The Critical Project Management Success Factors in Smart City Development: A Case Study of Vadodara Smart City Project.

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Abstract:

Since a smart city has no widely agreed definition. It means various things to different people. In this way, the conceptualization of Smart City varies from city to city and country to nation, depending on the degree of growth, the eagerness to adapt and change, the city inhabitants' properties and ambitions. Nevertheless, as an idea, Smart City empowers the town and its inhabitants to obtain numerous strange inventions and interventions related to the foundation. Most of the World's general population right now lives in metropolitan domains. This move from an essentially common to an on a very basic level metropolitan people is foreseen to continue for the accompanying couple of many years. Such enormous and complex social events of individuals unavoidably will all in all become chaotic and jumbled spots. Urban areas, megacities, produce new kinds of issues.

There is a need to study issues and challenges in Smart City in these urban areas of Gujarat. To identify and analyze the level of awareness, government schemes are distributed among 137 respondents. The observation and responses are converted in to understandable and orderly statistics are used to organize and analyze the data.

Introduction:

India is a country with a total population of 1.35 billion as on 20th May 2018 based on the latest United Nations estimates. Of this 70percentage of total population lives in villages and 30percentage lives in cities. Mumbai, Chennai, Delhi, Kolkata, Hyderabad, Bangalore, Pune, and Ahmedabad are among the designated metro cities in India. As apparent, India is less than 30 per cent urban and the quality of life in its cities is chronically low. However, with 2/3rds of GDP already generated in India's cities and with rural to urban migration patterns accelerating, the country faces a critical challenge: managing this rapid urbanization in a way that enhances the liveability of India's urban spaces. A large number of populations living in the cities, the country is in dire need to enhance the quality of living of its citizens in both urban and rural spaces.

India fights with different basic checks that continue hampering the headway of metropolitan establishment: complex power structures, land valuation challenges, limit openings, and financing deficiencies are all bit of the metropolitan test that is sufficiently getting India far from another round of shocking money related turn of events. India in like manner needs to address the recurring pattern issues of developing extraordinary establishment, solid waste evacuation, flood the heads, storm water and sewerage framework, etc achieving metropolitan decay, traffic gridlock and thusly a self-destructing individual fulfilment for a critical number of its inhabitants. The surge of urbanization that is clearing across India addresses one of the country's most essential open entryways similarly as one

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of its most certifiable challenges.

Most cities in Europe and America were set up in the nineteenth century when there was simple accessibility of land, gas and water. India is a late starter and is unmistakably increasingly swarmed and complex. Therefore, India requires a far more efficient and sustainable solution for servicing cities and can reap the benefits by using technology to learn from best practices from other parts of the world. Thus India, too, is on the road to building smart cities—world-class, self-sustainable habitats with minimal pollution levels, maximum recycling, optimized energy supplies and efficient public transportation. Despite the clear evidence of the linkages between smart city and socioeconomic goals, many policy makers and practitioners are not taking advantage of them. In many countries around the world, opportunities to achieve economic, social, and civic development goals through housing-related initiatives are being missed. One of such Good models include Smart City Mission.

This paper present assessment of Smart City Mission & study the critical success factors for better implementation of such socio-economic initiatives. Growing globalization, improved communications and reduced transport costs determine new challenges in city development. City areas face the problems of population ageing, high migration, and bad infrastructure resulting in the reduction of possibilities of efficient state management and business development. Thus, it is needed to re-analyse the role of rural areas in the frames of modern economy and to find ways for their efficient development.

Research question and methodology

intention to choose this topic for study was that how many people have benefitted from this scheme in the city areas under the scheme. Also, this topic has been selected to know how successful the scheme has been in terms of the project management.

Purpose of the study: -

- To study the different factors affecting the smart city projects.
- Determine how many factors underlie a set of observable variables.
- To understand variance among observable variables by using fewer, newly created factors.
- Define the meaning or content of the factors.
- To study the specific factor of PMI Talent Triangle (Leadership, Strategic Business Management and Technical) in smart city.

Source of data:

(1) Primary Information: - To get the primary information related to this study, the questionnaire was filled up to the respondent directly and the visit and inspection method were also used.

(2) Secondary information: - The library has been used for secondary information related to study, as well as information from smart city center in Vadodara. An Internet source is an important source of information in today's time. Information has been obtained from various websites.

Sample size: A sample size of 137 is considered and a random selection among all stakeholders like Client, Vendors and Consultants. And most important respective citizens. From client-side administrative officers of government belongs to Vadodara Police, Vadodara Administration, Vadodara Health Department, Vadodara Education Department, Vadodara Transport Department, and Vadodara Telecommunication Department.

Universe: Universe refers to the total of the units in field of inquiry. Our universes were selected through random method among Vadodara.

Snowball sampling: In sociology and statistics research, snowball sampling is a non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances. Thus, the sample group is said to grow like a rolling snowball.

Sampling unit: Sampling frame is the representation of the elements of the target population. Sampling unit of our study was in Vadodara.

Sampling technique: The selection of respondents was done on the basis of snowball sampling (non-Probability).

Analysis of data: -

After the collection of information in the research process, the data is analyzed. Analysis of the primary and secondary data received in the research study presented in the analysis of computer software such as Microsoft Excel, SPSS, etc.

