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India's National Smart City Mission: Analysis of Project Dimensions Including Sources of Funding

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Abstract: The term smart city is defined, and based on India's National Smart City Mission, it is explained what an emerging country can do to start making its cities smarter. Thereby the goals and the program's implementation are analysed, how it works, and how cities can participate. Moreover, Bhubaneswar and Pune are investigated regarding their smart city plans, goals, and first outcomes. Furthermore, challenges the program faced until now are mentioned and learnings for other emerging market cities on what went well in India and on what does not yet work out that well in the program.

Keywords: emerging market; India; smart city; smart solutions; sustainable development.

JEL: I38, J11, O18, R11, R28

Indijska nacionalna misija pametnega mesta: analiza dimenzij projekta, vključno z viri financiranja

Povzetek: Izraz pametno mesto je opredeljen in na podlagi indijske nacionalne misije pametnega mesta. Razloženo je, kaj lahko nastajajoča država stori, da naredi svoja mesta pametnejša. Zato v članku analiziramo cilje in izvajanje programa, kako deluje in kako lahko sodelujejo mesta. Poleg tega analiziramo mesti Bhubaneswar in Pune glede svojih pametnih mestnih načrtov, ciljev in prvih rezultatov. Poleg tega so v članku predstavljeni izzivi, s katerimi se je soočil program do zdaj, in spoznanja za druga mesta na hitrorastočih trgih o tem, kaj je v Indiji šlo dobro in kaj v programu še ne deluje tako dobro.

Ključne besede: nastajajoči trg; Indija; pametno mesto; pametne rešitve; trajnostni razvoj.

1 Introduction

In 2022 India will overtake China as the most populated country. A significant role thereby is playing the urban centers and the people's movements within the country. In the last decades, India's urban population has increased to around 377 million and got an essential factor for the booming national economy. The main reason for that development is rural to urban migration, and according to predictions, this trend will not stop in the next years (Spink, 2019). About 200 million people will probably move in the next 15 years from rural areas to the Indian cities, and by 2050 416 million people are expected to move to urban areas. In other words, this means that 30 people per minute move from village regions to cities in order toget a better living standard. This trend is a massive shift, and

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while urbanization, on the one hand, increases productivity and improves GDP per capita over the long term, it will, on the other hand, cause several challenges and impose stress over the existing system regarding services such as water, electricity, sanitation, schools, sewage, transportation, or health (Biswas & Mallick, 2018; Mishra et al., 2019; Sinha, 2018).

According to the estimations of government data, India would need USD 1.2 trillion over the next 20 years in capital funding to keep pace with its growing population's demands. This number means around USD 134 per capita to support the capital expenditure for the required urbanization in its urban centres. However, this amount is way too high, and the country cannot spend it. The country spends around USD 20 per capita, which is about 15 % of the required money. With this discrepancy, several problems come along: 24 % of the urban population lives in slums, of the sewage, only 30 % are treated, usage of public transit is declining, and around 50 % of all the drivers within a city are more than 12 hours per week stuck in their car to name just a few (Sinha, 2018).

The purpose of this case study is to provide a holistic report that explains and analyses India's Smart Cities Mission. It is explained how the Smart Cities Mission works and how Indian cities can participate, the guidelines and requirements of the program, and the current status in India looks like India is facing massive growth in its cities. Moreover, the goals and the implementation of the program as a whole are analyzed and from chosen projects in Rourkela or Pune. Therefore, acceptable practices from cities, such as Bhubaneswar, are presented together with challenges for the program. Thereby learnings and recommendations for other emerging markets are derived.

2 Methodology

The research questions for this case study are:

1. "What is the progress of the mission and what challenges does it face?" and
2. "What can other emerging markets take away from this mission?".

Regarding the theory, India's current situation has been investigated, and guidelines and the framework of the Smart Cities Mission. Regarding empiricism through the case study, the Smart Cities Mission was analysed regarding its goals, implementation, and progress, and the same happened with chosen cities and chosen projects of these cities. Thereby learnings for other emerging markets regarding smart city implementation were derived.

