Tat CAPITAL
Corporate Finance & FX Advisory

The role of Intelligent Transport System (ITS) & Smart Cities in the new age development paradigm

Ram Gorlamandala

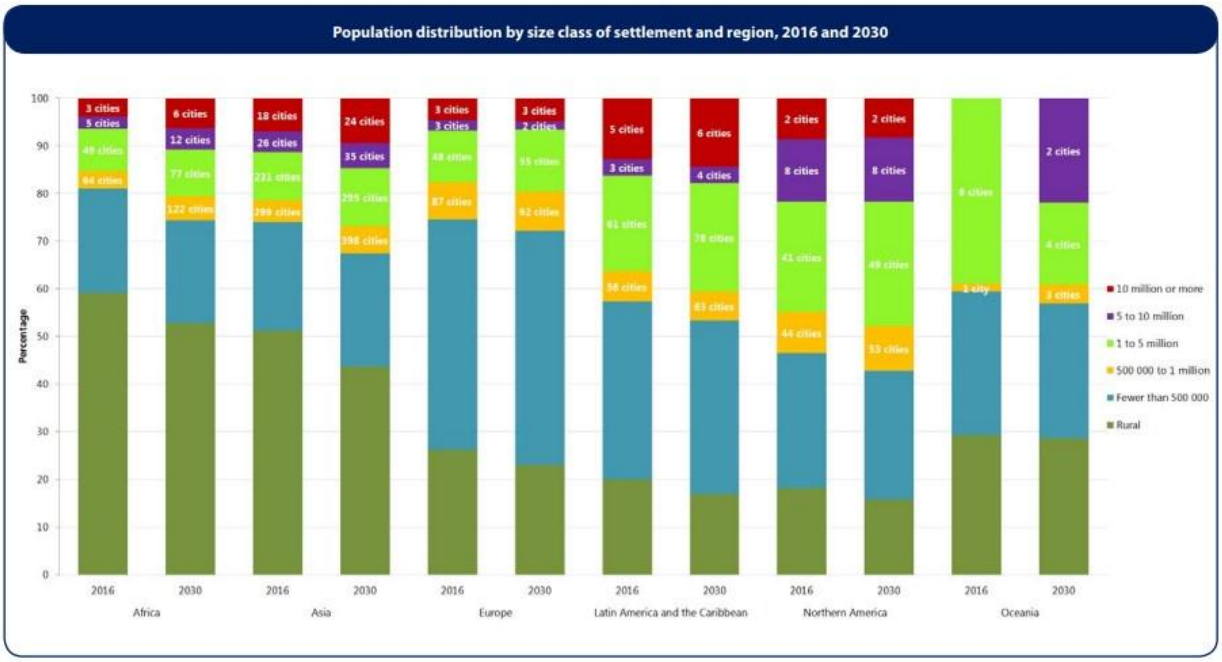
The role of Intelligent Transport System (ITS) & Smart Cities in the new age development paradigm

In our last insights, we saw the advent and evolution of Internet of Things (IoT) & related fields - their ongoing, humungous impact on the growth trajectory, and the need for connectivity to offer simpler, richer and energy efficient ways to perform any task. Harbouring on that resourceful role of connectivity, this time we will take a look at Intelligent Transport System (ITS) & Smart Cities markets, and how these have set out to play a crucial role in our global development.

According to The World's Cities in 2016 report of United Nations, more than half the world's population - i.e. an estimated 54.5% - lived in urban settlements in 2016. By 2030, they expect this to raise to 60%, wherein one in every three people will live in cities that has at least half a million inhabitants.

Key data findings:

- In 28 regions, more than 40% of the urban crowd are concentrated in a single city of more than one million inhabitants
- One in five people worldwide - i.e. 23% - live in a city with more than 1 million inhabitants
- By 2030, 662 cities are expected to have at least 1 million residents, and 730 million people will live in cities with at least 10 million inhabitants - i.e. 8.7% of world population
- Most of the world's fastest growing cities are in Asia and Africa, with most megacities from the global South
- Importantly, increase in city population is expected across all regions (image below)



With such rapid pace of urbanisation, the need for corresponding well-rounded development plans are crucial - right from providing basic amenities such as water, electricity, sanitation, health care to upgrading existing infrastructure, transportation, housing, etc. - the requirements are enormous, providing an impetus for a smart planning, and the need for what we now call 'Smart Cities'.

What is a Smart City / its Origin:

A smart city is an urban place which operates via interconnected systems to cater to economic development, sustainability, and market viability, whilst ensuring the welfare of everyone: the government, citizens, businesses, and the environment alike.

In other words, it is an urban development vision that offers enabling governance and essential services with the help of highly advanced architecture and infrastructure. This will include employment, healthcare, retail, real estate, public services such as water/waste management, distribution of clean and renewable energies, and intelligent transportation to its residents.

It will operate through Information and Communications Technologies (ICT) such as automated sensor networks to transmit, integrate and process data about all aspects of an urban environment, and provide solutions based on market supply & demand, predictive analytics and data science.

Through efficient integration of ICT & IoT, a smart city thereby offers solutions such as smart grids, urban mobility, wireless internet accessibility, information on traffic flows, speed and positioning of public transportation, emergency calls, etc., to promptly respond to citizen needs and improve lives.

"Investments in human and social capital and traditional (transportation) and modern (ICT) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government." (Caragliu, 2009)

Origin: The concept of smart cities originated first during the global economic crisis of 2008, wherein the tech company IBM had then began work on a 'smarter cities' concept as part of its Smarter Planet initiative. By 2009, this concept drew worldwide nation, and it has now taken the shape of several Smart Cities initiative that we see around the world today.

Early adopters of smart cities were Barcelona, Vienna, Amsterdam, etc., and as we know, have already become worthy of emulation. Now cities like Copenhagen, Dubai, Singapore, San Francisco, Chicago, New York, Miami, Nice, etc. are following suit. Infact, several governments around the world have started their own Smart Cities initiative to drive the country's economic momentum.

Sub-niche: According to Frost & Sullivan, the Smart cities tag will comprise the adoption of at least 5 of the following parameters, namely: smart energy, smart building, smart mobility, smart healthcare, smart infrastructure, smart technology, smart citizen, smart governance and smart education (image below).

In turn, each of its corresponding smart product or solution will collaborate its intelligent sensing technology with the internet to - interact and exchange data for optimum and efficient performance, send response triggers, and adapt & advice amidst the ever changing environment.

The Navigant Research's Q4 2014 Leaderboard report on Smart City Suppliers likewise identifies 5 industries (few are mentioned above) as the focus for smart city investment, and so does TM Forum's Insights report on Monetizing and Managing IoE Services, all in all highlighting the rich role of Smart Cities in steering the tech-enabled growth story of the century. TM Forum also identifies 'Smart Cities' as the richest 'mash-up' of all IoE verticals.

One of the crucial enablers of such a vertical is going to be an improved and intelligent transportation system. Even in traditional terms, transportation has played an important role in realising global and national growth by being the fulcrum of all activities/businesses, which run across the length and breadth of all economies. Transportation, in fact, accounts for 6-12% of national GDP in many developed countries.

