Understanding Role of Mobile Apps in Smart City Services

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Abstract

With the advent of new generation technologies and information driven "intelligent solutions", Smart City Projects are underway in many parts of the globe. Country level guidelines and implementation approaches may differ but key components of smart city solutions are same. In particular, urban mobility solutions and smart infrastructure services such as smart waste management are gaining momentum with the involvement of local municipal bodies and government institutions. This paper aims at reviewing and summarizing some of the developments in Urban mobility, smart waste management and smart retail solutions that are being implemented in various cities. Use of mobile apps, congestion pricing, interconnected mass transit systems are fostering growth of urban mobility adoption rapidly. In similar lines Smart Waste Management solutions are also moving beyond simple sensor based waste collection binds to integrated waste recovery and disposal systems driven by ICT applications, through management of data on all levels by all stakeholders. Lastly, success in the retail industry is all about timing, precision. innovative software applications, wireless devices ePOS Stations are giving rise to growing Smart Retail solutions across different value chain. Given the above premise, an attempt is made to envisage three key components of smart city solutions and the growing trends in the coming years.

***Keywords**: Urban mobility, Smart Waste management, Smart Retail, Smart communities*

1. Introduction

Smart Cities are indicators of developed economies. Once the citizens upgrade and update themselves, a developing country can become a developed one. Smart City is in full swing in India and around 20 cities have been selected by the government in the current stage of implementation. The mission mainly concentrates on innovation and technology to drive the growth of the cities and provide a better place for the citizens to live in.

Within the concept of Smart Cities, citizens' involvement is highly influential. This involvement can be entertained through mobile applications on their smart phones as smart phone has become the necessity of every urban citizen. To convert cities into smart, the problems of the citizens must be addressed in a smart way. As per recent research reports, global smart city market including smart mobility, smart healthcare and smart infrastructure is illustrated as below.
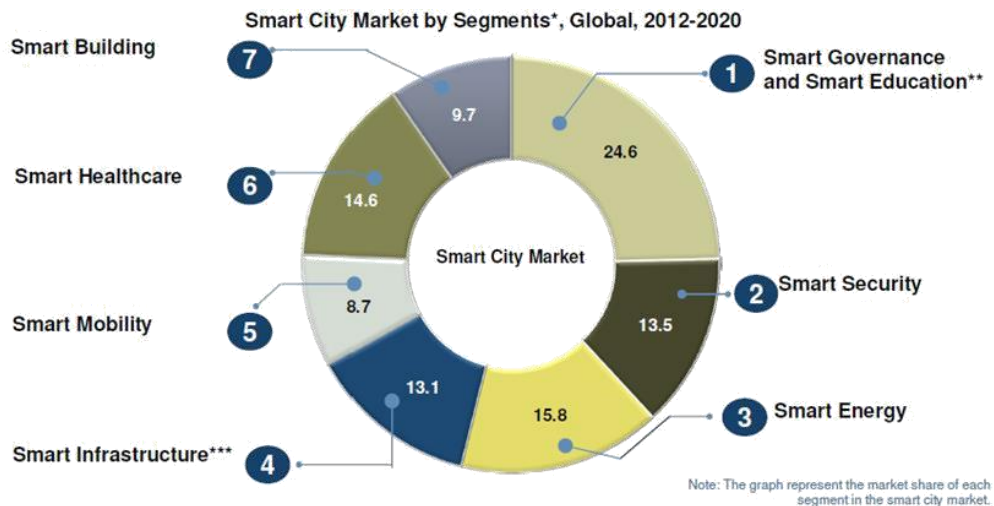
Figure 1. Smart City Market by Segments

In other words, smart city plans worldwide include components of smart urban mobility, smart retail, smart waste management, smart health, smart agriculture, smart grid, *etc.* For this research, urban mobility, smart waste management and smart retail are taken into consideration.

Urbanization is growing, placing intense pressures on city infrastructure and its resources. Urban Mobility is going to be one of the toughest challenges for cities around the world.[1] Mobility infrastructure has been ranked one on priority for those cities those are seeking to attract investors, and as such many growing cities have put this at top in agenda. It is found that affordable and efficient means of mobility for public-at-large can be crucial enablers of economic growth[2].Like any other country, India is also facing various mobility challenges such as significant rise in urbanization, road congestion, fuel prices, pollution, road accidents and health issues. Unless these problems are addressed in right perspective, this poor and painful mobility can affect adversely the economic growth and cause the quality of life to deteriorate. These problems can be resolved by multiple options. For instance, Real Time Journey Information, Smart Payment, Sharing resources (car and Bike pulling), Smart Parking, Balance of Demand and Supply *etc.* are going to be preferred options for solving urban mobility issues.