3 What is India's National Smart City Mission?

To react to the developments and combat the challenges mentioned in the Introduction, the Indian government with prime minister Narendra Modi introduced the "Smart City Mission" in 2015, intending to implement smart solutions in India's cities in 2022 (Spink, 2019). Sinha (2018) argues that it may seem counterintuitive at first that these cities should build themselves into smart cities if they cannot even keep up with the citizens' most basic needs. However, here it needs to be mentioned that smart cities do not only stand for technology solutions. Smart cities focus on sustainability, economic development, resource productivity, job creation, and functioning necessary core infrastructure to enable a decent living quality. The following core infrastructure elements should be included in a smart city: "adequate water supply, assured electricity supply, sanitation including a solid waste management, efficient urban mobility, and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization, good governance, especially e-Governance and citizen participation, sustainable environment, safety and security of citizens, particularly women, children and the elderly and health and education" (Ministry of Housing and Urban Affairs, 2017e).

The Smart Cities Mission's goal is to promote and encourage cities to provide that core infrastructure, give a decent quality of life to its inhabitants, a clean and sustainable environment, and apply smart solutions. An example of smart solutions is given in the picture below. However, it is not an exhaustive list, and cities are encouraged to add more applications (Ministry of Housing and Urban Affairs, 2017e). The picture shows various smart solutions the

cities could apply to get smart for e-governance, waste management, water management, energy management, urban mobility, etc.

Figure 1: Smart solutions. Source: Ministry of Housing and Urban Affairs 2017e)

How could these developments look like in more detail? The Indian Ministry of Housing and Urban Affairs (2017c) defined, therefore some features and described them:

- Mixed land use should include planning for "unplanned areas," and land uses close to one another to make land use more efficient.
- Housing opportunities should be expanded for all.
- Walkable localities should be created, including reduced congestion and air pollution, more interactions, and higher security. The road network will be created or refurbished not only for public transport and vehicles but also for cyclists and pedestrians. Necessary administrative services should be offered within walking or cycling distance.
- Open spaces like parks, playgrounds, and recreational spaces should be preserved and developed to enhance the citizens' quality of life and reduce urban heat.
- A variety of transport options should be promoted, including public transport, transit-oriented development, and last-mile para-transport connectivity.
- Governance should be made citizen-friendly and cost-effective. Therefore, online services should be increased to enhance accountability and transparency and online monitoring of programs and forming of e- groups to listen to people and obtain feedback.
- The respective city should be given an identity based on its main economic activity like local cuisine, arts, crafts, sports goods, education etc.
- Smart solutions should be applied to infrastructure and services to make areas less vulnerable to disasters, use fewer resources, and provide cheaper services.

Nevertheless, how does the whole mission/the whole project work? The Indian government initiates it, more detailed by the Ministry of Housing and Urban Affairs, which started the mission in 2015 (Smith & Pathak, 2018). The strategy of the mission follows an area-based development approach, more detailed four approaches: retrofitting (city improvement), redevelopment (city renewal), greenfield development (city extension), and a pan-city initiative where smart solutions should be applied covering more extensive parts of the city (Ministry of Housing and Urban Affairs, 2017c).

If a city wants to take part in the Smart Cities Mission, the process is as follows: at first, there is an intra-state competition where all the Indian states submit a shortlist of appropriate municipalities that meet the minimum criteria that were outlined by the responsible ministry. How many nominees each state could nominate were based on a formula weighting the urban population and the number of statutory towns. The result was that 21 states could propose one city up to Uttar Pradesh to propose 13 cities. After the proposals were submitted, 100 cities were chosen to take part in the program.