Despite its towering progress, the sector is ailed by several issues that need our attention. To cite a few: road transportation alone accounts for more than 40% of CO_2 emission around the world; in the United States, around 5.6 million car accidents happen in a year; and according to the European Commission, EU loses 1% of their GDP per year in urban congestion.

There are several such reasons pointing towards the global need for overhaul, and this is where the ITS niche rightly steps in.

Intelligent Transportation System (ITS):

As mentioned earlier, with almost 60% of the world population concentrated in an urban setting, if Smart Cities are the most important drivers of economic growth, then ITS is the backbone of all its functions.

Augmenting itself in the smart segment as Intelligent Transport System (ITS), transportation function ranges across network management systems, public transport ITS, freight and commercial ITS, road safety system, security/crime reduction ITS, Communication ITS, and automotive & infotainment telematics.

What does it do?

With its rich sophistication, it provides key, time sensitive solutions for every mode of traffic and transport. Its traffic management model offers optimised quality output at reduced costs, whilst enabling decision making to happen at a swifter pace. The existing transportation infrastructure when integrated with ICT & IoT will improve performance significantly, benefiting the urban transport through advanced control systems and sensor technologies.

Internet of Things (IoT) for instance is making transformational inroads in the transport segment by optimizing the movement of goods, services and people and paving way for better economic conditions, enhancing public safety, and assisting the environment by downsizing needless emissions.

The ITS offers real-time information about traffic flow to passengers/commuters, monitors traffic, averts road accidents, diverts congestions, reduces vehicle emissions, and so on. Passengers are able to take informed decisions with respect to transport requirements through its intermodal connectivity.

Origin: Even though Intelligent Transportation Systems (ITS) has been around since 1994, the contemporary solutions have risen its standards through traffic estimation, parking and route guidance, data analytics & decision support, fare payment, smart ticketing, insurance telematics, etc., with several of these already in heavy use. It is reported that few Smart Cities have already deployed transportation solutions with its required infrastructure, to support future transportation models.

Use of tools like predictive data analytics allows traffic jams to be predicted an hour before they occur, allowing commuters to decide accordingly. As the passenger experience improves, along with reliability and quality of information, the road ahead for the ITS industry looks more than appealing.

As mentioned in the last insights, Video-Analytics will be playing an essential role in both the city and transportation niches, reaching the greatest potential use by 2020. To reiterate, Mckinsey's Video meets IoT report mentions that the largest VA market will involve optimizing operations in cities and factories as well as aiding several functions in autonomous vehicles, such as blind-spot monitoring.

Let's look at the benefits and economies of scale that these niches bring to our countries.

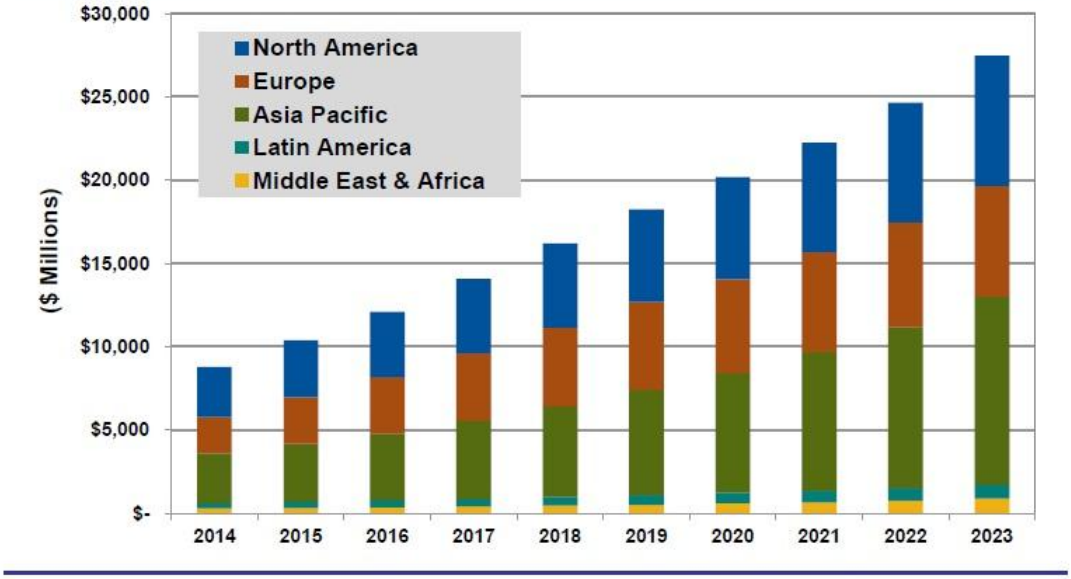
Economic Impact:

As per recent industry reports, the Global Intelligent Transport System (ITS) Market is expected to grow at a CAGR of 8.70 % during the period 2017-2021. In this period, they forecast Smart roadways to be the fastest growing sub-niche in the smart transportation segment, as it plays an integral role in improving connectivity for multi-modes of transport.

As for Smart City Markets, Frost & Sullivan reports that it will be worth a cumulative $1.565 Trillion by 2020. It also mentions that though there were no smart cities as of 2011, around 26 smart cities are expected by 2025 and 92 sustainable cities are expected by 2025. It highlights the latter to be built on eco & environment friendly basis, with or without the incorporation of 'intelligent' models.

Navigant Research Q4 2014 Leaderboard report on Smart City Suppliers, on the other hand, mentions a CAGR growth of 13.5% between 2014-2023 (image below).

Chart 2.1 Smart City Technology Annual Revenue by Region, World Markets: 2014-2023



(Source: Navigant Research)

It also mentions that the cumulative global investment in smart city technologies over the decade will reach $174.4 billion, helping the goals of sustainability, citizen well-being, and economic development.

The importance of a smart city vision lies in this ability to reach out to multiple stakeholders by benefiting all, and bridging gaps through an integrated solution. It looks for a holistic, mutual growth that is not only sustainable over time, but also highly intelligent to optimise performance and reduce costs.

The July 2017 Markets and Markets report estimates the smart cities market size to grow from USD 424.68 billion in 2017 to USD 1,201.69 billion by 2022, at a CAGR of 23.1%. It also forecasts building automation to grow at the highest CAGR during the forecast period, as the demand for a centralized monitoring and controlling system to ensure energy efficient performance has been towering up.

The potential of rapid connectivity & tech innovations in the communications domain, along with growing population, rising urbanization, energy use that catapults demand, and important governmental reforms are estimated as the major driving factors for the smart cities market.

As for Global Smart Parking Market, it is poised to grow at a CAGR of around 4.9% over the next decade to reach approximately $1461.52 million by 2025. Smart parking will be a hotspot for mobility in cities with high end automation solutions and software, wherein services including license plate recognition, parking reservation management, security, surveillance, valet parking, etc., will be undertaken.

Technology research company Technavio reports that the smart highway construction market will grow at an exponential rate and post a CAGR of almost 94% by 2021, and as per Markets & Markets, Smart Transportation Market will be worth 44.78 Billion USD by 2021.

Interestingly, in autonomous vehicles segment, one can see economic benefits trickling down in multiple ways. In Mckinsey's June 2015 report on The Internet of Things: Mapping the Value Beyond Hype, it mentions few benefits in terms of:

- Time: Use of Autonomous Vehicles could help realise $15 billion to $25 billion of value in cities. It reports that 1.2 billion people globally spend average 50 minutes in car driving per day, and with adoption of Autonomous vehicles, it will not only improve traffic flow but also help save up on driving time. The report further mentions that the total improvements in this segment, mainly with respect to time saved by travelers, could have an economic impact of $443 billion to $808 billion per year in 2025.