With the increase in population and change in the lifestyle patterns, humongous amounts of waste are generated in the country. So the need of the hour is to optimize the management of this service to reduce infrastructure, operating and maintenance costs, as well as reduce contamination directly associated with waste collection. This can be done with the help of Smart Waste Management by applying technology to the current operating system.

The internet of things (IoT) is driving innovation and new possibilities by means of bringing every object and client into the virtual realm. Retail has direct touch with potential purchasers that completely embrace generation and innovation. [3] Stores want to stay abreast with the modern day technology to earn the loyalty of the subsequent-era customer and capitalize on emerging business possibilities. The patron demands for comfort, product availability, and each personalised and contextualized interactions, as a result the shops are driven to adopt the changing IoT technology inside the coming years.

2. Urban Mobility

The real-time journey apps help you plan your journey before leaving and gives you clear idea of any congestion on any path. Citymapper is an integrated real time journey planning app which has successfully launched in London and New York [1]. The online and mobile service incorporates all possible routes across the city using all public transit modes, bike share options, pedestrian routes and real time service updates, together with pricing information of each transport mode.

For future scenario it is said that urban cars will need to be customizable, autonomous, green and shared with others. This will catalyse the trend which is seen toward car sharing versus ownership and expand shared services (whether car or bike) to a new level of convenience and flexibility" [4]. Car sharing apps help users find inexpensive car rental and borrowing opportunities offered by other app users in their local community. For instance, BlaBlaCar is a trusted community marketplace which connects drivers with riders. Driver with empty seats meets with co-travellers looking for a ride. These apps are making travel social, more efficient and money-saving for millions of members.

Smart Parking App puts the driver in control of their day. It removes the stress of driving around and finding a space which for parking [1]. This app helps finding the best space availability for each driver and directing them to it. Driver uses smart parking app to check parking choices and availability at their desired place before setting out. These Apps gives the driver full details of parking option available including prices, out-of- hour times and any restrictions.

2.1. Qualitative Analysis of Mobile Applications in Urban Mobility

Name of the app	REGION	Functioning of the app	Comments/ Recommendations
Together We Go(ToGo)	Mumbai, India	This app is trying to build trusted communities on all routes of the city. So that, any member can carpool to office daily with other likeminded people. It will add you to Chat groups like Whatsapp for carpooling based on home-office route. By using this app car owners can share their fuel cost with co-travellers, while co-travellers may find a daily commute partner at nominal cost.	People have used this app in Mumbai. They are finding it best and very innovative carpooling app in India. By using this app people are able to find rides on their office route and saving big bucks. People like its group and chat function. They got option for going to and from home to office. User friendly GUI and easy to understand app and traffic updates are value addition.
Bla-Bla Car	22 countries	BlaBlaCar is a world's largest trusted community who shares long distance rides. It has more than 25 million users in a total of 22 countries. It is a community that connects drivers who	In a flow of creating smart cities, safety is also one aspect to look upon. Women can travel with female members only to allow members to plan a ride share where the car owner and all co-travellers are women.

		has empty seats to the co-drivers who are looking for a ride.	
Lyft	San Francisco, US	Lyft is a privately held American Transport Network Company based in San Francisco. The company's mobile app facilitates people with peer to peer ride sharing. It connects drivers who have cars to passengers who need a ride. Except its availability in 200 U.S. cities, this is available in Indonesia, Malaysia, Singapore, Thailand, Philippines and Vietnam.	People in U.S. find it very useful. Users of Lyft app in U.S. are in large numbers, so these cars are always available. The cash less trip is very much safe and due to trusted profiles and background of car owners, people find it safe and secure service. People are very much happy with this app and that's why they gave 4.3/5 rating to this app.
PParkE	India	This app will troubleshoot all the parking problems in the city. You may know the parking availability in advance; you may come to know the rates of the parking on hourly basis, booking of your parking space online and you can pay from wallet. If you have parking space available, you can become partner with them and generate revenue.	People liked this smart parking initiative by PParkE. But they want the app team to include more places for parking because whichever are shown is not sufficient sometimes. And sometimes people had issue of wrong listing of parking rates online. If some of these areas will be improved, then this initiative will be a huge success.
ParkPnP	Dublin, Ireland	ParkPnP allows you to discover cheaper and more affordable parking in desired locations at the click of a button. ParkPnP works as a marketplace that facilitates people to list, advertise and then generate income from their unused or underutilized parking spaces. Your space will be advertised to	To solve parking problem in smart city, the initiative of pre booking of parking place was a must thing to do. By this app, if you have unutilized parking space, you can generate some revenue out of it and if you are finding some space for parking, you can book that place in advance and you can enjoy shopping or your meeting tension free.

