piserve

Smart Cities - Shaping Towards an Awesome Future

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Smart Cities - A glimpse into a smart future

A ‘Smart City’ is a future-focused urban framework bringing forth solutions to every aspect of urban life, with the help of a connected infrastructure.

It uses data, digital tools and human-centered design to create a great experience for its residents, as well as help with city-level decision making.

The world around us is going digital. Enterprises, organizations, and even your neighborhood mom-and-pop shop are trying their best to catch up to the latest thing in tech right now. They are all incorporating tech into their goals, potential (and current) revenue streams, and their day-to-day operations. Everything around us is progressing at a lightning-fast pace, with unheard-of prospects like commercial space travel being around the corner, thanks to companies like SpaceX and Blue Origin. We have devised new financial systems with cryptocurrencies, and NFTs (Non-Fungible Tokens) have paved the way for what ownership and digital assets would look like in the near future.

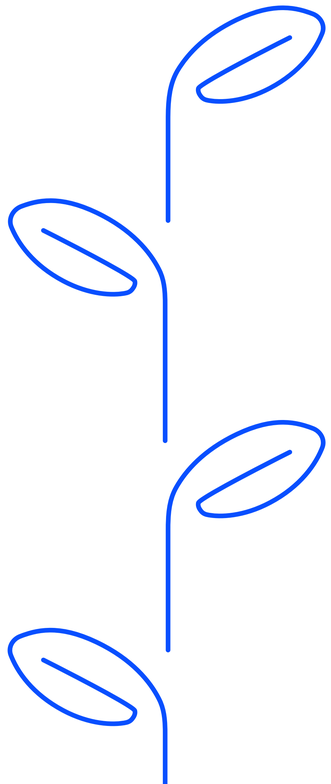
Cities though, with their limited budgets, see the process of digitization as a real uphill task. The onset of the COVID-19 pandemic exposed the fault-lines caused by their inability to progress, with businesses faltering and medical facilities being stretched to their limits. They also exposed the fragility of urban digital infrastructure, causing urban planners to urgently bring this discussion of digital modernization to the forefront. This shift towards technology and innovation has transformed the way people live and work, and has consequently transformed their behaviors and expectations. It has become imperative that cities have better social, environmental, and economic goals.

1. A glimpse into a smart future

To achieve this, businesses and Governments must work hand-in-hand, and must move towards creating smart cities.

According to Statista, global revenue from Smart City projects is estimated to be over 129 billion USD in 2021, with the United States taking the lead. With over3.47 billion 5G subscribers worldwide and increasingly larger investments in technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data, the prospect of smart cities continues to grow.

The United Nations broadly holds 5 categories for its sustainable development goals (SDGs) for cities: People, Planet, Peace, Prosperity, and Partnerships. City planning bodies today make sure to incorporate these into their goals, focusing on maximizing the welfare of its people.



% of cities including SDGs in their plans:

Prosperity

Ensure prosperous and fulfilling lives in harmony with nature

- Decent work and economic growth - **86%**
- Industry, innovation, and infrastructure - **79%**
- Sustainable cities and communities - **78%**
- Affordable and clean energy - **72%**
- Reduced inequalities - **60%**

Peace

Foster peaceful, just and inclusive societies

- Peace and justice strong institutions - **78%**

Partnerships

Revitalize global partnerships for global development

- Partnerships for the goals - **71%**

Planet

Protect natural resources for future generations

- Life on land - **83%**
- Life below water - **77%**
- Responsible consumption and production - **69%**
- Climate action - **64%**
- Clean water and sanitation - **78%**

People

End poverty and hunger in all forms and ensure dignity and equality

- No poverty - **91%**
- Quality education - **86%**
- Gender equality - **77%**
- Zero hunger - **75%**
- Good health and well-being - **89%**

Cities like New York, Barcelona, Paris, Copenhagen, Pune, Seoul, and Busan are great examples of established cities turning ‘smart’. It is important to know just what it is that makes these cities ‘smart’, and how they make the lives of the people living in them easier.

2

Smarter cities - Need them or want them?

By 2045, around 65% of the world's population will be living in cities, with 1.3 million people moving in each day and making the cities livable is the next big challenge in front of city planners.

Innovation never stops; new technologies are invented and discovered almost every day. While many of them may be in their nascent or even abstract stages, the likelihood of such technologies taking center stage is inevitable. Cities and their governing bodies need to be prepared to accommodate for leaps in technological evolution, and take steps towards modernizing themselves.

A few decades ago, only 20 cities had a population of over a million. Today, that number has grown 25 times over, with no signs of it stopping.