- Accidents: Use of autonomous/partially autonomous vehicles could result in an estimated economic impact of $180 billion to $200 billion per year. With 90% of car crashes in US attributed to human error, and more than 40% fatalities arising due to driver impairment from alcohol, distraction, drugs, or fatigue, the report estimates a 90% reduction in accidents through use of fully autonomous vehicles and 40% through partially autonomous vehicles, saving 95,000 lives per year.

- Fuel: Use of Autonomous Vehicles could result in 15% lesser consumption of fuel. In the absence of wasteful driving behaviors and integrated communication system across every vehicle, it points out how the cars travelling close at highways could reduce wind resistance and increase average speed. It also highlights the potential of altering automobile designs to make the cars lighter and fuel-efficient.

- Parking space: Frees up 15% of parking space, as auto parking requires no gap between cars for door openings. Reduces the need for parking lots and garages in city centers, as these could drop off & pick passengers and proceed to remote parking areas on their own. Additionally, adoption of car-pooling and ride-sharing options would peak the overall demand further.

- Safety: As we saw earlier, there are 5.6 million car accidents per year in the US, and property damage from collisions is estimated at $277 billion per year. With IoT based automatic braking in place, 25% of property damage per year due to low-speed collisions could be prevented.

- Security: Use of IoT tracking to substantially reduce low speed collision & theft could bring down insurance premiums by 25%.

Other economic impacts by 2025:

- Autonomous vehicles in urban settings - $204 billion to $235 billion per year - by reducing traffic accidents, fuel consumption, and carbon emissions.
- Outside urban areas:
    - Self-driving cars - $224 billion to $240 billion - based on time & fuel saved, traffic fatalities avoided.
    - Self-driving trucks - $25.4 billion to $38.7 billion - based on fuel saved, reduced emissions, accidents.
- Total value from condition-based maintenance including the value of reduced delays and longer equipment life will be:
    - aircraft - $35 billion to $73 billion per year,
    - military equipment and vehicles - $9 billion to $30 billion per year,
    - passenger vehicles and trucks - $340 billion per year [Mckinsey has assumed yearly cut of $700 billion for motor vehicle maintenance bill by 10-40% and extending car life by 3-5%],
    - rail systems - $33 billion per year [Mckinsey has assumed 10-40% reduction in routine maintenance costs and extending equipment life by 3-5%],
    - cargo ships - up to $34 billion per year.

- Productivity apps in the vehicle setting - $900 million to $2.2 billion per year - primarily through the use of AR technology for mechanics and air transportation workers.

- Collective vehicular setting - $210 billion to $740 billion per year, wherein IoT could help in monitoring and improving the performance of planes, trains, and other vehicles in use.

In The Royal Society Machine Learning April 2017 report, it likewise observes IoT role in routing of ships, airplanes, and other vehicles between cities using advanced navigation, in tracking containers and packages in transit, and estimates an economic impact of $560 billion to $850 billion per year in 2025.

From Smart Cities perspective, Mckinsey draws attention to the 70% buffer time involved in commuting, and the potential for its reduction. It could provide time savings of over $60 billion for cities per year, wherein collectively IoT transportation apps for cities could be worth over $800 billion around the world in a year. Use of IoT smart meters to reduce electricity loss and sensors to prevent water leaks will have an impact of $69 billion per year globally.

Smart healthcare IoT apps for air and water quality improvements to reduce pollution is estimated to have an impact of nearly $700 billion per year in the cities. Public health is considered the second highest contributor for cities, following transportation apps ($800 billion as mentioned above).

On the whole, the report estimates IoT apps in the cities could be worth $930 billion to $1.6 trillion per year in 2025, wherein it aids the Smart Cities vision of improved health and safety such as reduction in automobile deaths and pollution-related illnesses, efficient use of resources, time saving, tracking lost children, etc.

Functional Area:

In the ITS model, through IoT connectivity between vehicles & devices, along with GPS satellites, it offers precise navigation for vehicles. This connected navigation will be highly beneficial for various modes of transport as well as different industries, due to saving of cost, time, and the need for real time data.

Example 1: In air travel, connected navigation could save 2-5% per year in fuel/CO2 emissions in 2025 estimates Mckinsey, for a potential economic impact of $4.2- $5.2 billion per year.

Example 2: In Mckinsey's report on IoT value, it has highlighted the use case of auto giant Mercedes-Benz. The Benz car company uses an app to detect if a driver is heading home, and in turn instructs the home management system to adjust the house temperature, resulting in energy savings.

Similar car-based apps are expected in the future, such as connectivity to a smart refrigerator to identify what items to pick up on the way, and providing store suggestions based on location.

Rightly, Cars have already started leading the connectivity aspect with built in Wi-Fis and device connectivity to its infotainment system. Such connectivity gives the option to collect crucial data, which can be disseminated to efficiently manage performance, vehicular distribution, highway infrastructure or offer insights on traffic warning and flow control, automatic safety systems, emergency call services, etc.

Now that these connected models are evolving towards self-driving vehicles, addressing technological challenges and questions on safety & security have become critical for widespread adoption. While Self-driving car models have just started seeing the light of day, there are already options such as driver-assisted parking, intelligent cruise control and lane departure warning devices.

ITS traffic management solutions have also been proven to be effective to curtail traffic woes by predicting traffic, enabling ticketing and fare collection, providing analytics and decision support, etc. With roadside sensors, Radio-Frequency Identification (RFID) tags, and Global Positioning System (GPS), ITS could monitor and manage transportation holistically and more effectively.

The automation of roadways, railways and airways will further enrich passenger experience, aid in tracking and delivering merchandise and cargo, all in all enhancing business opportunities for both service as well as solution providers. Infact ITS & IoT integration could be applied across various segments such as transport and logistics, guidance and control systems, smart vehicles, security and surveillance systems, passenger entertainment & commerce, fleet telematics, etc.

Though advanced transportation management systems, it could provide network solution management, traffic light control, undertake electronic toll collection, predict road congestion, etc., and cater to commuters through advanced traveler information systems. The latter will offer crucial pre-trip information and real time data while journeying in the vehicle, whilst the advanced vehicle control systems will have technologies that aid and enhance safety of the driver & vehicle, maintain vehicular control, better performance, etc.

Products such as sensors for safety warning signals and advanced driver assistance systems; in-vehicle networking systems offering infotainment and safety services; and connectivity via Bluetooth and NFC-enabled devices for - a) advanced navigation systems, b) social media sharing, c) device-vehicle connectivity to offer diversified vehicle information services - will be made available.

Benefits:

- Decrease in travel time/costs, improved safety, reliability & emergency response.
- Increase in productivity as a result of improved freight service - with real time data on delivery.
- Reduction in air pollution
- Reduction in traffic accidents, injuries and fatalities
- Saving fuel, raising average highway speeds (through AV)
- Expanding the capacity of parking facilities with self-parking (through AV)

With increasing investments, innovations and demand in the industry, one can say these are further fueling the journey of ITS industry.