		potential parkers from across the country.	
SFPark	San Francisco, US	SFpark is San Francisco's system for managing the availability of on-street parking. Reducing traffic by helping drivers find parking benefits everyone. More parking availability leads to streets less congested and safer. Meters that accept credit and debit cards reduce frustration and parking citations.	SFpark makes finding and paying for parking faster and easier. Demand-responsive pricing information, via text, and through smartphone apps helps drivers find a space. With parking faster to find and pay for, it's going to be easier to enjoy the City's commercial areas.
CityMapper	U.S., Canada, Europe, Asia	Citymapper is the award-winning transit app making complex cities easy to use. It provides A to B trip planning with ETA (Estimated Time of Arrival) including all modes (subway, bus, rail, bike/car sharing), Real-time departures. Transit maps, Bike routing and live bike share information, constant updates, Line status and real-time disruption alerts these are the features of this app.	It's a must have app for many users. People are calling it best transport app ever. The best feature people liked is its alarm ringing system, whenever your station arrives where you need to get down. People found many areas for the scope of improvement like making it more users friendly, more interactive *etc.* And app should be available in many other regions of the world.
Moovit	800 cities across 60 countries	Moovit offers real-time public transit information and GPS navigation across all the possible transit modes. This app differs from traditional public transit apps as it is community-driven and integrates official public transit data with real-time data collected from users via crowdsourcing. It then integrates this crowd	The ratings submitted by 4 lakhs people. And they gave rating of 4.3 out of 5 for this app. The number shows the trust of people for this app. They found it very accurate and user friendly. Its UI is very simple, easy and understandable that a person of any age group can operate it. Most of the people are fully dependent on this app. This app is increasing its reach to more number of cities across the world.

		sourced data with public transit	

Industry associations, city authorities and other stakeholders worldwide have now formed UITP an international association for urban mobility. Various initiatives of UITP are now underway in different parts of the world. Recently, UMii, the first Urban Mobility Innovation Index, was officially launched on 28th August 2016 by Sheikh Hamdan Bin Mohammed Bin Rashed Al Maktoum, the crown prince of Dubai.The project, initiated and sponsored by the Roads & Transport Authority of Dubai (RTA), aims to provide a guide for cities around the world to foster innovation in their urban mobility services and systems. UMii is being implemented by UITP with the support of Future Cities Catapult.[9]

UITP (www.uitp.or) represents 1,400 member companies giving access to over 18,000 contacts from the fields of urban, local, regional and national mobility from more than 96 countries on all continents.[10]

3. Smart Waste Management

Fundamentals of waste management: Rethink, Reduce, Recover, Reuse and Recycle. With the progress of the nation towards smart cities, the above fundamentals have to be taken care of in a smart way, which calls for Smart Waste Management.

INDIAN SCENARIO

With the changes in lifestyle patterns, urbanization, increase in disposable incomes of the citizens have paved way for consumerism, that indirectly leads to increase in waste generation in India. India is one of the largest consumers of electronics and if continued, would be the fifth one by 2025. This would direct towards generation of e-waste which is highly toxic and non-decomposable. [5]

There is a lot of inefficiency in the present waste collection:

- Consumes time - without being aware of whether containers are full or not, trucks go and empty them.
- Soaring costs.
- Congestion and lot of traffic flow.
- Needless fuel consumption. [6]

GLOBAL SCENARIO

Amongst the regions as in APAC, MEA, Europe and Americas, APAC is supposed to generate the most industrial waste in the world, followed by the Americas, Europe and lastly MEA. The Americas have strong interest in efficient collection, sorting and recycling technologies. It is the global leader in industrial waste recycling rates, with high production levels in a wide range of waste-generating industries. [7]

Contribution of Mobile Applications towards SWM

As mobile services are becoming cheaper and more accessible in recent years, smart waste management solutions can be provided by applying technology to the existing operation system to enable communications both ways, amid the operators and the infrastructure structured in the city. [6] There is also a different aspect that should be taken into account when considering the relation that mobile phones have with recycling and waste management. The large amount of mobile phones and tablets that are entering

the market, result in greater e-waste quantities of special materials that need to be handled after use. The complex construction of such devices makes difficult their dismantling and subsequently their disposal too. Mobile devices have valuable metals and parts that need special care. The more technologically advanced a device is the more complex its waste disposal is.