About the Smart City Mission of India:

Is it BIG?

Of 4000 cities/towns in India, 100 cities got selected to be developed as Smart City basis the Smart City Plan (SCP) it prepares detailing out the projects it will undertake from the Smart City funds allocated by the Government. This SCP provides the framework for the projects to be executed with regard to the approach and methodology to be followed, its sources of finance, and implementation plan. The SCP comes into place for the city after considerable desk research analysis, meeting with public representatives, and citizen engagement. The total outlay for all the 100 cities is expected to be about $29 Billion.

What all does it INVOLVE?

The entire gamut of Smart City projects can be divided two categories:

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1. **Pan-City Solutions** – These would include projects which will profit the whole city through use of Information and Communication Technology (ICT) and coming about progress in local governance and delivery of public services.

2. **Area-Based Development (ABD)** – These would include distinguishing a region of the city and creating it by building up hard foundation through city improvement (retrofitting), city renewal (redevelopment) and city extension (greenfield advancement) which will end up being an achievement for different parts of the city to duplicate.

What are PAN CITY SOLUTIONS?

Basis analysis of various city's SCP, the Pan-City solutions typically involved the following interventions:

Waste Management – So as to guarantee process arranged approach of the waste from its assortment till its disposal. Many cities proposed the following:

- RFID tags for bins to provide whether it's served by collection vehicles or not
- Mobile application-based grievance redressal for effective complaint registration and monitoring till its closure
- CCTV monitoring of waste disposal sites for tracking the waste transported to the disposal site
- GPS enabled waste collection vehicles to ensure its movement along the designated route
- Waste to Compost/Energy Plant to reduce the waste disposal harmful effect on the environment

Traffic Management– Traffic Management-Basic evaluation of urban junctions, traffic signals, and traffic surveillance to enhance traffic conditions and violate traffic regulations. Many cities have suggested the following:

Adaptive Traffic Control System (ATCS)-To ensure that the length of traffic signals is focused on real-time traffic data to prevent excessive traffic delays and prevent traffic congestion on busy roads/lanes

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Traffic Violation Detection (TVDS) Device In traffic Violation Detection System (TVDS) – In order to curb and fix responsibility for traffic related violations various interventions were envisaged which involved:

- Red Light Violation Detection System, to capture the real time image of the license place and vehicle of traffic signal violators

- Speed Violation Detection System, to capture vehicle details which is travelling over the prescribed speed limit

- Wrong Direction Vehicle movement, to capture vehicle details moving in wrong direction in case of one-way lanes (for the entire day or particular span of time typically in busy roads of metropolitan cities)

- Free Left Lance Blocking Violation, to capture vehicle details blocking free left turning section of the roads/lanes.

- E-Challan system, integrated with the Regional Transport Vehicle database to provide printed challans and provide intimation of the penalties and violation via SMS/email and tracking it till its compliance

City Surveillance – Basic evaluation of vital areas of the city that require surveillance in order to provide law enforcement officers with resources. Many cities have suggested the following:

Installation of weather-proof High-Definition Day/Night Fixed and 360-degree motion controlled PTZ camera at different critical city locations with face recognition, crowd demonstration pattern and other analytical aspects to be monitored 24x7 by concerned city agencies.

E-Governance – Basis assessment of city services provided by the municipalities and other Govt. Departments, in order to streamline its facilitation and increased convenience for the citizens availing it. Many cities proposed the following:

- Development of Website encompassing all the citizen services like birth/death certificate, property tax payment, grievance redressal mechanism, marriage registration, building plan approval, etc. to be facilitated without the hassle of multiple visits of the citizens to the respective departments

- Development of Mobile Application to enable citizens to avail city services at the convenience of their fingertips

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WiFi Hotspots – Basis assessment of city recreational spaces like parks, playgrounds or transport facilitation places like Railway Station, Bus Stops. Many cities proposed the following:

- Installation of Wi-Fi hotspots to enable the citizens to access high speed data for gathering information about the city and other aspects free of cost up to certain data limit and post that at nominal charges

Smart Classroom – Basis assessment of city's Govt. Schools and Colleges. Many Cities proposed the following for these institutions:

- Installation of necessary hardware components (Computer, Video Conferencing Facility, Short-Throw Projector, etc) to enable the students of Govt. Schools and Colleges to not only learn from the digital content but also enable the faculties across the world to teach the students at real time.