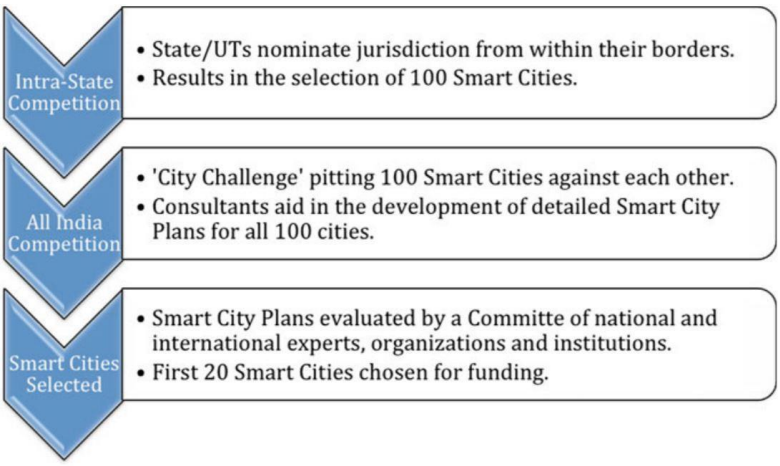

Figure 2: Smart Cities Mission Designation Process. Source: Smith & Pathak, 2018

The picture above shows that the first step described was the intra-state competition. Then, each city prepares its proposal for the "city challenge," including the chosen model, the city residents' consultations, how the aspirations are matched with the established vision or the proposal for financing the smart city plan. Thereby the cities got assistance from consultants to develop the best possible proposals. Afterward, these proposals will be evaluated by a committee consisting of national and international experts and organizations. In the first round in 2016, 20 winning cities were announced, which received funding to implement their plans and started action to make their cities smart. Following the first cohort of 20 cities, the remaining 80 cities were chosen between 2016 and 2018 (Ministry of Housing and Urban Affairs 2017b; Smith & Pathak, 2018).

To implement the mission at a city level, a so-called Special Purpose Vehicle (SPV) was created. The SPV task is to plan, appraise, approve, release funds, implement, manage, operate, monitor, and evaluate the smart city development projects. Each smart city gets its own SPV headed by a full-time CEO, and it will have board members of the central government, state government, and urban local bodies. It should be ensured that "(a) a dedicated and substantial revenue stream is made available to the SPV to make it self-sustainable and could evolve its creditworthiness for raising additional resources from the market and (b) Government contribution for Smart City is used only to create an infrastructure that has public benefit outcomes." (Ministry of Housing and Urban Affairs, Government of India, 2017d).

4 Financing projects

The projects can be executed through joint ventures, subsidiaries, public-private partnerships, or turnkey contracts.

Regarding the projects' financing, the Smart Cities Mission granted funding to the various cities based on their project proposals they submitted. So, every city was given seed capital from the government to convert around EUR 22 million for the most promising proposals. However, the cities are asked to come up with innovative funding sources as well to bridge the gap between the given seed capital and the money needed to fulfill their smart city plans. Therefore, some of the ideas were land monetization, public-private partnerships, and other sources of revenue such as developmental charges (Ministry of Housing and Urban Affairs, Government of India, 2017a; Sinha, 2018). Moreover, as the funds are limited, they must be used to address the citizens' challenges. Therefore, a comprehensive citizen engagement initiative is conducted to ask the citizens for their input from the very beginning to ensure their support also later in the process. It is essential to maintain two-way communication – city authorities must regularly share

updates with the citizens but still seek input from them regarding progress, quality of execution, and new ideas (Sinha, 2018).

5 Goals, financial implementation, and first outcomes

The goals are clear: through the above-described approach, comprehensive development of the chosen cities should take place and should improve quality of life, create employment, and enhance incomes for all (Ministry of Housing and Urban Affairs, 2017e).

In 2018, around six % of the total identified projects had been completed. Many projects had problems as the local governing bodies were unable to raise money using their resources, and there was resistance in the execution of projects in some cities. This means in numbers that 189 projects worth around EUR 280 million has been completed, that for 495 projects worth EUR 2.33 billion, implementations were underway, that for 277 projects worth EUR 2 billion, tenders have been floated and that 1987 projects worth EUR 12.76 billion were at detailed project report stage (SESEI, 2018). In the next year, 2019, the projects completed were already worth around EUR 890 million (Sharma, 2019).

