart city facilities with common people. Resource shortage, government accountability and structure in developing countries are among the leading causes of the inability to deliver public service (Bertot et al. 2016). In a research article (Giffinger 2010), the authors defined a smart city by giving six dimensions of a city which includes smart environment, smart governance, smart mobility, smart people and smart living. Wireless infrastructure and modern technology are there to enhance the political and economic efficiency and sociological economic development of the city (Hollands 2008).

**Chennai city profile**

Chennai is the capital of Tamil Nadu, and it is the fourth largest population with its population of 4.6 million (Table 1) (Census of India 2011). It is the smallest of all district, but it has the highest density of people, and it has the largest population, economy and education centre of south India. The Tamil Nadu government hired another major plan to guide urban areas with the help of satellite (Chennai city Metropolitan Development Authority [CMDA], 2008). The city of large mix of development such as residential, industrial, IT, office etc. the city as different of land users are residential, industrial and special hazards.

**Analytical survey in Chennai city**

The survey follows three conceptual frameworks to recommend for smart cities and explain the benefits of urban transformation. Based on simple random sampling method, the analytical survey questionnaire was collected from randomly selected number of respondents belonging to four different regions of Chennai, Tamil Nadu. The entire Chennai region has been divided into four zones as North, South, East and West. Since the questionnaire method needs in-person interaction with people, it’s tough to meet people in an early stage of the pandemic situation. Therefore, the number of sample of respondents has been limited to 200 by 50 samples from

| Year | Population |
|------|------------|
| 1961 | 1,729,141  |
| 1971 | 2,469,449  |
| 1981 | 3,266,034  |
| 1991 | 3,841,396  |
| 2001 | 4,343,645  |
| 2011 | 7,088,000  |
each of the four zones, respectively. Data were collected from 50 samples from each of the four zones for analytics. Thus, the total number of sample of respondents was limited to 200.

The questionnaire survey had conducted and analysed the most affecting factors of Chennai city when it transformed to a smart city. This takes 1 month to collect data, and the success rate of the survey turns to be 100% since the data received from all 200 respondents. Based on the number of people’s opinion of different categories, frequency and percentage analysis was done, whereas the descriptive analysis is a conformation of ranking of factors affecting the city. By using SPSS model and structural equation model (SEM), the confirmatory factor analysis had been executed.

Factors affecting Chennai city to become smart city

Traffic problem

There are several issues (Fig. 1) with traffic difficulties, counting economic costs probably due to interrupted travel times, halts and exit traffic flow and also concurrent pollution and road accidents (Ponnurangam & Umadevi, 2016). In Chennai city, vehicular movements are increased during peak hour, and thereby, traffic congestion occurs, and this would be one of the important topics in the city that needs to be resolved soon, and if one path is been congested, drivers might use other roads/paths which are not inherently designed for traffic and becomes overcrowded. Traffic congestion is rising at a rate of 7 to 10% for every year, while the growth of vehicular population is 12% per year. Here, the authors (Anush kumar et al.) discussed about the cause of traffic in centre city, inadequate planning of city development, unauthorized parking, reduction of public transport usage and increase in private transport habits.

Parking problem

As mentioned above, people feel comfortable with their own vehicles for their transportations; everywhere, traffic has been increasing which escalates to another problem called the need of parking area. The ASCE (ASCE 1989) perceives parking space as one of the biggest concerns in a metropolitan. In central city centres, three most important problems have been recognized: (i) deficiency of off-street and on-street parking; (ii) illegal use of loading places; and (iii) time limits. Parking proposals are seen as one of the powerful and dangerous measures for maintaining travelling demand patterns and redeploying travel in urban areas (Alho & de Abreu e Silva 2014). The search for on-street parking space was linked to environmental and social effects due to disruption of the network traffic flow, massively increased pollution level, time delays for other vehicles and other potential safety threats by the condition of vehicles (Brooke et al. 2014).

About 5.3 million vehicles are now on road in Chennai. Parking is the one among the other factors which needs the predominant care in a city. In Chennai, two different parking ways are in role on-street parking and off-street parking which has been deliberated in the article (Brooke et al. 2014). The rapid increase in traffic demand and the inequity between parking demand have been created.