The Pan-City Solutions shall be monitored centrally through a Command-and-Control Center which shall be a state of art building with necessary hardware and software components like video walls, data center, building management system, enterprise management system

<u>**What are ABD PROJECTS?**</u>

Premise investigation of different urban communities' SCP, ABD extends commonly elaborate the accompanying:

Financial Diversification – Many urban communities proposed the accompanying:

- One-Stop Center with ability improvement/brooding focus, distributing zones, resident help place in order to empower young people/working populace to procure their occupation along with giving a coordinated methodology towards business age

- Improved Living Environment – For improving the living climate of the city. Numerous urban areas proposed the accompanying: Improvement/Establishment of parks in open empty regions of the city with offices like open rec center Installation of Solar Panels in broad daylight working to diminish power use and create power through sustainable wellspring of energy. Impartial and Sustainable Infrastructure – For guaranteeing comprehensive turn of events and legitimate use of city framework. Numerous urban areas proposed the accompanying:

- Redevelopment of different dwelling units with admittance to essential administrations, consequently killing the ghettos and utilizing the empty spaces for more profitable use

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- Installation of Supervisory control and information obtaining (SCADA) to screen from a solitary point the water amount, quality, treatment and conveyance measure continuously

- Improved Health – For giving roads to improve donning ability of the city. Numerous urban areas proposed the accompanying:

- International Standard Stadiums for Badminton/Football/Hockey with all the required courtesies and offices to bridle the donning ability of the city

Evaluation of Smart City Mission of India:

- The Government of India launched the SCM on 25 June 2015 for the duration of five years (2015-16 to 2019-20). The Mission aims to improve living conditions in 100 existing cities across India. At least one city from every state/union territory was selected under the SCM to implement the concept of a 'smart city.' The goal was to be accomplished by improving various types of infrastructure and services including water, sanitation, energy, mobility, education, and health. Over 130 million urban dwellers (or 35 percent of the country's urban population) are expected to benefit from this initiative.

- In every Indian state/union territory there are numerous settlements; only a 100 were chosen for the SCM. The selection of the 100 cities was based on their preparation of a smart city proposal and other fixed criteria such as urban population, number of cities in the state, distinctive characteristics (i.e., any religious/historic/tourist importance; position as capital city; centre of business/industry/transport), and the performance of the city's civic agencies. Cities that received the highest scores on the basis of these criteria were chosen. In the preparation of their smart city proposals, cities sought assistance and opinions from citizens, elected representatives, urban planners, and Indian and foreign consultants.

- The 100 cities were selected in phases, with the 100th city being selected in June 2018. Following their selection, the cities constituted Special Purpose Vehicles (SPVs) and appointed Project Management Consultants to drive the initiative through decision-making, project designing, and financing. Exactly one year after launching the SCM, that is, from 25 June 2016, smart city projects began to be implemented in the selected cities. To assist state/local governments and citizens in preparing their visions of a smart city, broad guidelines have been formulated by the Ministry of Urban Development. These are

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based on four pillars of development: institutional, physical, social, and economic. The SCM document encourages cities to consider achieving the following smart city features: mixed land use, inclusive housing, walkable localities, open spaces, multiple transport options, citizen-friendly governance, and strong city identity. The central government's SCM outline states that its aim "is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions."https://www.orfonline.org/research/the-smart-cities-mission-in-delhi-2015-2019-an-evaluation-60071/ -_edn15

- The SCM guidelines also state that the costs for undertaking activities under the SCM will be borne by the Centre and the state/local governments on a "matching" basis. The total cost of the projects proposed under the SCM is estimated at INR 2,050.18 billion. Each city will receive approximately INR 2 billion each from the central and the state/local government per year. The SCM guidelines provide that "government grants of both Centre and State will be leveraged to attract funding from internal and external sources".

Primary Information Analysis

The Kaiser-Meyer-Olkin (KMO) Test

Kaiser-Meyer-Olkin (KMO) Test is a measure of how suited your data is for Factor Analysis. The test measures sampling adequacy for each variable in the model and for the complete model.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.746
Bartlett's Test of Sphericity	Approx. Chi-Square	761.387
	Df	190
	Sig.	.000

This table shows two tests that indicate the suitability of your data for structure detection. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in your variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with your data. If the value is less than 0.50, the results of the factor analysis probably won't be very useful.

Bartlett's test of sphericity tests the hypothesis that your correlation matrix is an identity matrix, which would indicate that your variables are unrelated and therefore unsuitable for structure

detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data.

Factor Analysis: Factor analysis is a factual method for distinguishing which fundamental elements are estimated by (a lot bigger) number of noticed factors. Such "hidden elements" are frequently factors that are hard to gauge, for example, IQ, sorrow or extraversion. For estimating these, we frequently attempt to compose different inquiries that - at any rate incompletely reflect such factors.is a statistical technique for identifying which underlying factors are measured by a (much larger) number of observed variables. Such "underlying factors" are often variables that are difficult to measure such as IQ, depression or extraversion. For measuring these, we often try to write multiple questions that -at least partially- reflect such factors.

Research Questions and Data

A survey was held among 137 applicants for study of smart city and project management. The survey included 20 questions on stakeholders' feedback on smart city and project management. We think this measure a smaller number of underlying satisfaction factors but we've no clue about a model. So, our research questions for this analysis are:

- How many factors are measured by our 20 questions?
- Which questions measure similar factors?
- Which satisfaction aspects are represented by which factors?