Regarding goals, the city of Rourkela can be taken as an example, which developed various goals under its area-based development plan. The goals are to cut emergency response times by 20 %, reduce the slum population by 30 %, create a new skill development centre, and increase renewable energy usage by 10 %. The pan-city initiative goals are to cut waiting time for public transportation by 50 %, treat and scientifically dispose of 80 % of solid waste and improve air quality by 20 % (Biswas & Mallick, 2018).

Another example is the neighbourhood Aundh-Baner-Balewadi (ABB) in Pune, where a model of liveability and sustainability should be created. They planned six critical initiatives in the area (Pune Smart City, 2020):

- To fix hard infrastructure and make it future-ready as the population will grow from 40000 to 160000. This includes BRT (Bus Rapid Transit) across the ABB are, an overhaul of 54 regular bus-stops with ICT solutions, 100 electric buses to complement the existing fleet, 46 km of road improvement, NMT (Non-motorized-transport) focus with 42 km cycle tracks, and redesign of 60 km footpath, increasing water availability from 90 lpd (liters per day) to 150 lpd to pilot 24/7 water access or rainwater harvesting through the creation of four sumps.
- To create social infrastructure according to benchmark standards, which includes additional 76 public toilets maintained to global standards, state-of-art fire stations as well as smart parking for 750 cars.
- To enhance the liveability quotient, which includes open space innovation. This means that there should be a garden within 5 minutes for each resident, open a vegetable market, increase the open space from now four to ten % of the total area, and make the area look better through 100 % underground wiring and vehicle-free road.
- To drive socially inclusive growth through the redevelopment of 400 slum households to make the region slum-free.
- To improve the sustainability quotient of the region. This includes smart streetlights, which bring 30 % energy savings, and the lampposts are fitted with air pollution sensors, a panic button, a CCTV camera, and a Wi-Fi access point. Moreover, a smart grid for 100 % power supply will be introduced, and solar rooftops to contribute 15 % of energy requirements.
- To deal with e-governance and citizen convenience and include an online portal for city operations such as tax assessment and services for citizens.

Another feature is the "Ease of Living Index," launched in 2018 by the Ministry of Housing and Urban Affairs (MoHUA). It should help cities to "systematically assess themselves against global and national benchmarks and encourage them to shift towards an 'outcome-based' approach to urban planning and management" (Ministry of Housing and Urban Affairs 2018). The index is divided into four pillars and 15 categories, which use 78 indicators, thereof are 56 core indicators, which measure those aspects which are considered as essential urban services, and 22 supporting indicators, which measure the adoption of innovative practices that are considered desirable for enhancing the ease of living. These four pillars are institutional with the category governance, economical with the category economy & employment, social with the category's safety & security, education, identity & culture, and health as well as physical with the category's transportation & mobility, power supply, assured water supply, solid waste management, public open spaces, housing & inclusiveness, mixed land use & compactness, wastewater management, and reduced pollution. The index calculation follows the dimensional index methodology, which refers to benchmarks. Moreover,

the weights assigned to each pillar and indicator are different, leading to a score between 0 and 100 for each city. In 2018 Pune was first in the Ease of Living Index with a score of 58.11, followed by Navi Mumbai, Greater Mumbai, Tirupati, and Chandigarh (Ministry of Housing and Urban Affairs 2018).

6 Acceptable practices from well-doing cities

Two examples of well-doing cities are chosen to show how the Smart Cities Mission concretely impacts a city. However, it has to be mentioned that comparisons between the various participating cities are not possible as every city focuses on different topics and has its development plans, which lead to different outcomes.

The first example is about the city of Bhubaneswar. The city focused on the topic of mobility and established; therefore, an e-mobility plan to improve on this topic through the Smart Cities Mission. The case there is that in the last decade the number of vehicles has tripled, there was a rapid increase in two- and four-wheelers but an even swifter increase in three-wheelers which are auto rickshaws. These auto-rickshaws account for 24 % of total trips in the city, far above the desirable standard of five %. Moreover, the city buses account only for six % of the total trips.