Road and safety problem

Due to the rapid growth of the population of vehicles is increasing in the city, road accidents are also an important factor that affects people in major ways which includes injuries and even death. As per the Global Status Report, more than 1.2 million people have been dying on roads worldwide every year, and 50 million people continue to suffer non-severe injuries (Global status report 2015). The accident is due to over drunken drive, talking through mobile while driving, unobservance to rules, etc. According to Krishnan et al. (2019), more than 1 million people are passing on every year, and 50 million people are getting injured globally in road accidents, and more than 70,000 people passing on each year in India as a result of road accidents, and this must be recognized as an important factor on public health. Nearly 241,751 people would suffer as a result of road traffic accidents by 2030 if this situation remains constant and if strong and incorporated traffic safety processes were not in place today (Gururaj and Gautham et al. 2017).
Waste management problem

Industrial growth and increase in population and their needs have resulted in migration of people from rural to urban cities, which turn out to be thousands of tons of MSW each day. Underprivileged collection and insufficient transport are blameable for MSWs (Bundela et al. 2010). The development of urbanization, advancement in technology and digitalization promote e-waste. Common wastes are spawns by humans for daily activities from residential, public, agriculture, industries etc. The wastes were classified into two types, compostable and non-compostable (Jha et al. 2011), due to inappropriate handling of solid waste management which causes pollution, environment impact and impacts on human health safety (Shazwin and Nakagoshi 2010). Many classifications of civic solid wastes were identified, such as food waste, commercial waste, institutional waste, waste from the street, industrial waste, waste from construction and demolition, waste from sanitation and so on (Syed 2006). In Chennai city, the waste management systems do not regularly collect wastes which lead people to dump wastes on water sources. Also the un-separated wastes by the public create difficulty in the implementation of recycling the waste, collection and proper disposal, in an environmentally friendly manner (Smart city 2015).

Storm water management

Storm water management, the increasing the rainfall intensity in monsoon and water enter into streets, houses and causes huge strain for the people. The recent exploration of Chennai flood (Nov to Dec 2015) creates more impact on everyone. The main reason for flooding is none other than low-lying area and improper drainage, due to elevate downstream water level (source: Urban Storm Water Management Developing Countries 2015).

Pollution problem

The need for mobility is enhanced by population growth and economic development. As a result, the environmental impact of CO₂ carbon emissions can be discussed. This pollution has resulted in increased production, increasing public services, and increased the amount of huge waste affecting the ecosystem by the increase in CO₂ emissions (Pop & Prostean 2018). There is no discussion about air pollution as a serious health issue in India. In 2006, the Central Pollution Control Board carried out a source distribution survey in six cities — Bengaluru, Chennai, Delhi, Kanpur, Mumbai and Pune. Air population mainly involves solid or liquid or gas or noise which blends with atmosphere which generate problems to humans, plants, environment and animals the pollution mainly from these two factors, vehicles and another one is industries.

Shipping, automotive industry, chemical and petrochemical industries, software services, healthcare and production takes the shape of Chennai’s economic base. The pollutant air from factories; power plant; vehicle like bike, car, train and buses; and the stunning rate of vehicular population grows in Chennai city.

Vehicular emission creates more impact problems by emitting suspended matter (SPM), carbon monoxide (CO), sulphur dioxide (SO₂) and nitrogen dioxide (NO₂).

Drinking water problem

Water is a primary natural resource and a fundamental human need. The monsoon was always very bad, and so this is a cause for low water levels. Two major sources of water are surface water and groundwater. Drinking water continues to be a problem. Natural reasons and human causes can also play a major role in the issue of water shortages. Chennai city has mainly 5 storage reservoirs which are (1.) Poondi – 3.231 TMC; (2.) Cholavaram – 0.881TMC; (3.) Red hills – 3.300 TMC; (4.) Chembarambakkam – 3.645TMC; (5.) Veeranam – 1.465TMC (Murugesan et al. 2015). It is estimated that demand will rise to 76% to 114% of water use in the future 2050 (Maheshwari & Ravi Kumar Pillai 2001). In Chennai, drinking water is transported through pipe line and mobility. Water contains impurity or mixing sludge which cause health issue to urban people.