Factor Analysis Output I - Total Variance Explained

Right. Now, with 20 input variables, PCA initially extracts 20 factors (or "components"). Each component has a quality score called an Eigenvalue. Only components with high Eigenvalues are likely to represent a real underlying factor.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	percentage of Variance	Cumulative percentage	Total	percentage of Variance	Cumulative percentage
1	**4.985**	24.927	24.927	4.985	24.927	24.927
2	**2.112**	10.562	35.489	2.112	10.562	35.489
3	**1.530**	7.651	43.140	1.530	7.651	43.140
4	**1.303**	6.517	49.657	1.303	6.517	49.657
5	**1.097**	5.487	55.144	1.097	5.487	55.144
6	**1.017**	5.083	60.226	1.017	5.083	60.226

7	.988	4.938	65.164			
8	.849	4.246	69.410			
9	.796	3.982	73.392			
10	.780	3.901	77.293			
11	.676	3.378	80.671			
12	.617	3.084	83.755			
13	.582	2.908	86.663			
14	.552	2.762	89.425			
15	.457	2.284	91.709			
16	.446	2.229	93.938			
17	.351	1.755	95.693			
18	.330	1.650	97.343			
19	.302	1.510	98.852			
20	.230	1.148	100.000			

Total Variance Explained			
	Rotation Sums of Squared Loadings		
Component	Total	percentage of Variance	Cumulative percentage
1	2.454	12.270	12.270
2	2.306	11.531	23.801
3	2.210	11.048	34.849
4	1.930	9.650	44.499
5	1.591	7.956	52.455
6	1.554	7.772	60.226

So, what's a high Eigenvalue? A common rule of thumb is to

"Select components whose Eigenvalue is at least 1"

Applying this simple rule to the previous table answers our first research question:
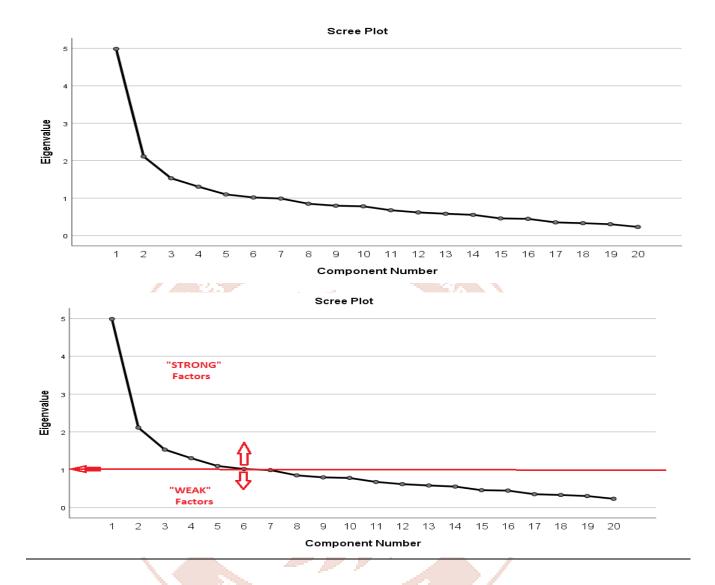
"Our 20 variables seem to measure 6 underlying factors"

This is because only our first 6 components have an Eigenvalue of at least 1. The other components -

having low quality scores- are not assumed to represent real traits underlying our 20 questions. Such

components are considered "scree" as shown by the line chart below

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Factor Analysis Output II - Scree Plot

A scree plot visualizes the Eigenvalues (quality scores) we just saw. Again, we see that the first 6 components have Eigenvalues over 1. We consider these "strong factors". After that -component 7 and onwards- the Eigenvalues drop off dramatically. The sharp drop between components 1-6 and components 7-20 strongly suggests that 6 factors underlie our questions.

Factor Analysis Output III - Communalities

So, to what extent do our 6 underlying factors account for the variance of our 20 input variables? This is answered by the r square values which are called communalities in factor analysis.

Communalities		
	Initial	Extraction
Q. 1. Role of project management is important for proper implementation of the smart city.	1.000	.658

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Q. 2. Leadership quality among the head of offices of the stakeholders like Municipal Commissioner, Administration etc. is important to monitor and smooth implementation of the project.	1.000	.559
Q. 3. Both the project management and role of project manager is very important to implement the smart city project.	1.000	.364
Q. 4. To properly implement the smart city project, it is required that project manager has a leaderships quality and proper technical knowledge to execute the Smart city project.	1.000	.690
Q. 5. Role of head of office like the Police Commissioner, Manager, District Collector is very important to implement the smart city project in VADODARA.	1.000	.603
Q. 6. The Smart cities are 'the good' for VADODARA as the technology and infrastructure required to be upgradation.	1.000	.544
Q. 7. The smart city project is implemented using guideline provided by standard project management methodology like PMP/ PRINCE2/TOGAF.	1.000	.589
Q. 8. The main issues of VADODARA development as a smart city attempt to reconcile economic, environmental and social objectives through interconnected governance and coordination.	1.000	.697
Q. 9. The proper in-depth study on the basic infrastructure of VADODARA for communication technology and gap which we require to achieve smart city objectives are required to be evaluated.	1.000	.493
Q. 10. Smart city should have efficient delivery of public utilities such as water, electricity, solid waste, sanitation and sewerage as well as associated government services.	1.000	.683
Q. 11. Smart city should have mechanism for supply- demand matching of surface transport services to provide congestion free roads and minimal waiting time.	1.000	.561
Q. 12. Smart city should have active surveillance monitoring and alerts at vantage points in the city to provide the much-required public safety for citizen.	1.000	.580
Q. 13. Smart city should have a demand availability of reliable emergency services such as ambulance, fire safety.	1.000	.558
Q. 14. The role of Information and communication technology (ICT) plays an important role in the implementation of smart cities.	1.000	.551