So, the city developed a vision that it becomes through participatory decision- making, responsible governance, and open access to information and technology the following:

a) "Transit oriented city with a compact urban form that promotes active, connected and sustainable mobility choices.
b) Livable city providing a diverse range of housing, educational and recreational opportunities; while enhancing its heritage, arts, and traditional communities.
c) Child-friendly city providing accessible, safe, inclusive, and vibrant public places.
d) Eco-city co-existing in harmony with nature for nurturing a resilient, clean, green, and healthy environment.
e) Regional economic centre attracting knowledge-based enterprises and sustainable tourism activities by leveraging and empowering its institutions, local businesses, and informal workforce" (Bhubaneswar Puri Transport Services, 2017).

What progress could be achieved in the mentioned projects? A bus modernization plan was developed comprising of institutional restructuring of the city agency, procurement of additional 500 buses, and policy framework and strategies for buses' operationalization. A transit infrastructure corridor was developed with a road network of 32 km and the necessary infrastructure to ply e-buses on these routes, catering to multi-modal transit infrastructure facilities. Regarding public bicycle sharing, the city started the procurement of 1000 bicycles where at least 25 % are e-bicycles. Depending on the bidders, this number could rise to 100 %. Besides, the city will start to provide the necessary power charging infrastructure.

Moreover, an amendment to building regulations was conducted to incorporate e-vehicle charging facilities in the buildings. Furthermore, an e-mobility plan was developed together with the International Finance Association to achieve the e-mobility vision. It will congregate all city authorities' initiatives and make a plan for joint implementation to reach the common goals.