Autonomous Vehicles (AV), for instance, have applications in a wide range of use case settings as well as industries. They are already used in industrial environments such as mines like mine cars and ore trucks. There also other uses of AV such as the use of drones in cricket matches to drop the ball to the Umpire, drone-based product delivery by Amazon UK, etc.

Mckinsey reports that use of remotely controlled vehicles in the mining industry can help them gain an additional nine hours of production time per day, streamline operations and reduce costs. For instance, Aus-British mining company Rio Tinto sought out autonomous dump trucks, which are aided by remote control and rely on sensors to avoid obstacles. The truck-to-truck communication system allows them to maintain a safe distance from one another.

As for AV, few car manufacturers are expecting self-driving cars on the road by 2020, pending regulatory approval, and Mckinsey estimates the year to be 2025, before fully and partially autonomous cars are used in cities around the world. [The partial model only tends to safety/critical functions, while the former is fully self-driven.]

Importantly though, regulatory issues need a resolution, for it will shed clarity on how will autonomous vehicles be brought to public roadways, how will they be regulated and insured.

For instance, looking at the safety aspect of autonomous cars, they need to recognise a range of environmental features such as obstacles, road signs, other vehicles, and even pedestrians. Since it is impossible to hard-code every rule and response, keeping in mind the multitude ranges and possibilities of things an AV will come in contact with, Machine Learning algorithms aid AVs to adapt to a range of features, and respond in accordance to each unique setting.

ML algorithms, as we saw in last insights, will also help in analysing historical data on traffic flows, enable efficient optimisation and dynamic adjustments as it responds to different pressures according to the time of day. The Royal Society's Machine Learning Report highlights the example of UK's biggest shopping centre in Gateshead, wherein a network of road sensors, are setup to record vehicle flow and congestion. They help predict when and where traffic problems will arise, allowing traffic personnel intervention before they take place. This has improved the congestion predictions by up to 50% and reduced emissions - making way for an improved shoppers' experience.

As for sensors and wireless connections, they will also help gauge a vehicle's performance for condition based maintenance routines, thereby benefiting the customer for its cost efficiency, compared to the periodic maintenance routines. Mckinsey points out how these sensor data can aid vehicle manufacturers in designing more reliable products, eliminating needless features, and in understanding customer requirements to tailor make the models. Mckinsey estimates this pre-sales enablement to increase sales productivity of suppliers by as much as 2% - viz., $13 billion per year in 2025, with an estimated $800 billion market for vehicles, and 2-7% through usage-based design - viz., $7.6-$44 billion per year in 2025.

In TM Forum's 2016 report on Monetizing and Managing IoE services, it mentions that insurance companies are offering reduced premiums to those drivers who use sensors to track vehicle location, acceleration and speed. This reiterates the corresponding influence and benefits that these Smart niches offer to other industries.

In logistics, it helps in recommending most efficient ways to store products, predicting fuel consumption of different delivery vans based on their route and traffic flows, etc., ensuring improved efficiency and productivity. Other use cases in the industry:

- IoT tracking betters container utilization by 10-25%, reducing annual spending by nearly $13 billion per year in 2025.
- An estimated 0.5% & 3% of packages are lost in transit in advanced and developing economies respectively, and through the use of tags at every step of shipping, we could reduce the lost count by 30%.
- Goods damage in transit costs about $5 billion per year, and with use of smart packages to monitor temperature, humidity, etc., it is reduced by 50%. [Damage and loss together could have an economic value of $15 billion per year.]
- Tracking & remote monitoring of defense equipment could lead to 3-5% productivity gain with an impact of $15.6 billion to $27 billion per year in 2025.

In an article by Central State, it talks about how new age tech and IoT are aiding the banking sector, wherein financed cars could be tracked through sensors. This adds as a layer of security for nonpayment vehicles, allowing the lenders to cease or disable the vehicle until payment is repossessed.

So now this will ensure a 30% drop in auto loans; however a right regulation norm to ensure security and privacy clauses of the vehicle owners remain uncompromised, is crucial in these scenarios.

Such profound impacts make it evident that the Internet of Things and related niches hold a key role in orchestrating the smart movement, be it for cities or ITS.

Telefónica's Global Product Manager for Smart Cities Sergio Garcia Gomez says, there are six keys that make a city smart - parking, street lighting, environment, waste management, transport and tourism. With highly populous crowd settled in, rising demand, and complex infrastructure, no doubt cities are target-rich for these applications. Let's look at some of them:

Smart Healthcare:

With rise in awareness and increasing proximity to apps and related tech, the health and fitness niche is doing very well, as citizens are moving towards healthy diet, everyday fitness, etc., all around the globe. It is no wonder then to see the estimate of Reports&Reports.com, which says this segment will grow by 25% every year from 2016-2020.

With the use of sensors, the market is able to capture those users who need active monitoring, be it young or old, giving real time data of vital signs to avert critical conditions. From wearables and apps like fitbit, which help in tracking exercise and weight goals, to apps that assist people in taking the right dosage of medicines at the right time, the solutions of the niche are widely varied.

However, the crucial market share will belong to electronic health records (EHR) with its sheer volume, aiding the Healthcare growth along with Big Data, Analytics and AI niches, which offer better insights and thereby better care to the patient and family.

For example, we saw in our last insights that with the use of deep learning and related streams, the systems are able to provide accurate diagnostics, saving people's lives, which would not have been possible otherwise.

With smart healthcare in picture, the efficiency and ease of processes, along with accuracy and data knowledge widely rises - viz., monitoring one's heart, sleep patterns, learning patient behavior and symptoms, details of steps taken, distance covered, calories burned, etc., can now be easily tracked in one's smart phone. With such easy access to large data, it helps practitioners, enthusiasts and patients alike in saving time and money by offering detailed insights at the touch of a button.

In an article by YMediaLabs, the author talks other potential possibilities in the industry, including scheduling appointments, instant messaging of patient info to health care provider, improving mental health state, connectivity of med apps and devices, etc., with an estimate of almost 50% of practitioners introducing medical apps in their practice within next 5 years.

Mckinsey in fact predicts rise in the adoption of health management ecosystems, wherein the advanced digital offerings would aid people to control how and from whom they accept their health care services, along with how much price they are willing to pay for it.

Smart Infrastructure - Waste Management:

It has been estimated that the global waste is expected to double over the next 10 years, requiring the crucial presence of waste management in all countries. For instance, according to GHMC reports, a city like Hyderabad in India generates 3,800 metric tonnes of municipal solid waste per day. In the U.S., it is estimated that consumers waste about 30% of food - viz., 133 billion pounds of food each year.

This is precisely why one of the key points of waste management has always been the 3Rs - Reduce, Reuse, Recycle, as this could drastically reduce the way we discard what we call 'waste' - saving our energy, resources and thereby the environment. Infact, when the country of Sweden created a buzz with its revolutionary waste management, emphasis was soon made on the need to recycle than incarcerate the waste.

As for food products, use of IoT/M2M applications could drastically reduce this wastage through asset and material tracking, as restaurants, grocery stores, etc., will be able to track exact quantities of the food they regularly sell with these apps and thereby see a significant reduction in waste and spoilage.