Q. 15. The seed funding allocated in the budget in just a small stepping stone. For them, projects to bloom and became a reality it requires both financial and working celebrations across all stakeholders.	1.000	.574
Q. 16. Smart city should have Integrated Traffic Management System with eChallan system to provide the much-required Traffic Enforcement for citizens.	1.000	.533
Q. 17. For Smart city projects, an Agile Project Management approach is more suitable than traditional waterfall approach.	1.000	.620
Q. 18. For a Project Manager, Leadership quality is most important than knowledge of Professional Project management framework (like PMP/PRINCE2/TOGAF) or Strategic business management skills for the successful completion of the smart city project.	1.000	.691
Q. 19. For a Project Manager a Knowledge and understanding of Professional Project management frame works (like PMP/PRINCE2/TOGAF) is most important than Leadership or Strategic business management skills for the successful completion of the smart city project.	1.000	.752
Q. 20. For a Project Manager, a Strategic business management skill is most important than Leadership or Knowledge of Professional Project management frame works (like PMP/PRINCE2/TOGAF) for the successful completion of the smart city project.	1.000	.745

Extraction Method: Principal Component Analysis.

So, if we predict Q1 from our 6 components by multiple regression, we'll find r square = 0.658 -which is Q1' s communality. Variables having low communalities -say lower than 0.40- don't contribute much to measuring the underlying factors.

You could consider removing such variables from the analysis. But keep in mind that doing so changes all results. So, you'll need to rerun the entire analysis with one variable omitted. And then perhaps rerun it again with another variable left out.

If the scree plot justifies it, you could also consider selecting an additional component. But don't do this if it renders the (rotated) factor loading matrix less interpretable.

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Factor Analysis Output IV - Component Matrix

Thus far, we concluded that our 20 variables probably measure 6 underlying factors. But

<div align="center">**"Which items measure which factors?"**</div>

The component matrix shows the Pearson correlations between the items and the components, these correlations are called factor loadings.

Component Matrix^a						
	Component					
	1	2	3	4	5	6
Q. 16. Smart city should have Integrated Traffic Management System with eChallan system to provide the much-required Traffic Enforcement for citizens.	**.631**	-.096	.188	.196	-.207	-.095
Q. 10. Smart city should have efficient delivery of public utilities such as water, electricity, solid waste, sanitation and sewerage as well as associated government services.	**.627**	-.217	**-.325**	-.205	.030	**-.307**
Q. 4. To properly implement the smart city project, it is required that project manager has a leaderships quality and proper technical knowledge to execute the Smart city project.	**.572**	.041	**.431**	.004	.079	**-.410**
Q. 15. The seed funding allocated in the budget in just a small stepping stone. For them, projects to bloom and became a reality it requires both financial and working celebrations across all stakeholders.	**.547**	.044	-.252	-.234	.122	**.373**
Q. 12. Smart city should have active surveillance monitoring and alerts at vantage points in the city to provide the much-required public safety for citizen.	**.541**	**-.322**	**-.321**	-.152	.005	-.241
Q. 3. Both the project management and role of project manager is very important to implement the smart city project.	.526	-.205	-.009	.001	.127	.172
Q. 11. Smart city should have mechanism for supply-demand matching of surface transport services to provide congestion free roads and minimal waiting time.	.515	-.174	-.474	-.079	.183	-.030

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Question						
Q. 8. The main issues of VADODARA development as a smart city attempt to reconcile economic, environmental and social objectives through interconnected governance and coordination.	.510	.089	.333	-.449	-.333	.072
Q. 2. Leadership quality among the head of offices of the stakeholders like Municipal Commissioner, Administration etc. is important to monitor and smooth implementation of the project.	.505	-.385	.068	.338	.088	.170
Q. 17. For Smart city projects, an Agile Project Management approach is more suitable than traditional waterfall approach.	**.485**	**.315**	**-.396**	-.034	-.161	.319
Q. 14. The role of Information and communication technology (ICT) plays an important role in the implementation of smart cities.	.479	-.002	.242	.368	.124	.335
Q. 9. The proper in-depth study on the basic infrastructure of VADODARA for communication technology and gap which we require to achieve smart city objectives are required to be evaluated.	.476	.028	.359	-.326	-.075	.154
Q. 1. Role of project management is important for proper implementation of the smart city.	.471	-.384	.207	.312	-.290	.255
Q. 13. Smart city should have a demand availability of reliable emergency services such as ambulance, fire safety.	.456	-.378	-.271	.305	.029	-.199
Q. 20. For a Project Manager, a Strategic business management skill is most important than Leadership or Knowledge of Professional Project management frame works (like PMP/PRINCE2/TOGAF) for the successful completion of the smart city project.	.393	.733	-.059	.222	-.001	.016
Q. 19. For a Project Manager a knowledge and understanding of Professional Project management frame works (like PMP/PRINCE2/TOGAF) is most important than Leadership or Strategic business management skills for the successful completion of the smart city pr	.345	.632	-.026	.348	-.137	-.304