Crime rate problem

Chennai city is one of the most secured places; however, minor rate of crimes takes places. The cases are murder, rape and kidnapping (Smart city 2015).

Frequency and percentage analysis

The analysis organized in the first section describes the frequency and percentage analysis of the demographic variables of the study which includes gender, age, qualification and profession.

Gender

The profile of the respondents of the study based on their gender is presented in Table 2. From the data, the majority of the

| Gender | Frequency | Percent |
|--------|-----------|---------|
| Male   | 167       | 83.5    |
| Female | 33        | 16.5    |
| Total  | 200       | 100.0   |
respondents of the study are male (83.5%, \(N=167\)). The study included only 16.5% (\(N=33\)) of female respondents.

**Age**

Table 3 shows the age profile of the respondents of the study. From the table, it can be seen that the majority of the respondents of the study are young belonging to the age group 18–28 years (59.0%, \(N=118\)). Around 27.5% (\(N=55\)) of respondents belong to the age group 28–38 years. Finally, the sample of respondents belonging to the age group 38–48 years consisted of 13.5% (\(N=27\)).

**Educational qualification**

Table 4 shows the educational qualification of the respondents of the study. The majority of the respondents of the study are undergraduates (39.0%, \(N=78\)). Around 24.0% (\(N=48\)) of the respondents were having postgraduate qualification. A total of 19.0% (\(N=38\)) of respondents have “other” qualifications like ITI, diploma and certification qualifications which were included in the study. However, respondents with higher secondary and below qualification consisted of 18.0% (\(N=36\)) of the sample.

**Profession**

Table 5 shows the profession of the respondents of the study. The majority of the respondents of the study are working in the private sector (40.0%, \(N=80\)). Around 27.5% (\(N=55\)) of the respondents are working in the government sector. A total of 14.5% (\(N=29\)) of respondents are self-Employed. The study also included “other” respondents consisting of home makers, job seekers and temporarily unemployed professionals consisting of 18.0% (\(N=36\)) of the sample of respondents.

**Descriptive statistics**

The second section discusses about the descriptive statistical analyses in which statistical methods like minimum statistic, maximum statistic, mean, standard deviation, skewness and kurtosis were used to analyse the data from the respondents of the study.

| Age group | Frequency | Percent |
|-----------|-----------|---------|
| 17–28     | 118       | 59.0    |
| 28–38     | 55        | 27.5    |
| 38–48     | 27        | 13.5    |
| Total     | 200       | 100.0   |

| Educational qualification | Frequency | Percent |
|---------------------------|-----------|---------|
| Higher secondary and below| 36        | 18.0    |
| Undergraduate             | 78        | 39.0    |
| Postgraduate              | 48        | 24.0    |
| Others                    | 38        | 19.0    |
| Total                     | 200       | 100.0   |

The study identified that eight factors, viz. traffic problem (TP), parking problem (PP), storm water problem (SW), waste management (WM), road safety problem (RS), crime-related problem (CR), pollution problem (POLN) and drinking water problem (DW), were predominantly affecting the development of a sustainable smart city. These factors were identified based on an extensive review of literature carried out by the researcher on the core topics related to the research. In total, 40 items were used to measure the eight factors. The items were measured using a scale of 1 to 5 with scale options like “completely disagree”, “disagree”, “neither agree nor disagree”, “agree” and “completely agree”.

The descriptive statistics of the data collected from the industry respondents of the study is shown in Table 6. The descriptive statistics considered in the study included minimum statistics, maximum statistic, mean statistics, standard deviation, skewness and kurtosis statistics.