There are few regions and initiatives that are already leading the Waste Mgmt. momentum. For instance, the city of Seattle had set a record recycling rate of 58% in 2015; the Minneapolis city's

optional organic waste recycling program saw 40% solid waste customers signing up to participate as of October 2016; a plastic recycling program in Netherlands had aided in creating a cost-efficient & eco-friendly pet pavilion cum public space; one of Peru's Metro station has a fun and interactive recycling bin to recycle subway tickets, which was set up by few of its citizens.

The Smart Cities Waste Management program through newer initiatives has slowly started stirring interest with a potential for large scale, impactful implementation. In fact, the enormous rise in landfills, environmental concerns, loss to other species life, etc., makes it a quintessential necessity to keep up with this momentum.

With the use of advanced tech like RFID or other connectivity sensors in trash bins, one can determine waste levels; with fuel efficient collection vehicles and geotagging this could further help in saving fuel, time, etc., by sending an optimal route for collecting vans. It is estimated that this could result in almost 80% cost reduction over the next decade.

These sensors can detect how full the containers are based on its storage indicator, transmit the information to the waste management system and let operators know if there are containers that require immediate pickup.

Example1: A US waste management company Enevo has received much traction, wherein its product when placed on container lids disseminates info on the load capacity, threshold levels for emptying, forecast future routes, etc., making the mechanism efficient and aiding cost cutting by up to 50%. It also tracks if collections are completed as scheduled, and its heat sensor sends an alert, if fire is detected in the container.

Example2: Through data on clogged basins, New York City does site visit and identifies restaurants that are illegally dumping grease. With 95% accuracy, this helped in terms of better time management, fewer clogged basins, and increased revenue through fines.

Smart Safety & Security:

Public security is a growing concern for cities around the world. With rising urbanisation, cities have become a hub of inter-racial, cross-cultural community, which needs to cater to employment opps, basic utility services, entertainment for its people from all quarters. To ensure a peaceful co-existence, and keep a tab on crime-fighting activities, it has become important for the govt. to set up various tools and communication channels to improve public services.

The live feed of surveillance cameras and sensors to assess conditions in critical and crowded areas improves location safety system and monitoring, as well as identify threats in real time to alert operators. This kind of incident detection & management helps in creating incident records with details on frequency, location and lifecycles to detect potential scenarios, predict crime patterns and identify areas with recurring issues.

Not only does this reduce crime, but it makes the city an attractive destination for tourists as well as businesses, promoting further development. Even for the citizens, a safer neighborhood with use of biometrics, proper communication channels to report incidents and answer safety queries acts as a huge motivator to engage in everyday life, which in turn drives the economic activity of the country.

Many companies are offering IoT solutions in the form of Video Analytics, Big Data, Wearables like body-worn cameras, etc. to cater to this demand. Ex: Huawei's safe city solution uses 'enterprise' LTE (eLTE) technology to provide police and emergency services helping in city monitoring and ensuring citizen's safety. IBM offers Intelligent Video Analytics solution to ease the process of discerning multitude records, as the security aspect is always time sensitive. It offers advanced quick search, citizen privacy protection, etc., helping the law enforcement professionals to nag the offender on time.

In Nairobi, Huawei's communications network links 1,800 surveillance cameras with 195 police bureaus and 7,600 police officers. Likewise for the 2013 Asian Youth Games, Huawei undertook surveillance & protection of 14 stadiums and nearby roads to ensure key areas of the event are safe and under control.

Smart Energy:

Energy consumption around the world has catapulted to enormous amounts, and the need for a sustainable, and resource efficient approach has become the need of the hour to keep up with the current and future needs of the economies. This is where Smart Energy steps in as it offers efficient alternatives, timely reminders and data warnings when a product lies idle but consumes energy. For instance, in a supermarket chain, refrigeration of time and temperature sensitive products is a requirement; however these invariably use a lot of energy. In order to keep the products cool, both the warehouse and the store uses 24 hour supply.

Through the use of advanced tech, it can assess when energy demand is high, and have the supply intermittently stopped to reduce overall capacity demand and to keep the power network stable.

Smart Meters:

Using them at our homes will offer continuous, real time energy monitoring, allowing us to ascertain our energy usage levels. Infact, this data will offer corresponding insights to the suppliers to tailor-make tariff packages as per every customer, and assist in reducing bill amount.

With inter and intra connectivity between themselves and other appliances, it could decide whether or not to use a high power source based on price, supply, etc. Ex: In the UK, the government has set 2020 as target year to fit every home with a smart meter to monitor energy usage in real time, reiterating their potential impact.

The insights are highly beneficial to the end user as well, for it gives an understanding of how much we spend on energy, how much of it can be saved with right usage, and more. Most energy monitors give both past and current energy usage numbers, and few others even offer an option to set up monthly budget, prompting us to be smart with our consumption - for example, this will help us shift to LED bulbs, pro-green products and energy efficient durables such as washing machines and dishwashers, which ensure less water/power usage, etc.

With a range of niches assisting the Smart Cities vision, we have only looked at few of the segments of the wide gamut of Smart Cities market. It extends to **Smart Citizen, Smart Governance, Smart Environment, Smart Building, etc.**, wherein each of the niches in turn aim to stabilize its current models with sustainable, intelligent and efficient approaches that offer long lasting growth potential to all members of the community.

Smart governance, for instance, involves holistic city planning and information to aid all activities of commerce and everyday living. Here, city officials should orchestrate a compelling and realistic growth strategy, one which engages the citizens and local businesses, benefitting the community with the use of intelligent infrastructure and by promoting harmonious living.

Smart governance will involve consensus and delegation amidst various parties - be it political, public or private, and this will not be easy. However as we all know, the public–private partnerships have always played an instrumental role in delivering high quality infrastructure and lower cost benefits.

Here, Mckinsey highlights the need for concrete, measurable goals with an ROI focus and rigorous performance metrics to benefit from the process, wherein it estimates $400bn saving per year with quicker permissions and structured projects. Ex: Britain's road-building partnerships had high-level guidance and conditions for building toll roads.

Truly, an enabling governance alone can ensure this accountability factor - be it design, delivery, or management of capital investments. Right from facilities of smart lighting & dimming, smart roads, reduced pollution, availability of Wifi, citizen's access to smart education, smart mobility, advanced water management, business friendly policies that attract investments and talent, along with proximity to critical business resources, and related infrastructure, all take precedence for a well-rounded growth.

In the GDTN Smart cities report, it takes an example from 2010, wherein a competition was held in Ruhrgebiet, Germany to identify a city that serves as a real-world model to reduce carbon footprint in an industrial region, with its best practices to be adopted as a model for other cities in the region as well as to industrial cities around Europe.

The city of Bottrop was declared a winner for its clear commitment to carbon footprint reduction - from all its political players, along with over 20,000 members of the Bottrop community, who expressed their support in the application; wherein the mayor was part of the project evaluation committee.

As we can see, the potential could be endless. Mckinsey, therefore, mentions the importance of a city determining its key offering - what does it want to be known for, and build the city around that vision. It says, for economic development, a city could consider the whole business community as its client, and undertake steps to make that client successful. It highlights the US states of Georgia, which built a job-training facility for would-be autoworkers, and South Carolina, which established an apprenticeship program with manufacturers.