Q. 18. For a Project Manager, Leadership quality is most important than knowledge of Professional Project management frame work (like PMP/PRINCE2/TOGAF) or Strategic business management skills for the successful completion of the smart city project.	.479	.597	-.152	.080	.272	.046
Q. 6. The Smart cities are 'the good' for VADODARA as the technology and infrastructure required to be upgradation.	.429	.163	.182	-.446	.318	.024
Q. 7. The smart city project is implemented using guideline provided by standard project management methodology like PMP/ PRINCE2/TOGAF.	.497	.060	-.033	-.108	-.551	-.150
Q. 5. Role of head of office like the Police Commissioner, Manager, District Collector is very important to implement the smart city project in VADODARA.	.402	-.083	.418	.051	.485	-.151

Extraction Method: Principal Component Analysis.[a]

a. 6 components extracted.

Ideally, we want each input variable to measure precisely one factor. Unfortunately, that's not the case here. For instance, Q16 measures (correlates with) components 1 and 3. Worse even, Q12 and Q17 even measure components 1, 2 and 3 simultaneously. If a variable has more than 1 substantial factor loading, we call those cross loadings. And we don't like those. They complicate the interpretation of our factors.

The solution for this is rotation: we'll redistribute the factor loadings over the factors according to some mathematical rules that we'll leave to SPSS. This redefines what our factors represent. But that's ok. We hadn't looked into that yet anyway.

Now, there's different rotation methods but the most common one is the varimax rotation, short for "variable maximization. It tries to redistribute the factor loadings such that each variable measures precisely one factor -which is the ideal scenario for understanding our factors. And as we're about to see, our varimax rotation works perfectly for our data.

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Factor Analysis Output V - Rotated Component Matrix

Our rotated component matrix (below) answers our second research question: "which variables measure which factors?"

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
Q. 10. Smart city should have efficient delivery of public utilities such as water, electricity, solid waste, sanitation and sewerage as well as associated government services.	.766	.064	.040	.223	.145	.137
Q. 12. Smart city should have active surveillance monitoring and alerts at vantage points in the city to provide the much required public safety for citizen.	.723	-.044	.102	.167	.075	.109
Q. 11. Smart city should have mechanism for supply- demand matching of surface transport services to provide congestion free roads and minimal waiting time.	.645	.071	.105	-.051	.039	.354
Q. 13. Smart city should have a demand availability of reliable emergency services such as ambulance, fire safety.	.615	.043	.400	-.099	-.004	-.086
Q. 19. For a Project Manager a Knowledge and understanding of Professional Project management frame works (like PMP/PRINCE2/TOGAF) is most important than Leadership or Strategic business management skills for the successful completion of the smart city project	.060	.840	.028	.111	.020	-.169
Q. 20. For a Project Manager, a Strategic business management skill is most important than Leadership or Knowledge of Professional Project management frame works (like PMP/PRINCE2/TOGAF) for the successful completion of the smart city project.	-.069	.831	.037	.089	.052	.195
Q. 18. For a Project Manager, Leadership quality is most important than knowledge of Professional Project management frame work (like PMP/PRINCE2/TOGAF) or Strategic business management skills for the successful completion of the smart city project.	.095	.691	.002	-.026	.233	.386
Q. 1. Role of project management is important for proper implementation of the smart city.	.115	-.087	.746	.272	-.077	-.010

Question						
Q. 2. Leadership quality among the head of offices of the stakeholders like Municipal Commissioner, Administration etc. is important to monitor and smooth implementation of the project.	.271	-.046	.676	-.018	.138	.085
Q. 14. The role of Information and communication technology (ICT) plays an important role in the implementation of smart cities.	-.071	.215	.644	.020	.210	.203
Q. 16. Smart city should have Integrated Traffic Management System with eChallan system to provide the much required Traffic Enforcement for citizens.	.277	.223	.489	.374	.139	-.086
Q. 3. Both the project management and role of project manager is very important to implement the smart city project.	.286	-.015	.380	.117	.194	.294
Q. 8. The main issues of VADODARA development as a smart city attempt to reconcile economic, environmental and social objectives through interconnected governance and coordination.	.025	.035	.068	.788	.174	.198
Q. 7. The smart city project is implemented using guideline provided by standard project management methodology like PMP/ PRINCE2/TOGAF.	.310	.236	.125	.619	-.192	-.048
Q. 9. The proper in-depth study on the basic infrastructure of VADODARA for communication technology and gap which we require to achieve smart city objectives are required to be evaluated.	-.021	-.007	.170	.549	.313	.253
Q. 5. Role of head of office like the Police Commissioner, Manager, District Collector is very important to implement the smart city project in VADODARA.	.090	.052	.262	-.005	.724	-.013
Q. 4. To properly implement the smart city project, it is required that project manager has a leaderships quality and proper technical knowledge to execute the Smart city project.	.230	.256	.204	.377	.578	-.229
Q. 6. The Smart cities are 'the good' for VADODARA as the technology and infrastructure required to be upgradation.	.096	.072	-.113	.283	.534	.389

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Q. 15. The seed funding allocated in the budget in just a small stepping stone. For them, projects to bloom and became a reality it requires both financial and working celebrations across all stakeholders.	.267	.099	.161	.164	.055	.661
Q. 17. For Smart city projects, an Agile Project Management approach is more suitable than traditional waterfall approach.	.209	.415	.121	.186	-.261	.535
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]						
a. Rotation converged in 9 iterations.						