From Table 6, it is very clear that, as per the rating of the respondents of the study, parking problem with a mean value of 4.30 and standard deviation of 0.40 was the top-rated factor in the development of sustainable smart city. This was followed by the factor traffic problem (TP) mean value of 4.29. Storm water problem was the third rated factor with a mean rating of 4.04. The factor “waste management” received a mean rating of 3.99. The factors like road safety problem (\(M=3.83\)), drinking water problem (\(M=3.8\)), crime-related problem (\(M=3.69\)) and pollution problem (\(M=3.68\) POLN) were the least rated factor influencing the development of smart city. The values of skewness and kurtosis were below the prescribed limits for all the eight factors indicating that the data are normal and suitable for other statistical analyses.

| Profession | Frequency | Percent |
|------------|-----------|---------|
| Self-employed | 29        | 14.5    |
| Private sector | 80        | 40.0    |
| Government sector | 55        | 27.5    |
| Others      | 36        | 18.0    |
| Total       | 200       | 100.0   |
Based on the mean values, the ranking of the factors is shown in Table 7.

**SEM model**

SEM is a very potent analytical method that is the combination of multivariate statistical methods and widely used by sociologists such as economists, teachers and marketing researchers. It is based only on the testing of a new model of the relationships between variables in the mind of the researcher before the research is done, via data obtained from the research (Hair Jr et al., 2010).

The final section describes the confirmatory factor analysis using structural equation model. Statistical Package for Social Sciences (SPSS) Software version 21.0 was used for data analysis. The SEM modelling was carried out using AMOS 21.0 software.

The confirmatory factor analysis (CFA) (Hollands 2008) model was developed using various Sustainable Smart City Development factors like traffic problem, parking problem, storm water problem, waste management, road safety problem, pollution problem, drinking water problem and crime-related problem. The software package, namely, AMOS 20.0, was used to develop the structural equation modelling.

Figures 2 and 3 show the unstandardized and standardized estimates for the model on Sustainable Smart City Development factors.

From the standardized estimates, the value of loading of each variable on the factor is above 0.4 which shows that the model is valid.

The values of regression weights of the SEM model are presented in Table 8. The contribution of individual parameters like drinking water problem, pollution problem, road safety problem, waste management, storm water problem, parking problem and traffic problem toward factors influencing smart city development was found to be significant as the $P$ value is less than 0.05. Here, the $P$ value (path model) is the probability under a specified statistical model that a statistical summary of the data intend to be equal to or more extreme than its observed value.

**Model fit summary**

The goodness of fit of the model is given in Table 9 that indicates how well the models fit the set of observations. From the given table, it’s very clear that the values for measured parameters were compatible to the recommended values. Henceforth, the model can be taken into consideration as a good fit model. The values obtained for the indices like goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), Tucker-Lewis index (TLI), relative fit index (RFI) and normed fit index (NFI) were greater than the recommended value of 0.9 which shows that the model is perfectly fit. Root mean square error of approximation (RMSAE) value was less near the recommended value of 0.09 (Hair Jr et al. 2010), indicating that the model is fit. Overall fit index values generated for the model are in conformance with standard values. Therefore, it can be concluded that the CFA model is valid and the chosen parameters contribute extensively to the Sustainable Smart City Development.

### Table 6 Descriptive statistics (N = 200)

| Smart city factors     | Minimum | Maximum | Mean  | Std. deviation | Skewness | Kurtosis |
|------------------------|---------|---------|-------|----------------|----------|----------|
| Traffic problem (TP)   | 3.40    | 5.00    | 4.29  | 0.45           | 0.34     | -0.65    |
| Parking problem (PP)   | 3.80    | 5.00    | 4.30  | 0.40           | 0.74     | -0.75    |
| Storm water problem (SW)| 3.20   | 5.00    | 4.04  | 0.38           | 1.02     | 1.35     |
| Waste management (WM)  | 3.40    | 5.00    | 3.99  | 0.50           | 1.13     | 0.01     |
| Road safety problem (RS)| 3.00   | 5.00    | 3.83  | 0.60           | 1.11     | -0.14    |
| Crime-related problem (CR)| 2.00  | 5.00    | 3.69  | 0.60           | 0.44     | 0.11     |
| Pollution problem (POLN)| 2.80   | 4.60    | 3.68  | 0.53           | 0.11     | -0.94    |
| Drinking water problem (DW)| 2.60 | 5.00    | 3.81  | 0.47           | 0.20     | 0.97     |