As the number of cities and the population within them grows, their economic, political, and technological requirements inflate. Economically, cities are hubs for a globalized world. With the sustained surge in new technologies, cities are beginning to find new ways to improve their operations and develop. Politically, a major shift in influence is visible, with many progressive ideas making a foray. But – just as Spiderman's Uncle Ben once wisely said – with great power comes great responsibility.

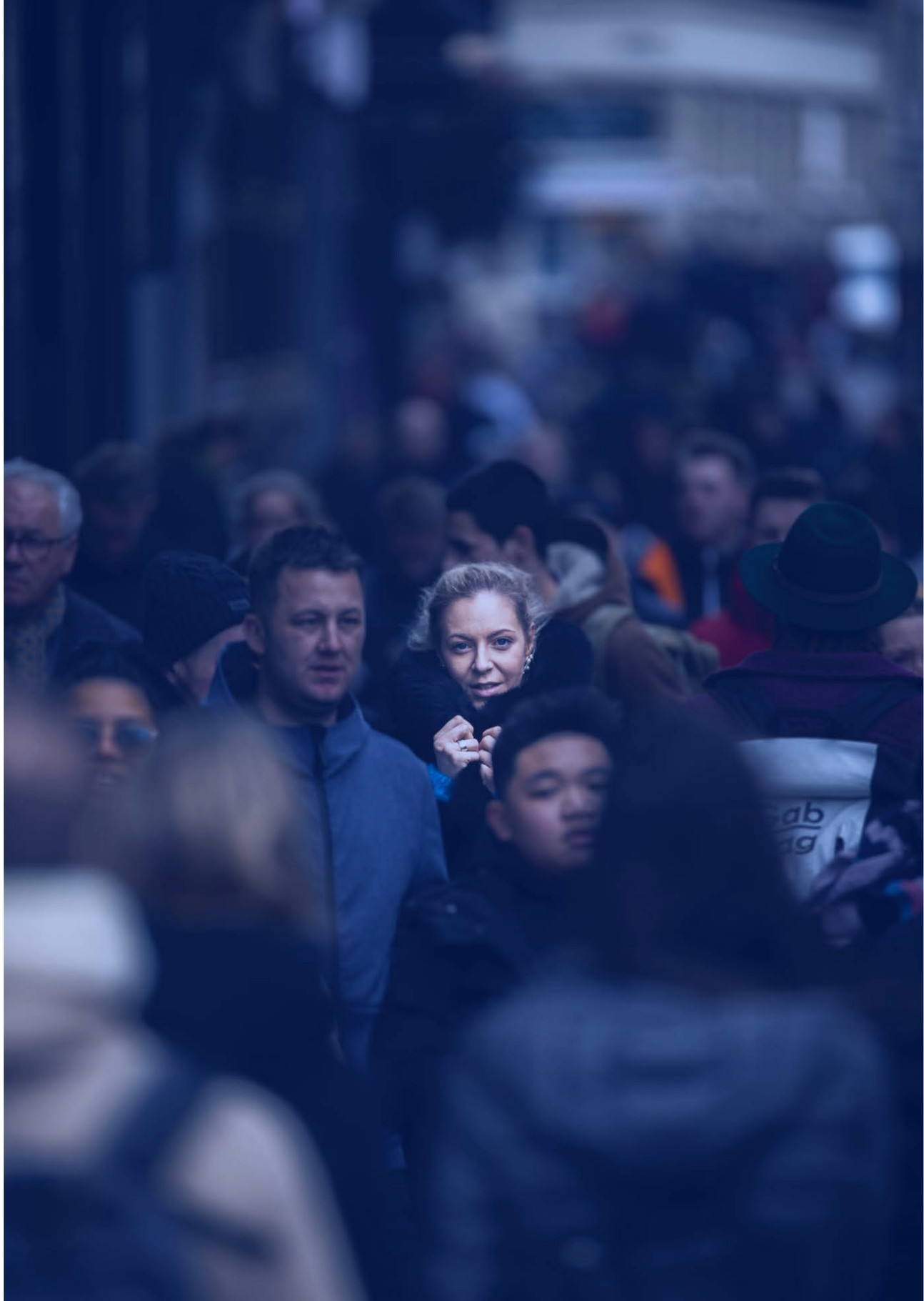
A city's plans are laid out after taking into consideration a host of complex and intertwined networks, infrastructures and environments. A city's plan must include its various stakeholders (citizens, businesses, transportation systems, communication networks, water works, and energy supply) in its decisions, to best benefit its inhabitants. City authorities take care of its day-to-day operational activities, and ensure citizens. They coordinate work across many departments, allocate funds towards public upkeep, and plan ahead to advance the city, among many other duties. City authorities mete out welfare

2. Smarter cities - Need them or want them?

programs to improve the quality of life of its citizens, providing public health, education, and safety. It is also the city authority's job to create an ecosystem encouraging local business progress, while minimizing its impact on the environment. Water and energy and its supply are of utmost importance to cities to foster social and economic growth.