Popularity & Adoption:

With the vision for Smart Cities, measures on sustainability, innovation in public services, and economic development have gained prominence in governments worldwide, attracting investments in related technology.

For instance, Sensen Networks, the Australian patented technology company that we looked at in our last insights offers services in these niches. In Intelligent Transportation, it uses combination of cameras, GPS, Lidar, Radars, Time servers, Video-IoT analytics and cloud hosted back office software. Its Intelligent Transportation solutions - SenFORCE, SenSIGN and SenPARK - delivers solutions on civic compliance, traffic data and law enforcement to city councils, road authorities, national parks, and transit agencies around the world. [Read our feature article on SenSen Networks in this month's insights.]

In this interesting article by Fast Company, the author talks about Smart Cities from a 3-generation angle, wherein the city of Barcelona has taken much of the highlight for its rich juxtaposition of smart technology with smart governance, as well as the city of Vienna for its active citizen partnership. With both of them having over 100 active smart city projects, as well the city of Vancouver, which engaged 30,000 citizens in the co-creation of the Vancouver Greenest City 2020 Action Plan. It shows how a collaborative effort from all quarters could be quintessential in bringing the Smart Cities initiative to fructify fully and wholly.

Let's look at some of the examples of adoption by cities around the world:

- San Antonio - street light adjustments based on weather such as a stormy season to improve visibility and reduce accidents
- Chicago -
    - Rodent population control through predictive analytics, wherein trash dumpsters that are full and attract more rats are determined. This has led to 20% more efficiency in controlling rats, reports city's chief data officer Tom Schenk.
    - Ascertaining code violations through predictive analytics in the city's 15,000 restaurants, wherein their 8-week trial showed results two week faster (on average).
    - Goal of 50 sensors to alert relevant departments when bridges freeze, and to report water quality in Lake Michigan.
    - Noise pollution, traffic congestion programs are also underway as per Commissioner and CIO Brenna Berman, Chicago Department of Innovation and Technology (DoIT).

- Copenhagen - goal of becoming the first carbon neutral major world capital by 2020
- San Francisco - smartphone app to find available and closest parking spots in garages throughout the city, with a hope of expansion to monitor open spots on the streets [Intelligent Transportation Society of America has estimated that 30% of all traffic congestion in cities are due to drivers looking for a parking space.]
- Hamburg, Germany - a lofty goal to eliminate all cars within city limits by 2034
- Barcelona -
    - embedded sensors in the city streets to alert users of open parking spots, which has resulted in reduced traffic and use of fuel, ultimately helping the environment through lower carbon dioxide emissions
    - $58 million annual savings using smart water meter technology reports Cisco
- Florida -
    - San Diego & Jacksonville - smart LED streetlight pilot programs through GE Lighting, with approximately 50 intelligent LEDs installed in each city, covering around 10 blocks

        - South Florida - to set up the world's largest streetlight deployment of 500,000 smart LED streetlights, of which 75,000 are already completed, reports Brandon Davito, Vice President of smart cities for Silver Spring Networks. [Smart LEDs have both sensors and connectivity, which aids in data collection to analyse where further development and upgradation is needed]
    - Songdo in Incheon, South Korea - $35 billion, 1,500-acre private real estate development built by Gale International along with technology partner Cisco. It has cut energy and water use by 30%, and reduced operating costs through regulated electricity and water usage.

      "There are no wires, it's all underground. There are no garbage trucks. All garbage is sent underground through a pneumatic process. In homes, parents can connect to schools and talk to teachers through telepresence," said Anil Menon, Deputy Chief Globalization Officer, Cisco.

    - There are also real-time information on buses and trains already available in cities like New York, Chicago, Singapore, etc., wherein commuters check the status in app and save their waiting time. Mckinsey estimates this real time data to reduce waiting time by 15% approx, and expects a potential widespread use as GPS-enabled monitoring systems are already popular amidst commuters. This will have a potential impact of $13 billion to $63 billion per year.

In the 2014 Navigant Research Leaderboard Report, it identifies the contribution of several companies that are playing a leading role in the smart niches including IBM, Cisco, Schneider Electric, where the latter even has broader company initiatives for strengthening its smart city offering. It mentions that Microsoft's CityNext program likewise has had a hand in positioning the tech giant amidst heavyweight infrastructure firms like Siemens, Hitachi, and Toshiba. It goes on to emphasise the ever widening array of Smart market with companies like Ericsson and Huawei contending for a leader role, wherein communications and IT infrastructure play a crucial role in this segment.

Let's look at couple of those contributions:

- Company: Ericsson | Focus : smart energy, smart transportation, and smart security
    - Smart transportation - offers ITS framework using ICT infrastructure
    - Service - device and connectivity management to enable applications such as traffic efficiency, road tolls, vehicle interaction, transportation safety, vehicle infotainment, and goods management.
    - Example - Brazil - chosen by Telefônica Vivo in May 2014 for digital city project in Águas de São Pedro - to provide the project with smart lighting and smart parking solutions and for systems integration.

- Company: Silver Spring | Focus: smart healthcare, smart transportation, smart security, smart environment
    - Network platform in environmental sustainability, health, safety, and transport
    - Service - traffic and transportation management incl. street lighting and traffic control applications
    - May 2014 - acquisition of Streetlight Vision (Paris), a specialist supplier of street lighting control and management software.
    - Example -
        - ☒ Paris - deployment of a smart street lighting and traffic control system in parts of Paris.
        - ☒ Florida Power & Light - to connect and control 75,000 street lights in Miami-Dade County, leveraging the utility's existing smart grid network.
        - ☒ Copenhagen - to deliver the networking platform for 20,000 intelligent street lights as a potential precursor to a broader range of city management projects such as traffic management.
        - ☒ Glasgow - intelligent street lighting project - to integrate LED street lights, traffic cameras, and sensors into two adaptive lighting systems to monitor vehicle, bicycle, and pedestrian traffic and dynamically dim and increase illumination accordingly.
        - ☒ a) Streetlight.Vision - completed over 400 city projects in 15 countries, with a strong presence in Europe and Asia. b) Silver Spring - building an ecosystem of partners including suppliers of luminaires, devices, and controls, as well systems integrators.

Tesla, one can say is making several such inroads in these niches, and has already brought out some of the most sophisticated connected cars. The company is looking to forge ahead in its autonomous driving vehicle program as well, and is equipping sensors for data collection. With a new sensor suite on the second generation Autopilot, it has 8 cameras, all-around ultrasonic sensors, and a forward-looking radar.

The company wrote to its owners, "We are working hard to improve autonomous safety features and make self-driving a reality for you as soon as possible. In order to do so, we need to collect short video clips using the car's external cameras to learn how to recognize things like lane lines, street signs, and traffic light positions. The more fleet learning of road conditions we are able to do, the better your Tesla's self-driving ability will become." In fact, Tesla is already known for using wireless software downloads to add new features and fixes.

Speaking of autonomous vehicles, UK's Philip Hammond, as we saw in our last insights, has been really keen in keeping the country at the forefront of these niches. With that vision, he had announced 390 million pounds for the development of autonomous and electric cars, wherein 100 million pounds will be allocated for new testing sites for these self-driving vehicles.

Dr Graeme Smith, chief executive of driverless car technology group Oxbotica, which also benefited from this funding, said: "We are at a real inflection point in the development of autonomous technology."