Component Transformation Matrix						
Component	1	2	3	4	5	6
1	.525	.357	.471	.428	.303	.316
2	-.387	.818	-.382	.074	.017	.173
3	-.585	-.129	.265	.383	.560	-.332
4	-.081	.390	.633	-.500	-.187	-.395
5	.049	-.037	-.090	-.643	.700	.293
6	-.472	-.184	.391	-.041	-.265	.720

Extraction Method: Principal Component Analysis.

 Rotation Method: Varimax with Kaiser Normalization.

Our last research question is: "what do our factors represent?" Technically, a factor (or component) represents whatever its variables have in common. Our rotated component matrix (above) shows that our first component is measured by:

Q. 10. Smart city should have efficient delivery of public utilities such as water, electricity, solid waste, sanitation and sewerage as well as associated government services.
Q. 12. Smart city should have active surveillance monitoring and alerts at vantage points in the city to provide the much required public safety for citizen.
Q. 11. Smart city should have mechanism for supply- demand matching of surface transport services to provide congestion free roads and minimal waiting time.
Q. 13. Smart city should have a demand availability of reliable emergency services such as ambulance, fire safety.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 1 as "**citizen's expectations**". This is the underlying trait measured by Q10, Q12, Q11 and Q13.

Our rotated component matrix (above) shows that our second component is measured by:

Q. 19. For a Project Manager a knowledge and understanding of Professional Project management frame works (like PMP/PRINCE2/TOGAF) is most important than Leadership or Strategic business management skills for the successful completion of the smart city project
Q. 20. For a Project Manager, a Strategic business management skill is most important than Leadership or Knowledge of Professional Project management frame works (like PMP/PRINCE2/TOGAF) for the successful completion of the smart city project.
Q. 18. For a Project Manager, Leadership quality is most important than knowledge of Professional Project management frame work (like PMP/PRINCE2/TOGAF) or Strategic business management skills for the successful completion of the smart city project.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 2 as **"Talent Triangle of PMI:** Leadership, Strategic Business Management and Technical Knowledge"** This is the underlying trait measured by Q19, Q20, and Q18.

Our rotated component matrix (above) shows that our third component is measured by:

Q. 1. Role of project management is important for proper implementation of the smart city.
Q. 2. Leadership quality among the head of offices of the stakeholders like Municipal Commissioner, Administration etc. is important to monitor and smooth implementation of the project.
Q. 14. The role of Information and communication technology (ICT) plays an important role in the implementation of smart cities.
Q. 16. Smart city should have Integrated Traffic Management System with eChallan system to provide the much-required Traffic Enforcement for citizens.
Q. 3. Both the project management and role of project manager is very important to implement the smart city project.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 3 as **"ICT and other aspects of Smart city"** This is the underlying trait measured by Q1, Q2, Q14, Q16 and Q3.

Our rotated component matrix (above) shows that our fourth component is measured by:

Q. 8. The main issues of VADODARA development as a smart city attempt to reconcile economic, environmental and social objectives through interconnected governance and coordination.
Q. 7. The smart city project is implemented using guideline provided by standard project management methodology like PMP/ PRINCE2/TOGAF.

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Q. 9. The proper in-depth study on the basic infrastructure of VADODARA for communication technology and gap which we require to achieve smart city objectives are required to be evaluated.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 4 as **"Governance"** This is the underlying trait measured by Q8, Q7 and Q9.

Our rotated component matrix (above) shows that our fifth component is measured by:

Q. 5. Role of head of office like the Police Commissioner, Manager, District Collector is very important to implement the smart city project in VADODARA.

Q. 4. To properly implement the smart city project, it is required that project manager has a leaderships quality and proper technical knowledge to execute the Smart city project.

Q. 6. The Smart cities are 'the good' for VADODARA as the technology and infrastructure required to be upgradation.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 5 as **"Leadership"** This is the underlying trait measured by Q5, Q4, and Q6.

Our rotated component matrix (above) shows that our sixth component is measured by:

Q. 15. The seed funding allocated in the budget in just a small stepping stone. For them, projects to bloom and became a reality it requires both financial and working celebrations across all stakeholders.

Q. 17. For Smart city projects, an Agile Project Management approach is more suitable than traditional waterfall approach.

Note that these variables all relate to the respondent receiving clear information. Therefore, we interpret component 6 as **"Work life balance"** This is the underlying trait measured by Q5, Q4, and Q6.

After interpreting all components in a similar fashion, we arrived at the following descriptions:

Component 1 - **"Citizen's expectations"**

Component 2 - **"Talent Triangle of PMI:** Leadership, Strategic Business Management and Technical Knowledge**"**

Component 3 - **"ICT and other aspects of Smart city"**

Component 4 - **"Governance"**

Component 5 - **"Leadership"**

Component 6 - **"Work life balance"**

We'll set these as variable labels after actually adding the factor scores to our data.