These systems show a symbiotic connection, and can be effectively used to improve a city's performance and efficiency across many parameters. However, they are now vulnerable to significant sustainability challenges and threats to their operations. Here are a few short examples to illustrate this. With populations increasing, traffic management has become a headache; Water resources in a city are prone to leakage, pollution, and theft; Air pollution is a growing concern in the cities, owing to an increase in floating particulate matter. When it comes to meeting energy requirements, the current systems employed are questionable at best, and detrimental to ecological systems at worst.

As cities face these significant challenges, they must find ways to work more efficiently, with the use of modern technologies. By acting now, city authorities across the world can make use of fewer resources and yield outputs. And so the age of smart cities dawns.



3

Smart Cities - An ideal model

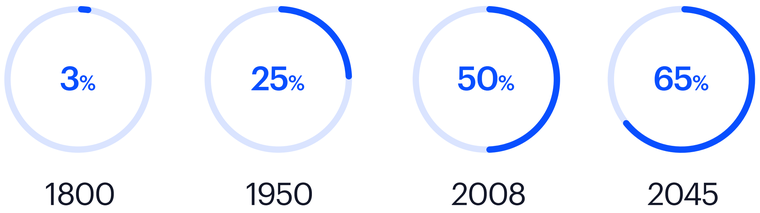
A city becomes ‘smart’ when it significantly invests in human and social capital, better quality infrastructure, and in disruptive technologies, to fuel sustainable economic growth and improve the lifestyles of its people. With judicious natural resource management and governance, cities can turn into more efficient, ‘smarter’ ones.

Goals of Smart Cities

- Economic Growth
- Quality of life
- Carbon footprint
- Sustainability

According to UN reports, in the 1800s, only 3% of the world's population lived in the cities. However, around half the world’s population moved into cities by 2008. By 2045, it is expected that 65% of the world's population will be living in cities, with 1.3 million people moving in each day. As the population is rapidly on the rise, authorities are now on the path to make a smooth, free-flowing lifestyle for its citizens, seamlessly blurring the urban-rural divide.

Percentage of world population living in cities



As of 2021/2022, there are 21 megacities in the world, each with a population of over 10 million. Tokyo leads the list with a population of 36 million.

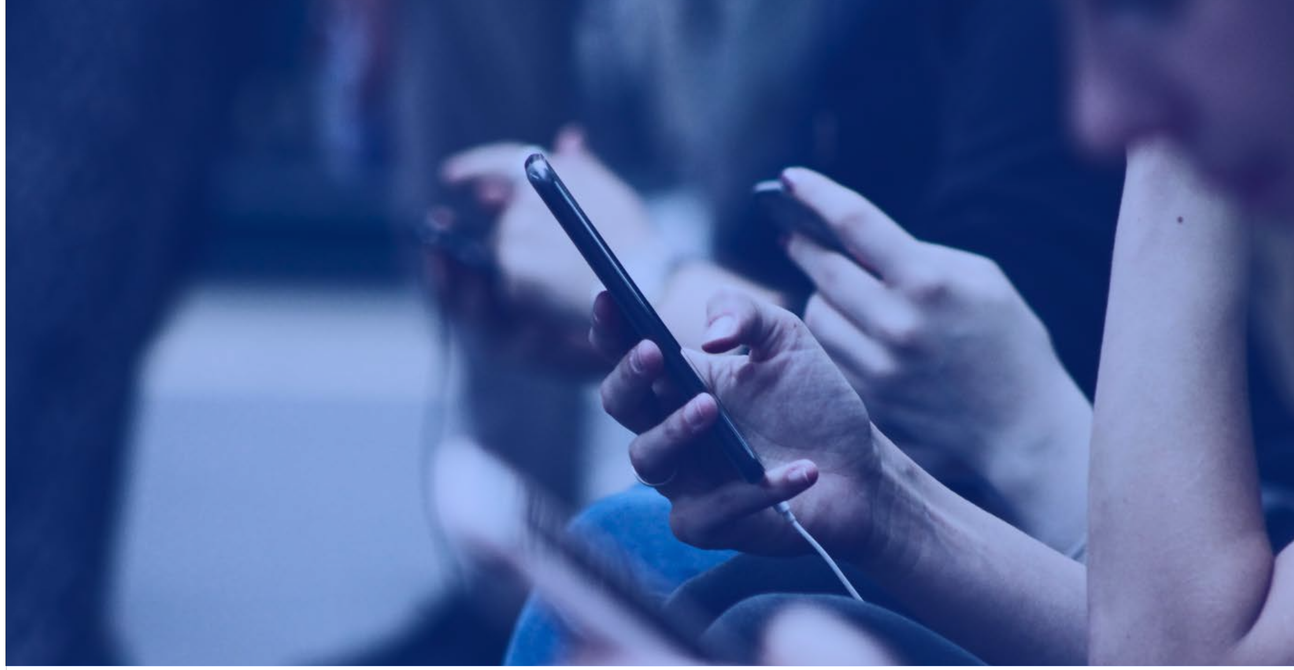
What makes a ‘Smart City’?