3.1. Qualitative Analysis of Mobile Applications in SWM

Name of the app	REGION	Functioning of the app	Comments/ Recommendations
I clean India mission	India	Allows citizens to post photos of unclean areas in their region and mark it on app, and organize a cleanliness drive for same. The app connects to Facebook and Twitter accounts of the user and allows the user to post photos and share their story on these social media sites.	Must get in touch with government bodies to plan out how the waste can be processed and make users aware of it
Pom Pom	New Delhi, India	The start-up converts all the accumulated trash into their raw form which can be then used to make new products. By a single tap on the app, doorstep service is provided and the respective person collects all the trash and pays the right amount to the user.	On the website of the start-up, they can do a statistical study as to how much recyclable waste is generated in each household per week/per month/per year and how much the user can earn in return.
Ecolekt	Bangalore	Features include click and sharing the e-waste and then schedule a free pick up. In return the user gets reward points which can be redeemed as gift vouchers from various online/offline stores of their choice.	The app must not be confined to Bangalore. They must expand and cover more localities under them.
Sllixo	Bangalore	Allows the user to create an account on the app and then go either for buying or selling of trash by posting an ad. While posting an ad, the user has to mention the quantity in terms of kg, give a brief description about the trash and enter the price at which	The application should mention the names of the buyers locality-wise. This would help the people of Bangalore to dispose off their waste in much more easy way.

		he/she wants to sell.	
Encashea	Bangalore	The user can select the location for a suitable pickup. The user is given a referral code by which he/she can get 5% extra amount on their next service, when his/her friend schedules a pickup using the referral code.	The application can add on GPS features to it, so that it accounts for more convenience to its users. The mobile application should move to Tier-I &Tier-II cities for keeping the environments clean, instead of focusing only in Bengaluru city.
iScrap App	US and Canada	Users in US & Canada can get information about scrap metal prices, directions, business contact information and much more. The iScrap app provides information to scrappers, peddlers, homeowners and contractors like plumbers and electricians regarding how to recycle their scrap metals.	They can add a favourite option on all the scrap yards, so that if a user wants to visit the same scrap yard which he/she had visited earlier, can visit easily.
Recyce for Greater Manchester	Manchester, UK	With the help of GPS technology, one can find nearest Household Waste Recycling Centre, Furniture re-use scheme, Charity Shop and Electrical Appliance Scheme. Provides tips on how to reduce food waste, how to use real nappies and tips on composting, re-use household items.	The implementation of the mobile application has to be looked into as well as the features defined by the application must be provided in a crystal clear way, so as to reduce the churning of customers.
Smart Bin Mobile	USA	IoT fill level sensors are installed in bins which indicate the user on the app as to the level of bin filled. The other features of these sensors are that it measures all types of materials and liquids provided with GPS	Knowledge of IoT sensors and smart bins has to be communicated to people on a larger scale so as to get more users on to the application. Later the mobile application can expand its coverage after capturing the market in USA.

		tracking. Hence the app helps the users to navigate the smart bins and use them efficiently.	

4. Smart Retail

Today, mobile is a very important touch point for retailers to retain customers. Smartphones enable consumers to access internet anytime and anywhere and play a crucial role when consumers shop both online and offline. Customers want to engage with retailers while buying and retailers must deliver experiences that match those expectations. Consumers demand convenient and personalized experiences and retailers struggle to satisfy these demands through their existing apps and mobile strategies.[8] A survey was conducted to know how often and in what contexts the customers use mobile apps and to find out how consumers use smart phones for retail activities. The results showed that customers use the smartphone to locate a store or check the store hours, to check order status, to read product reviews, to find a discount coupon, to compare prices with other stores, to learn about in-store promotion or event and many more. Consumers use retail apps for three main reasons: Convenience, Speed and Personalized Experience.[8] Retailers are very well aware of the challenges they face in getting consumers to download and use their apps. They must design apps that are differentiated, and provide a valuable customer experience thus giving reasons for consumers to come back to the app again.