"The UK has a number of nascent world class companies in the area of self-driving vehicles, which have a huge potential to change the world, whilst creating jobs and producing exportable UK goods and services. We have a head start and now we need to take advantage of it."

European cities are also leading the way in the Smart market, in fact Europe is estimated to have the largest market share in 2017, giving a great platform for smart city vendors to innovate in the fields of smart energy, mobility, and governance. The important targets of European Innovation Partnership (EIP) on Smart Cities and Communities are estimated to be better public transits, more energy efficient buildings and transportation, reduced carbon emissions, and sustainable environment. Ex: European rail systems have adopted Condition-based maintenance approach and reported 30% reductions in maintenance expenses. Compared against rule based maintenance, Mckinsey estimates this approach will increase the lifespan of track by 3-5%, leading to an annual economic potential impact of $5-$10 billion
in 2025. In this approach, sensors help determine the weight and number of trains that plied on the track.

As for Asia Pacific, it is projected to grow at the fastest CAGR and is expected to dominate the market by 2022. Example1: The city of Abu Dhabi, for instance, is not far behind in its ITS initiative. It uses adaptive traffic control in 125 main intersections, wherein the centralized control system collects data from intersection sensors to monitor real time traffic, and adjusts the length of traffic light timing as per volume to better its traffic flow, reduce delays and to prioritise public transport, ambulances, or emergency vehicles, as need arises.

Mckinsey reports that such improvement in speed traffic flow is between 5-25%, thereby estimating that the adoption of adaptive traffic control and smart meters will reduce time spent in traffic jams and circling for parking spaces by 10-15% - viz., more than $500 billion per year globally in 2025.

Example2: Air China with a view to improve its maintenance process has resorted to downloading real time aircraft performance data to its ground-based systems. This will bring in increased efficiency, reduce downtime, bring down costs of routine maintenance, and aid in longevity of the equipment. Such condition-based maintenance in airplanes could reduce maintenance spending by 10-40%, increase profitability for air carriers, reduce mechanical delays by 25% and cut equipment replacement by 3-5%.

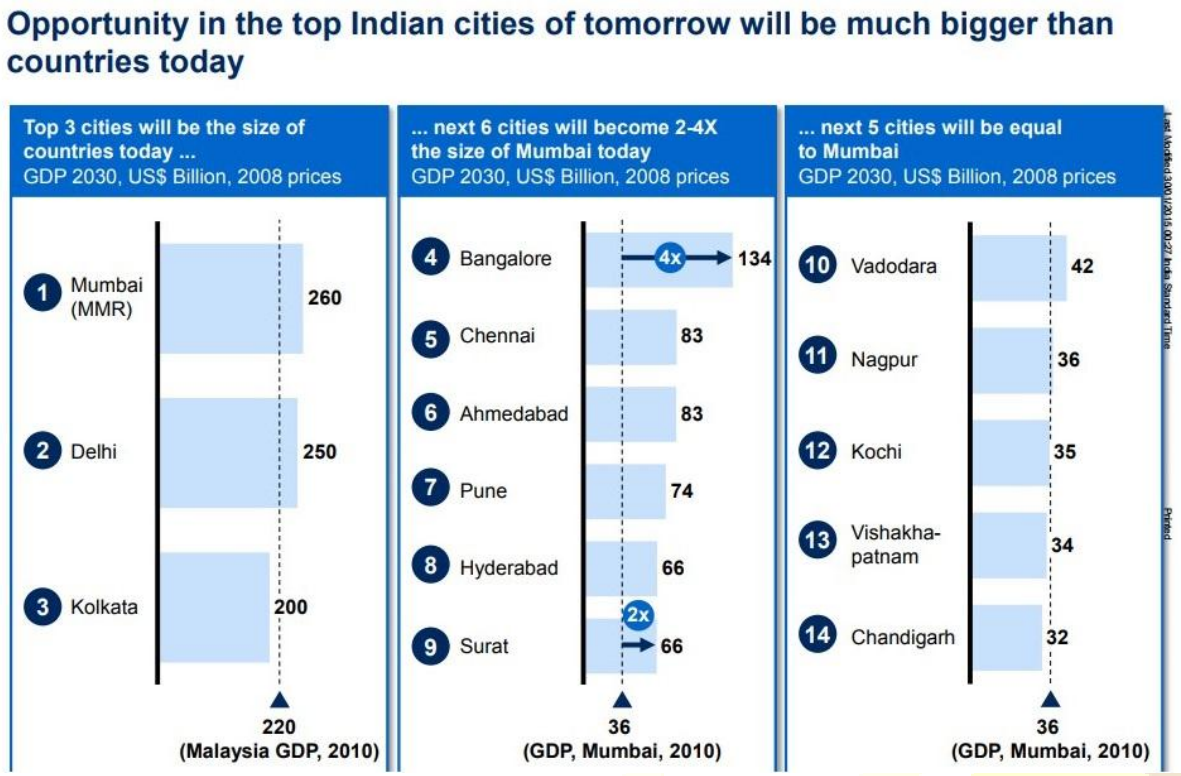
India/Australia:

In the subcontinent, Prime Minister Narendra Modi has started India 2020 Smart Cities initiative to accelerate the growth momentum of the country, which is already one of the fastest growing economies in the world. With newer business and investment reforms attracting attention to India's investment landscape, along with rising entrepreneurial tide, this Smart Cities initiative looks to create further influx of employment, innovation, and efficiency into the young Indian market.

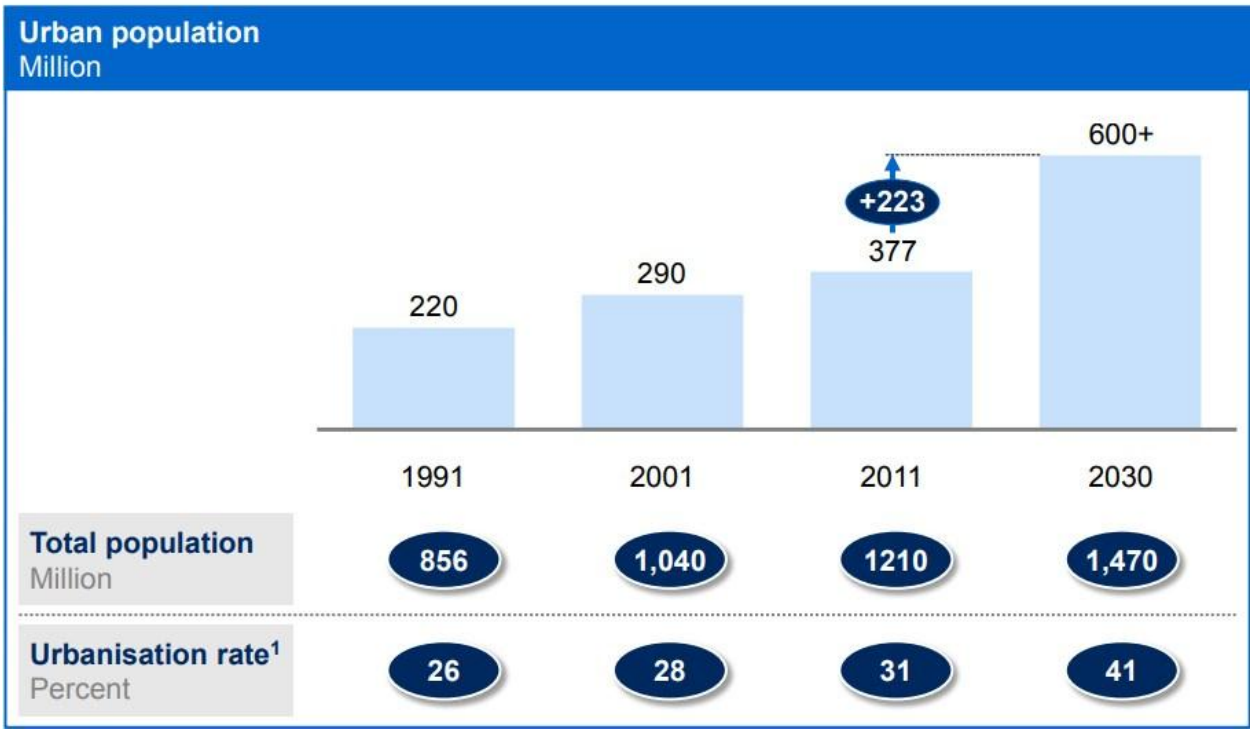
Mckinsey's Jonathan Woetzel had mentioned that the pace of Indian urbanization is 3,000 times the impact of the UK industrial revolution, where it is taking about 10-15 years to double income of a billion people. He says,