### Table 7 Ranking of factors influencing smart city development (N = 200)

| Smart city factors     | Mean  | Std. deviation | Rank |
|------------------------|-------|----------------|------|
| Parking problem (PP)   | 4.3   | 0.4            | 1    |
| Traffic problem (TP)   | 4.29  | 0.45           | 2    |
| Storm water problem (SW)| 4.04  | 0.38           | 3    |
| Waste management (WM)  | 3.99  | 0.5            | 4    |
| Road safety problem (RS)| 3.83  | 0.6            | 5    |
| Drinking water problem (DW)| 3.81 | 0.47           | 6    |
| Crime-related problem (CR)| 3.69 | 0.6            | 7    |
| Pollution problem (POLN)| 3.68  | 0.53           | 8    |
Conclusion

The smart city concept clearly defines that different aspects of cities are different things. Area-based development plays a dynamic role in terms of the smart city project that improves the quality of better living and the surroundings. Pan city development focuses on the state-of-the-art technology and is a research model to implement future projects. This study clearly defines a smart city's different methods, components, strategies and applications. The first section describes the frequency and percentage analysis of the demographic variables of the study which includes gender, age, qualification and profession and examines number of occurrences. The descriptive analysis is describing the factors affected by ranking method which is calculated by mean, standard deviation
and kurtosis. Reliability refers to the extent to which, if the measurements are repeated several times, a scale produces consistent results. In the analysis, ranking of factors influencing the smart city is based on the mean value. In that case, parking pollution problem is the highest mean values and the most affecting factor in a city and that should be resolved by the smart city project implementation.

These above-mentioned solutions are reliant on a fused approach from the government together with the private sector and citizens themselves. However, smart cities can use emerging technologies such as the Internet of Things to improve the lifestyle of inhabitants and create a team-up living solutions for the rising universal urban community.

**Author contribution** All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Priya J, Palanisamy C and C Vinothini.

**Availability of data and materials** All data generated or analysed during this study are included in this published article.

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### Table 8 Regression weights of the SEM model

| Observed variable          | Latent variable                                      | Standardized estimate | Unstandardized estimate | S.E  | C.R  | P   |
|----------------------------|------------------------------------------------------|-----------------------|-------------------------|------|------|-----|
| Crime-related problem      | Factors influencing smart city development           | 0.796                 | 1.000                   | 0.076| 12.33| *** |
| Drinking water problem     | Factors influencing smart city development           | 0.400                 | 0.397                   | 0.071| 5.614| *** |
| Pollution problem          | Factors influencing smart city development           | 0.661                 | 0.741                   | 0.075| 9.851| *** |
| Road safety problem        | Factors influencing smart city development           | 0.874                 | 1.110                   | 0.079| 14.088| *** |
| Waste management           | Factors influencing smart city development           | 0.857                 | 0.900                   | 0.066| 13.709| *** |
| Storm water problem        | Factors influencing smart city development           | 0.496                 | 0.393                   | 0.055| 7.082| *** |
| Parking problem            | Factors influencing smart city development           | 0.533                 | 0.444                   | 0.058| 7.673| *** |
| Traffic problem            | Factors influencing smart city development           | 0.868                 | 0.819                   | 0.059| 13.964| *** |

### Table 9 Goodness of fit: AMOS model (industry)

| Variable            | Recommended value | Obtained value |
|---------------------|-------------------|----------------|
| Chi-square value    | -                 | 72.903         |
| P value             | $P > 0.05$        | 0.000          |
| RMSEA               | < 0.2             | 0.115          |
| RMR                 | < 0.08            | 0.013          |
| GFI                 | > 0.90            | 0.917          |
| AGFI                | > 0.90            | 0.851          |
| CFI                 | > 0.90            | 0.936          |
| TLI                 | > 0.90            | 0.911          |
| RFI                 | > 0.90            | 0.881          |
| NFI                 | > 0.90            | 0.915          |
| Chisq/df            | < 5.0             | 3.645          |

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### Declarations

**Ethics approval** Not applicable.

**Consent to participate** Verbal informed consent was obtained prior to the questionnaire survey.

**Consent for publication** The participant has verbally consented to the submission of the case report to the journal.

**Competing interests** The authors declare no competing interests.

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