The core element of a smart city is that they leverage data and the latest in digital technologies to make better decisions and enrich the lives of its citizens. Real-time data allows authorities to keep track of how citizens behave,

understand their changing demands, and respond with fast, low-cost solutions.

A smart city can be said to consist of 3 layers. First comes the technology base, which consists of a network of smartphones and sensors connected to the internet. Next comes the specific applications and softwares designed to translate the raw data into alerts, insight, and plans of action. This layer requires the right tools, which can be fulfilled by service providers and app developers. The final layer consists of cities, companies, and the larger public.

Smart Cities succeed only when their underlying technologies and applications are widely accepted by the general public.



The general public must find it safe and convenient to use the transit, efficiently use energy and water, and make good use of the city's infrastructure and system, while actively engaging with the city’s technologies.

Let's take a quick glance at how smart cities make way for a better quality of life. Various sensors, applications, data analytics, and fast internet allow city authorities to track water and energy consumption. Moreover, a judicious distribution of these resources becomes feasible with the use of technology. Also, with efficient technologies, pollution can be kept under check, making way for improved air quality. When it comes to traffic, authorities can use intelligent traffic management software and make way for a smooth flow of vehicles. Lastly, the healthcare sector works well and is better managed, and as a consequence of these improved living standards, crime rates would come down.

4

Inter-operable cities

For various cities across the globe, becoming a smart city is a goal far from being realized. The journey is a long one, with many serious decisions to make. These include the choice of technologies and the vendors to work with. These choices become crucial in what they try to achieve along the road.

A lack of standards and no synchronicity across city facilities remain to be the biggest hindrance to the development of smart cities. Meanwhile, constant progress and increasing recognition for the need for cities by citizens, vendors, and other stakeholders is good news. By creating ecosystems and tackling problems collectively, interoperability becomes feasible.

Inter-operable cities are:

Let's have a look at why we need interoperable cities. Multiple sensors gather data to assess air quality in parts of the city at specific times. You can take measures to control the vehicles in an area and curb pollution.

Smart lighting systems reduce energy consumption, resulting in a reduction in energy costs by illuminating when and where needed. Smart traffic systems reduce congestion while waste systems identify when to empty waste bins and in which area have the bins filled faster. Together, they act as a single system, making way for proper route and waste management.

Civic bodies are now adopting digital technologies, making it easier to streamline their operations. This saves further operation costs. while making it easier for citizens to access services. A few modern cities closely collaborate with their citizens to co-create a city where they too are a part of decision-making. In a utopian world, cities would have a proper strategy to address both immediate priorities and a holistic vision for the future.

However, in reality, a range of factors act as hindrances. Budgetary and funding issues are key pressing issues for cities. Whether it's to improve air quality or to make the city safer, a proper budget is required.

Cities use 60-80% of the world energy use.

By taking an open approach, civic bodies have the power to navigate around various potential issues. This allows the city to add smart applications with ease. This open approach allows data from connected infrastructures to have a smooth exchange, without any major technological logjams. This creates a more holistic picture of the city and opens up new opportunities. Moreover, cities can scale projects with fewer hardships.

This creates a more holistic picture of the city and opens up new opportunities. Moreover, cities can scale projects with fewer hardships. An open approach to smart cities allows each element to work together, increasing their collective power. Let's take an example of how this integrated approach works. A city collects data from the traffic department. The city planners identify areas where more accidents are seen to occur. Now, they can coordinate with the lighting department and focus on increasing visibility in those areas. The city council can also dispatch and keep more emergency units in those areas ready, in the event of an accident.

5

Smart Buildings – Sustainable and personalized experiences

With the advent of new technologies, buildings too have become smart. They are more efficient, more productive, healthier, and more comfortable to be in, while catering to the personalized requirements of its residents. Since buildings are an integral part of smart cities, smart buildings can create a sustainable future for cities and the planet at large.

What's 'Smart' about these buildings?