4.1. Qualitative Analysis of Mobile Applications in Smart Retail

Name of the app	REGION	Functioning of the app	Comments/ Recommendations
ePaisa	India	ePaisa app allows merchants and retailers to accept payments on the go, easily integrate Sales and Marketing tools. Through this app it is possible to send e-receipts, bills and invoices via SMS or e-mail. Store managers can track inventory in real time and access real time sales data via cloud. This app can also connect to a printer and barcode scanner.	This app is very useful for the retail stores like BigBazar, DMart, More Retail, etc where the shoppers have to wait for a long time for bill processing. This app can help reduce the crowd and mismanagement in large stores and also help retailers to smooth their processes.

MoWa- Mobile Payments	India	It helps pay money and receive money from people on your mobile. Through this app you can make payments to friends, family, merchants with just their phone number. It supports all banks in India. Through this app it's not required to load money into an additional account. You just need to link your credit / debit card & pay directly from it. Its main advantage is that you no longer have to share any bank account details to anyone in order to receive money.	With payment banks coming up, these kind of mobile apps also have a good future. Especially in small towns and villages where we don't have many bank branches, Mowa can help people to access banking facilities by linking their bank accounts with this app. As we all know that smart payments are one of the features in smart city, so this app is definitely going to play an important part in it.
TabShop-Point of Sale	US	With this app, the mobile becomes an easy to use retail POS cashier that offers support for Bitcoin credit card payments. The cashier system allows retailers to print invoices in local currency. It supports the scan of QR code marked products by using the integrated cam of your tablet.	If all retail stores and restaurants are equipped with this app, it can benefit them by managing their stocks and payments. It will digitize their operations and thus reduce mismanagement. So in a smart city this app can play the role of making the stores smart. It will reduce dependence on physical money and also benefit customers.
Restaurant POS + Ordering	Singapore	This android app allows customers to make quick ordering by looking at food pictures and even the waiter, server or cashier can click on the picture to confirm the order. Orders can be taken even when customers are outside the outlet. Also the payments can be collected via the app.	The basic aim of reducing the dependence on printed money and also simplifying the operations of SMEs can be fulfilled with such apps. Fast ordering of food and fast delivery are expectations of both the customer as well as provider, so these smart solutions will be definitely welcomed by them and can contribute in the smart city concept.
Bigbasket - online grocery	India	It offers fresh fruits and vegetables, groceries and staples, spices, packaged products, meat, beverages, personal care products and many more in the online market. The app guarantees on time delivery and quality of the products.	Online grocery delivery might not seem a necessity but it is definitely a parameter of making a city smart. Such services must be available in smart cities since they ease the life of people and also provides goods at lower prices than the market

Netmeds- India Ki Pharmacy	India	Netmeds offers a range of prescription and non-prescription items, including vitamins, diet supplements, herbal products, pain relievers. The nearest pharmacy linked with netmeds will promptly deliver the medicines. It is also possible to track the order status in real time and also view the prescription history	Online medicine shopping is a new trend in India and is currently restricted to the big cities. But this initiative is certainly worth appreciating since many people face problem in locating a pharmacy when there is an urgent need. These apps must be given a boost so that all individuals can avail the facilities of living in a smart city
Amazon	U.S. and India	Amazon app provides online shopping of Electronics, Books, Kitchenware, Appliances, Healthcare, Apparel, Sports, Shoes, Jewellery, Furniture and more	Online shopping is the very basic activity that people are engaging in. Such apps are really needed in today's world since people love to shop from their homes. So a smart city must be equipped with such services and also the villages around such cities should be brought under the network of online shopping

5. Conclusion

Success of such smart initiatives for urban mobility, smart waste management and smart retail etc in pursuit of creating harmonious and smart community living depends upon active involvement of all stakeholders. It is not just the Government or organisations with business interests who can nurture and grow these developmental solutions. A lot of involvement is required from common public resulting in co-creation of sustainable smart solutions. Awareness needs to be built among the citizens about the applications that they can leverage to simplify their day to day activities. It is only when citizens participate actively that city can be truly called smart.

In the Indian perspective, key success factors for implementation smart city solutions, will largely depend upon the level of citizen participation and project management capabilities at ULB/district levels by adapting to measurable KPIs. Recent announcements about Indian Smart City Plans (SCPs) have called for active involvement of Public private participations, especially the managed services providers (MSPs). A conducive and dynamic model for implementing and monitoring the "maturity level" of such initiatives is thus imperative.

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