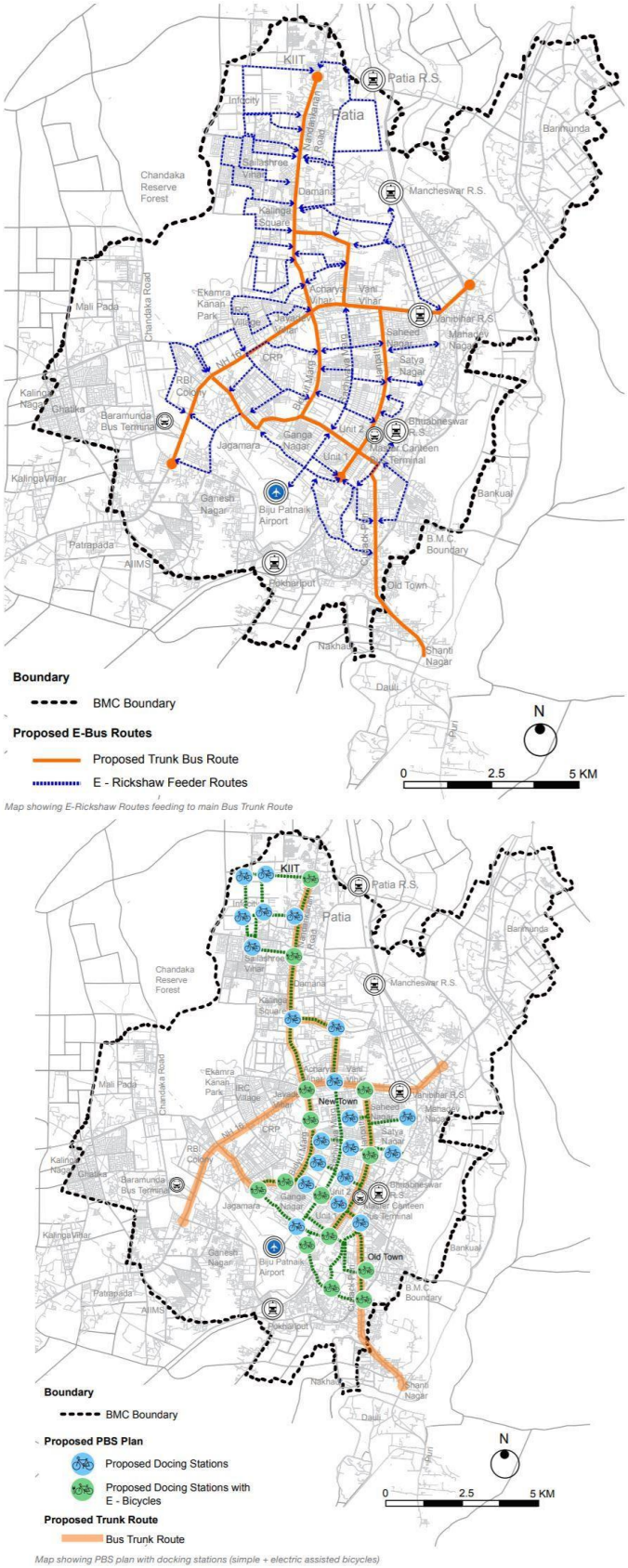

Figure 3: Mobility Plans Bhubaneswar. Source: Bhubaneswar Puri Transport Services, 2017.

The pictures above show where the e-bus routes go through the city and how the e- rickshaws and the (e-) bicycles could work as feeders for the e-buses as part of a holistic mobility concept (Bhubaneswar Puri Transport Services, 2017).

The second example is about the city of Pune and its implementation of the so-called quick win-projects. Such quick-win projects need to be identified and rapidly executed to build momentum and win the citizens' confidence, critical for such initiatives. Such projects demonstrate short-term results and increase stakeholder buy-in. However, at the same time, the cities also prioritize larger, long-term projects like 24/7 water supply. Examples from Indian cities for quick-win projects are redesigning streets or rejuvenating urban spaces on what Pune focused. The leaders in Pune also set out on such a quick-win strategy to create public spaces that capitalize on existing assets to promote health, happiness, and well-being. Pune redesigned streets and improved safety and walkability combined with a smart element project that created and focused on six essential components. These key components are (Sinha, 2018):

1. Wi-Fi hotspots across strategic locations such as parks, hospitals, and other public spaces.
2. Environmental sensors to monitor critical parameters such as air quality and noise pollution.
3. Public announcement systems to broadcast both general and emergency messages to improve communication and public awareness.
4. An emergency response system to increase citizen safety.
5. A variable message system that deployed electronic display boards, placed across the city, to broadcast messages, alerts, and city updates; and
6. A scalable command and control centre, which assimilated data from all of these elements to monitor and manage smart- city operations from a single hub.

As it can be seen, all these goals are relatively easy to implement and have a direct and quick impact on the citizens to quickly show them the first benefits of the Smart Cities Mission and its projects. Simultaneously the work on the long-term projects started as well in which Pune focuses on mobility to enhance its bus infrastructure and start its metro project.

7 Challenges for the program

Although many things are going well in the program, there also some challenges for the Smart Cities Mission. Firstly, it has to be said that the government with the program provides a useful framework. However, every city of the chosen 100 has to develop its plans, finance the project, and manage the implementation by itself. So, some cities are doing better than others, and all of the challenges may not be true for all participating cities. Challenges are (SESEI, 2018; Bharne & Patil, 2020):

a. The smart cities' financing, as it is estimated that around EUR 88 billion are needed over the next 20 years, would be around EUR 5 billion per year. It will be a challenge to finance all of the projects, primarily as they also rely on private investment and public-private partnerships.
b. The Urban Local Bodies' financial sustainability is often not self-sustainable, and the tariff levels often do not mirror the provided services' costs, leading to financial losses.
c. To integrate formerly isolated legacy systems and make them smart to achieve citywide efficiencies. It is essential to determine the city's weak areas to consider them, such as 100 % distribution of water supply and sanitation.
d. Many Urban Local Bodies are limited in their technical capacity to ensure timely and cost-effective implementation of projects.
e. The three-tier governance consisting of the central government, state government, and local body needs effective coordination to implement smart city solutions successfully.
f. To provide clearances promptly, especially for timely completion of the projects. Therefore, they should use online processes, and a regulatory body should be set up for all utility services.
g. Building capacities for 100 smart cities is a complex task, and many projects are delayed due to a lack of quality workforce. More money for capacity building programs focusing on training, contextual research, and knowledge exchange would be needed.
h. The reliability of utility services is a challenge as well, as for every smart city, services such as electricity, water,

or broadband are essential and needed 24/7, which is currently not everywhere possible with the existing supply and distribution system. Therefore, cities need to shift towards renewable green sources like green buildings and green transport, which is part of many smart city strategies to reduce their electricity demand.