Smart buildings use a variety of technologies and tools to save energy, reduce waste, and increase efficiency while maximizing its residents' comfort and personalization. With technologies like the Internet of Things (IoT) comes embedded sensors, cloud technologies, data analytics, LED lights syncing to the internet, and smart security. Lights automatically turn on when you step into the room and turn off when you step out

off when you step out improving energy savings. The same can be seen with water consumption, when using similar technologies. Additionally, smart buildings have higher security and intruder detection systems. The data collected from IoT-powered sensors come in handy when managing the lighting, building security, parking, heating, resource scheduling, and more. However, the true power of smart buildings comes when each tower shares data with one another. Siloed building systems incur significant operational inefficiencies as they lack interoperability, and are unable to perform various functions within a building.

Interestingly, building owners now look at bringing all towers under an umbrella network. When once-independent buildings share their historical and real-time data along with insights, building owners can take their efficiency to new heights. Personalized experiences that make workspaces more comfortable and productive for employees would then become a possibility.

Building owners leverage cutting-edge technologies to reduce energy usage and costs while lowering their overall carbon footprint. Green buildings give an employee-friendly vibe, with companies reporting reduced employee absenteeism and lesser operating costs. As for the employees, they feel healthier and more productive.

5. Smart Buildings – Sustainable and personalized experiences

According to one of the world's leading newswire networks, GlobeNewsWire, the global smart building market is forecasted to grow from $49.28 billion in 2019 to $127.09 billion by 2027.

Smart Building Management

Smart buildings let employees personalize the lighting and temperature at their workspaces, while providing building managers with real-time data on all operations and activities in the building. This data and its insights help the building managers maximize operational efficiency, while reducing their carbon footprint and energy consumption. This is ideal for managers, helping them streamline their maintenance operations.

Remote Building Management

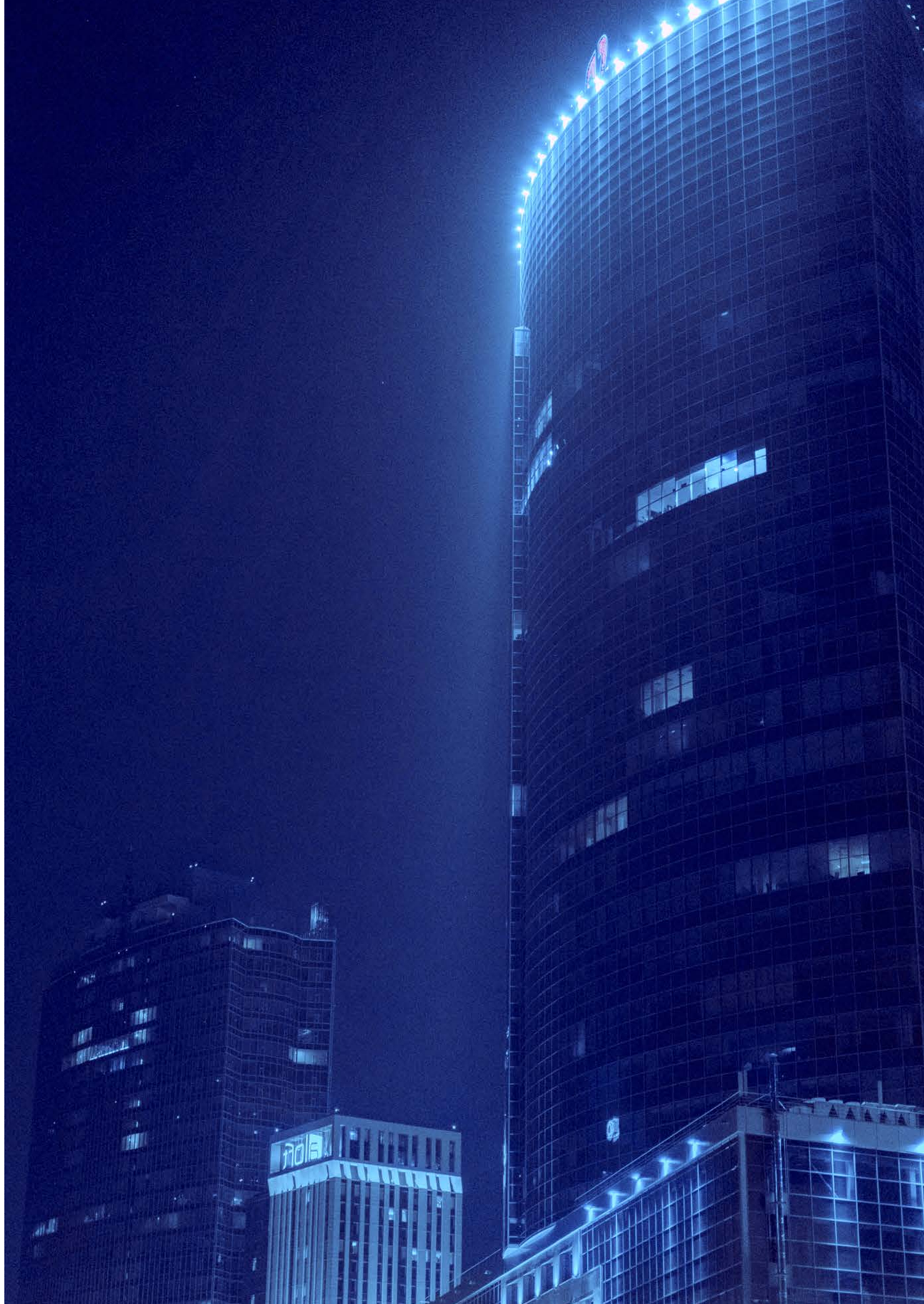
COVID-19 showcased to the world the importance of remote management technologies. A connected building management system (BMS) allows off-site engineers to receive alerts like water leaks and fire crises via sensors or track security risks through video feeds. A remote manager can analyze, assess the situation, and even fix these issues from their seats.