"That means we are moving 10 times faster with 300 times as many people. So, 3,000 times the impact. This is a revolution—an asteroid hitting the planet."

Here are couple of images that throw light on this increasing rate and growth potential:



Cities are likely to house 40 percent of India's population by 2030



With that in mind, in the first round of the smart city mission, 20 cities were named including Kochi, Ahmedabad, Aurangabad, Ponneri, Tumkur, etc., with 80 more in line. Consulting companies such as CRISIL, KPMG, McKinsey and 34 other firms will prepare action plans for 88 of these proposed cities, under the supervision of urban local bodies and state governments.
From a funding and financial perspective, many of these cities will have special investment regions/economic zones with modified regulations and tax structures to attract foreign investment. Options such as public private partnerships, various central and state government schemes are also looked at. Ex: The Japan International Cooperation Agency (JICA) is already funding the national river conservation project.

The Urban Development Ministry will be allocating Rs 100 crore to each city over the next five years, wherein it has already released Rs 2 cr per Mission city for the preparation of its 'Smart City' Plans. The Centre has set aside Rs 48,000 crore for the Mission with urban local bodies receiving them at frequent intervals in the next five years, and the State is expected to make a matching contribution to total to an estimated Rs 96,000 crore.

Let's now look at the city of Pune as an example, which has 14 projects to get set for its Smart City plan.

- Pune Municipal Corporation (PMC) is issuing bonds for the first time to aid development programs
- "2,800 crore water project is expected to be implemented over the next five years, wherein every household in the city will have uninterrupted water supply
- Around 1,750 busses fitted with a GPS tracking system and a pilot health monitoring system is operational on 30 buses
- Incorporation of citizen designs in roads, junctions and parks under 'Make Your City SMART' project, with the current pilot model tried out in its affluent suburb Aundh

Under the smart city vision, the Smart City Development Corporation Limited (SCDCL) has also launched India's first 'Interoperable Smart Card', which will be a single payment card for various transport modes across the city.

Real-estate giant Lodha Group's MD, Abhishek Lodha, had remarked, "Over the next ten years, India is projected to move from a $2.2 trillion economy to twice that; all the growth sectors will need space to do business."

As for Australia, major strategic plans and leadership support has had a significant change in the past two years, with smart councils driving the momentum. Right from climate change, smart energy, transport/mobility, to affordable housing, healthcare, education, etc., several things need to be addressed, and the National Smart City Plan launched in 2016 is having an instrumental role in this vision.

Cities such as Townsville, Launceston and Western City have made their entry into this vision, and Smart Communities and Suburbs program are providing necessary smart city plans and projects to up the ante. One of the issue that has been pointed of course is 2% of national taxes reaching the cities, with 85% going to the federal government, and 13% to the states. However, Australian cities are catching up with the rest of the world. The Government's Smart Cities and Suburbs Program is infact providing $50 million grant for innovative tech solutions to urban challenges. Let's look at some examples:

Ex1: A two-year trial of driverless shuttle bus sees its launch in Sydney Olympic Park recently, with a view to bring in AV to the roads, and reduce number of road deaths, as 90% of crashes are due to human error.

Roads Minister Melinda Pavey had commented, "Sydney still needs a good efficient road work system that can use driverless cars that can have public transport and that can deal with the population growth that we're expecting."

Ex2: Joondalup in Western Australia has now the vision of becoming one of Australia's most innovative and liveable cities. With Telstra's help, it now uses sensor based real-time data, helping the city officials monitor efficiently, tracking bins that need emptying, whilst having a tab on few environmental information.

https://youtu.be/Hgzm8EF6Ezc

Ex3: A world-leading concept on smart waste removal has been set up in Sunshine Coast Council, wherein automatic waste collection works itself through an intricate system of underground pipes to a waste collection facility, using airflow at a speed of 70 kmph, replacing street bins with waste inlets.

Angus Taylor, Assistant Minister for Cities and Digital Transformation had said, "There is a great appetite for innovation within local councils, who are at the forefront of smart city initiatives."

Conclusion:

Implementation of Smart City concepts along with its sub-niches has its set of challenges. A successful implementation requires the complete support of residents, businessmen and tourists, along with an enabling governance to actively involve in energy saving, utilizing new technologies, and other related measures.

On one end, a handle on addressing the technical and regulatory issues, will be key to determine the success, as questions on privacy and security could otherwise mire the potential of many of these apps.

Mckinsey in its IoT report further draws attention to the need for political consensus to support these IoT apps, as many will draw heavily on investment of public funds. This requires an uncompromising vision for sustainable, mutual growth. Example - installation of adaptive traffic-control systems that

changes traffic lights using sensor data will require motivated political personnel to implement the feature in the cities.

Also, in the ITS segment for instance, all the vehicles across roadways, railways and airways are capital goods with long-term life. The need for newer or upgraded vehicles and equipments to be compatible with IoT tech will play a crucial role in the adoption of IoT. Mckinsey estimates a 40-50% replacement of the equipments in use today. Further, constant connectivity over long distances be it land, sea or air also becomes essential, along with the availability of advanced tech such as sensors at lower-cost and the ability to interpret data.

If these are resource end challenges, at the other end, whilst making residential, commercial and public spaces sustainable might have great rewards, realising its maximum benefit and optimising total energy also rests with how well aware the end users are and their behaviour.

Goal has been set and work is underway, growing in tandem with innovations, investments and initiatives. This rising interest from all quarters for a smart development could as well be the right trigger to create rippling effects of smartness for a smart world. One key takeaway is for everyone concerned to be relentless in the smart vision, so as to have long lasting benefits in the years to come.

Phone: +612 8387 5901 | Email: info@tat.capital | Website: www.tat.capital
Address: Level 14, Suite 1403, Spring Street, Sydney, NSW 2000, Australia