Adding Factor Scores to Our Data

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It's pretty normal to add the genuine factor scores to our information. They are regularly utilized as indicators in relapse examination or drivers in bunch investigation. SPSS FACTOR can add factor scores to our information, yet this is frequently an impractical notion for 2 reasons:

1.   Factor scores may be added for cases without missing qualities on any of the info factors.

2.   Factor scores are z-scores: their mean is 0 and their standard deviation is 1. This confounds their translation.

As a rule, a superior thought is to figure factor scores as means over factors estimating comparative components. Such methods will in general associate impeccably with "genuine" factor scores, yet they don't experience the ill effects of the previously mentioned issues. Critically, we ought to do so just if all info factors have indistinguishable estimation scales. Since this holds for our model, we'll add factor scores with the punctuation underneath.

Result:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
FAC_1	137	1.00	3.75	1.4015	.45004
FAC_2	137	1.00	4.00	2.1144	.81493
FAC_3	137	1.00	2.60	1.3664	.35775
FAC_4	137	1.00	3.00	1.8637	.50739
FAC_5	137	1.00	3.00	1.5523	.44361
FAC_6	137	1.00	3.50	1.8285	.60767
Valid N (list wise)	137				

This descriptive table shows how we interpreted our factors. Because we computed them as means, they have the same 1 - 4 scales as our input variables. This allows us to conclude that

"**Talent Triangle:** Leadership, Strategic Business Management and Technical Knowledge" is rated best (roughly 2.11 out of 4 points) & impact most significantly

Findings:

- For summarization of a large number of variables into a smaller number of factors. Define the meaning or content of the factors we have used Factor Analysis Techniques. After interpreting all components, we arrived at the following factors affecting SMART Cities:

- Component 1 - **"Citizen's expectations"**

- Component 2 - **"Talent Triangle of PMI:** Leadership, Strategic Business Management and Technical Knowledge**"**

- Component 3 - **"ICT and other aspects of Smart city"**

- Component 4 - **"Governance"**

- Component 5 - **"Leadership"**

- Component 6 - **"Work life balance"**

- Out of above mentioned six factors we further analyse that "**Talent Triangle:** Leadership, Strategic Business Management and Technical Knowledge" is rated best (roughly 2.11 out of 4 points) & impact most significantly.

Conclusions and suggestions:

- Every city is a captivating and complex microcosm of foundation, individuals, and machines, portrayed by a dependably moving development of conceivable outcomes and difficulties. A keen city is a city, fit for re-examining itself by setting (and accomplishing) new measures for the public authority help and achievement of its masses. In spite of an accentuation on innovation the product and frameworks ought to generally disseminate into the texture of regular metropolitan life remaining to a great extent undetectable, comparative with our everyday human requirements.

- Vadodara is at the spot of third in the rundown of urban areas is positioned fourth in the usage of shrewd city plan. Vadodara accomplished Investment Conversion Ratio (ICR) of 95percentage for the undertakings it had proposed as a piece of its shrewd city plan. VMC authorities have arranged venture to the tune of Rs.2000 crore to create Vadodara as a keen city. The undertakings that have been seen critical advancements incorporate the travellers data focuses or the city character focus, CCCC, SCDA for water supply framework, ghetto free city, execution of GIS and residue canister free zones. Sensor-based road lighting the board framework in the inside street so during off pinnacle hours which are after 11 pm when the traffic thickness on the inward streets of society is low the sensor based will work likewise.

- Enough managing framework cuts down expenses, grows proficiency, helps natural targets, and improves earnestness. To pull in a skilled labour force, Asian urban areas need to give made framework, including ICT, and a high type of life. This along these lines pulls in new associations and human resources and overhauls the expected financial advancement of the city itself. By and by as indicated by the Area Based Development, they have zeroed in on barely any key regions like re-developing the Vishwamitri riverfront and besides various zones like Alakapuri zone which is the

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central business locale, Bus Terminal and Railway Station. It expects to focus on each domain and structure it in a brilliant way.

- **Critical Success factors:**
  - Proactive collaboration of all stakeholders:

    → Pan-city solutions have been derived from robust stakeholder consultations. Through SPV and task force committee, coordination between departments including internal VMC departments, Traffic, Transport, and VUDA etc at various stages of implementation is targeted to be achieved. For example: for integration of Central Command and Control Centre with CCTV, a close coordination between traffic police, VMC and SPV will be ensured.

  - Acceptance by citizens:

    → As robust citizen inputs through consultations had been received from citizens in the process of finalizing the project interventions, there is high likelihood that project will instantly be accepted amongst citizens. For example: as inferred from citizen engagement and subsequent SWOT, public transport has been one of the major challenges in the city. While Smart Buses project is one of the key solutions to address the issue, it is also expected to be immediately accepted amongst the all sectors of society.

  - Technology Integration & Convergence:

    → The ICT enabled solutions envisaged in pan-city proposal are proposed to be built using common API's and technology, which would ease the integration between projects, further facilitating to integrate solutions with Integrated Operations Centre (CCCC). Also, convergence of proposed pan-city projects with various other schemes would be a check on timelines thus becoming a value addition to success of the project.

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