5. Smart Buildings – Sustainable and personalized experiences

BMSs let building owners access real-time analytics of energy consumption. Thus, a business owner can have a predictive graph of energy usage, detect ways to save them, and make budgetary adjustments.

Flexible, smart workplace

Not everything can turn virtual. A few service-based industries like retail, hospitality, hairdressing, cafes, gyms, etc., need to continue their operations in brick-and-mortar stores. However, smart buildings give them flexibility, allowing them to develop omnichannel experiences for their customers.



6

Challenges & how to overcome them

An increasing number of cities are showing an interest in joining and becoming one among the world's leading smart cities. However, this achievement doesn't come without tackling a few major challenges. Complex strategies and mapping them out, lay out the obstacles needed to be overcome. The involvement of the public, stakeholders, service providers, vendors, and IT providers comes into the picture while listing these challenges. Let's have a look at the key challenges faced by city authorities:

- Disruption of the labor market
- Infrastructure Management
- Social Engagement and Inclusivity
- Privacy Concerns
- Political Differences

Disruption of the labor market

With more disruptive technologies being invented every day than ever before, various traditional jobs will be bound to disappear. This might cause unemployment on an unprecedented scale. With this happening, people need to explore new skills to remain employable, as new job roles would replace older ones.

As for cities, the key challenge is ensuring that this big shift is as smooth as possible. The authorities must be rapid in making the turn, as the unemployment rate can shoot up fast if not acted upon swiftly. With higher unemployment, the city soon runs out of money to address social challenges.

The swift growth of automation and robotics creates a lasting impact on the labor market. Companies, and building and machine owners reap the benefits of this computerization. Human labor becomes less important, resulting in lesser pressure to increase wages. As a result, inequalities between people increase unless the authorities take steps to balance them.

Authorities should focus on how to better integrate the contributions of its citizens in a highly automated world, by taking steps towards their upskilling and effective welfare programs.

6. Challenges & how to overcome them

Infrastructure management

To make the lives of citizens better, the city council uses smart technologies and sensors to collect data. From air quality to identifying black spots, all the information needed to improve well-being is available.

However, there are complex infrastructures that power and maintain these sensors. Various metropolitan areas face the challenges of traditional, old infrastructures. High-speed internet, transportation tunnels, and underground wiring are on the rise.

Fund allocation for new projects is limited and time-consuming. Meanwhile, citizens might find installing new sensors mildly frustrating. The effective execution of a smart city's plans rely on Public-Private Partnerships. Councils should use the cost-efficient measures put forth by Private companies in smart city projects, to reduce the burden of expenses, as well as incorporate ways by which it can educate citizens on the benefits they would receive upon progressing towards a smarter city.

Social engagement & inclusivity

Although smart cities make the lives of citizens better, gaining acceptance and including everyone is not easy. Not everyone is digital-savvy. A group might find it hard to adapt to modern digital technologies and equipment. Citizens need to

benefits of smart cities and their true potential. People in general are resistant to change, but the key to success is educating them the need for smart cities.

This can only work when the public is aware of the changes they would see in their lives and confident enough to know that their rights and privacy will be respected while implementing said changes. Authorities should build awareness campaigns with private companies, as well hold town halls to know what their citizens' thoughts and insights are on the push for a smart city.

Privacy concerns

Digitalization is at the core of smart cities. Smart cities will store a huge volume of data digitally and oversee the internet connectivity of a multitude of physical devices. While this digitalization has its perks, it can have an adverse effect on the privacy of the citizens.

Digital systems influence almost all aspects of our lives, with our personal data stored somewhere digitally. Be it our shopping history, the films we watch on Netflix, or our health records, each of our activities have a digital footprint on the cloud. Threats to digital storage come from two fronts. First is the threat of attackers hacking digital systems, resulting in unauthorized access to personal data. The second threat is businesses using data analytics to govern someone's lifestyle, habits, and more. It's an alarming fact that businesses might know more about a person than they know about themselves.