i. Another challenge is the societal adequacy and lack of awareness about ICT as smart citizens play an important role in using smart solutions.
j. Efficient governance is also a critical challenge to maintain growth in smart city projects. The projects and the implementation of them require control and monitoring. Therefore, the government introduced in a first step an implementation and monitoring process to improve the performance of the various projects).

8 Conclusion

What is positive and can be taken away from other countries in emerging markets? An important point is the comprehensive citizen engagement initiative that the city finds together with its citizens its core problems they want to work on. In the Smart Cities Mission, every city focused on one to two core issues. By asking the citizens, their support should be ensured from the very beginning. However, it is also the other way round crucial that the city authorities share regular updates about the progress. Most cities that engaged intensively with their citizens are best in the program.

Furthermore, the Indian program used competition between the various cities that applied for the program to improve the planning quality and encourage innovative funding sources. This resulted in high-quality submissions with specific objectives as the funding was based on project proposals, and the resources were adjusted with the citizens' expressed priorities.

Another critical point is vendor participation. Some projects are in India executed for the first time, so often, rework is necessary to apply the solutions locally. For example, a traffic management system in India has completely different requirements than in a developed country, as in India. There are way more motorcycles. Therefore, a partner knowing the culture and mindset to create tailored solutions can be essential.

Moreover, a holistic development approach should be achieved as cities should also develop certain small areas. Thereby, core infrastructure should be addressed, and things like open spaces to increase liveability. That facilitates the finding of funding sources and those citizens are more likely to pay for those developments when they realize the real benefits of such neighbourhoods.

To build momentum and win the citizens' confidence, it is important to realize "quick" projects such as redesigning streets or rejuvenating urban spaces to demonstrate short-term results.

In general, the process and the framework of the Smart Cities Mission is well done. It is focused on sustainability, economic development, etc., by building core infrastructure combined with smart solutions, and thereby, liveability and quality of life in the respective cities are enhanced. A clear strategy is defined with a straightforward process on how to take part in the program.

However, some topics do not yet work well. The first point is the financing of the projects, the cities get seed capital from the Smart Cities Mission, but they also need to find investors or other possibilities for bridging the gap between the seed capital and the money needed. Another challenge regarding this topic is to run smart services self-sustainable, not to make losses. Moreover, many projects have the problem that they are delayed and not timely implemented.

Moreover, in India, it doubts that smart initiatives do not improve the urban poor's lives in informal settlements. Targets of the program are essential services and housing improvements to all. However, some groups were probably not sufficiently factored into development plans. Furthermore, private stakeholders are increasingly involved in smart city projects, which risk primarily corporate interests are served. To minimize the Smart Cities Mission's impact on the Indian state finances, many municipalities across India could enter the bond market in the next years, which could lead to a shift away from the initially planned welfare-centric idea of the projects (Spink, 2019).

In conclusion we should expose that the actual situation related to COVID-19 pandemic has influenced the projects and it could be an opportunity that smart cities projects gain on importance. Furthermore, Smart Cities Mission initiated by the Indian government is a practical and essential step for the participating cities if the goals and projects are implemented well and if the promise that the projects should serve all citizens is held. The mission is vital as there are living around 377 million people in the Indian cities, and in the next 15 years, around 200 million people will move from rural to urban areas, which causes several challenges for the existing system. Therefore, smart solutions should be implemented across India to focus on sustainability, economic development, resource productivity, and job creation, combined with core infrastructure.

The limitations for this case study are that the conclusions are only derived from the Indian Smart Cities Mission and that so far, only an analysis of the goals, projects, and implementation was possible so that no long-term outcomes could be investigated. Therefore, more research on such smart city projects is necessary, and evaluating the Indian Smart Cities Mission in a few years.

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