The Internet of Things (IoT) opens a whole new world of possibilities. With all kinds of machines connected, the role of human intervention becomes less. Even though the technology boosts productivity, it has its cons.

Steps to safeguard a citizen's online footprint need to be taken to overcome this obstacle. This has to be done at a legislative level, with the implementation of base standards for privacy and security, as well as forging partnerships of trust with companies that enjoy goodwill from the public. Digital literacy is another step that is to be taken to reduce the odds of citizens falling for phishing schemes – a big detractor today, preventing digital progress.

The world creates more data in every two days than the entire human history had up to 2003.

Political differences

The prevailing political climate always plays a significant role in city planning. The intricate and complex dynamics of politics is one of the major challenges that hinder smart city initiatives. Large-scale projects face risks in raising funds from multiple stakeholders. The funding of such projects exposes it to interest from the national, state, and local levels, as well as private enterprises. A perfect situation where politics can lead to conflicts of interest.

Political cycles can have a lasting impact on projects. If there is a change in the establishment before the project's completion, there is renewed scrutiny from the new people in power, resulting in delays and project complexities.

Smart city projects need strategies that span across administrations, policy changes, and funding schemes. They need lock-in periods, ensuring a smooth implementation, irrespective of political transitions. Projects of this nature should be as far from populist tampering as they can be, with the creation of separate bodies with no political biases for their implementation.

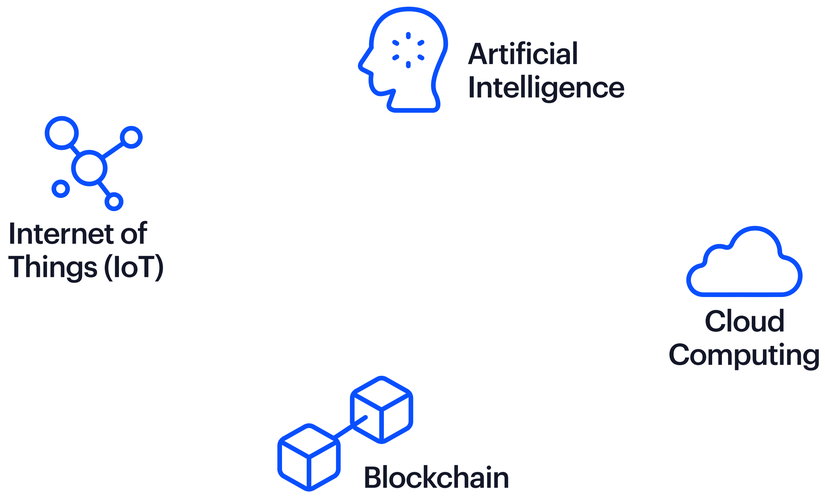
6. Challenges & how to overcome them

7

The technologies

Technologies are an undeniable part of the new era, paving the way for a smooth, connected way of living. Similarly, technologies are the building block of turning cities into future-ready, smart ones.

Disruptive technologies for Smart Cities:



Internet of Things

The Internet of Things (IoT) is the nervous system of smart cities. Simply put, IoT is a collection of interconnected electronic devices that communicate with each other, be it smart lights, cars, traffic systems, or others. They consist of sensors that collect data and share it with a central system. All smart city solutions have IoT as the base, where electronic devices communicate with each other.

Cloud Computing

The data collected by the IoT sensors need a storage facility. Instead of storing them in their own computing infrastructure or data centers, the civic authorities can rent a space for storing the data in a remote center, over the internet – in a cloud. In simple terms, cloud computing is the on-demand delivery of IT resources over the internet as and when needed, instead of owning and maintaining specific hardware. One key benefit is the lower upfront cost and doing away with the trouble of owning and maintaining your own hardware.

Artificial Intelligence

Smart city projects collect a huge volume of data collection via sensors. However, this data is of no use without proper analysis. Here is where Artificial Intelligence (AI) comes in. Simply put, AI makes sense of the data collected, facilitating machine-to-

machine interaction. Let's take a simple example. AI studies the data collected from the traffic department to identify the rush hours in a city.

Blockchain

Blockchain applications are relatively new to the smart city picture. The technology is crucial as it secures data flow, boosting the city's security and transparency. Blockchain facilitates smart contracts, making billing, transaction processing, and facilities management easier and more secure. For example, blockchain is ideal for making transactions, as one cannot alter the records, preventing corruption. Additionally, some concepts of energy sharing use blockchain in their smart grids. No corrupt practices get past blockchain technology.

Other technologies

While we went through the primary technologies used in a smart city, they are not the only ones. There are various technologies that go into building a smart city. These include Machine Learning (ML), Big Data, Geospatial Technology, Computer Vision, Drones, etc.

A smart city is the collective working of various technologies complementing each other.

8

Smart City solutions

Cities become efficient by tackling a multitude of smaller problems with ease. With a plethora of technologies at their disposal, city authorities can use them to address the problems of the public, more efficiently than they do today. Let's have a look at some of the many solutions to conventional issues seen in a smart city.

Smart street lighting

The importance of well-lit streets needs no mention. However, traditional lighting systems have their list of flaws, with the most glaring one being how wasteful they can be, staying switched on irrespective of the number of people or vehicles on the street. Smart lighting solves this issue by being far more judicious with energy usage, consequently making streets efficiently lit and safer for pedestrians and motorists. Sensors detect the presence and movement of people and vehicles and accordingly trigger the street lights to turn brighter. When there is far less movement and activity, the lights go dim. The lamps consume far less energy compared to traditional lighting systems. Moreover, the lights' sensors can detect traffic and set illumination priorities for emergency vehicles.

More cities are now adopting smart lighting, over conventional street lighting. Copenhagen plans to become the first carbon-neutral capital worldwide by 2025, employing a host of smart solutions to tackle it, including smart lighting.

Smart traffic control

According to the World Bank, over 55% of the world's people live in cities. With populations increasing and vehicle usage skyrocketing, traffic jams are bound to go up in the coming years.

Traffic jams are and will remain to be a big concern for city planners as its management is no piece of cake. We can expect more blocks and an increase in air pollution in the coming years. That is, if no smart solution is deployed for its redressal.

IoT-enabled sensors can capture real-time data of the volume and timing of traffic across the city. Along with GPS (global positioning system), traffic authorities can identify the exact location of traffic. With AI steering vehicles, the central traffic control unit can analyze the data to direct traffic lights and signals to ease jams.

Clubbed with technologies like smart lighting solutions, traffic management becomes much easier. It can also save more energy, while making the city a safer place. Cities like Barcelona, Cambridge, and Copenhagen boast proven examples of these smart traffic solutions. The solutions include dynamic traffic forecasting and integrative ticketing to ease blocks.

Smart parking solutions

With the increasing number of vehicles in cities, demand for parking spaces has rapidly climbed. Finding an optimal parking solution has been a headache for city planners.

One possible solution is fitting IoT sensors at parking spots. They can identify if a vehicle has occupied a spot, and keep track of how many parking spots are available. These sensors transmit real-time data to drivers looking for spots. A driver can book a spot before parking their vehicle. This will then be unavailable to others.

This system optimizes the available parking space in a city by transmitting real-time data. As for drivers, they would find it easier to find parking slots, eliminating the need for driving around looking for a spot, and clogging up roads and streets.

IoT-enabled fire prevention

From wooden furnishings to wires and cables, inflammable objects surround us everywhere. Without proper fire prevention and detection systems, the risk of fire accidents and fatalities remains precarious. A truly smart system that can avert accidents, not just detect them, is thus required.

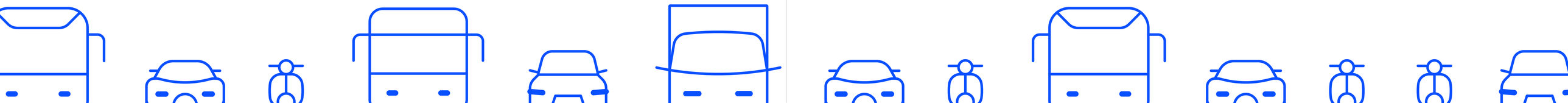
A possible solution for fire safety can be one which is IoT-enabled. Physical sensors are embedded into the floors, walls, and ceilings in closed areas like buildings. These sensors are then linked to a centralized node or gateway wirelessly. The data is then routed to a cloud-based application which keeps track of the occurrence or the likelihood of fires in many places at once. If one of the physical sensors detects smoke or a fire, the application sends out an alert to the place's owner as well as the fire department.

This not only allows for the timely detection of fires, but also sends out the required information to the fire department to better combat the issue at hand. A crucial part of this system's functioning is whether pieces of the system work and are online. The cloud-based application will allow users to keep track of the condition of their physical sensors, aswell as issues in the overall system, remotely.

Real-time upkeep of drainage systems

Supplying water with minimal leakage and treating and disposing of sewer water are two serious challenges that plague urban areas. Also, to efficiently overcome these challenges, it's important to maintain the machinery in top working condition and prevent their breakdown.

Physical sensors placed within major pipes and arterial connections, throughout the circulation route, can be used to monitor water pressure and the presence of foreign substances which can clog the pipes. If there is an unusual drop in the water pressure in one stretch of the pipeline, the system will be able to determine a possible sign of a leakage.

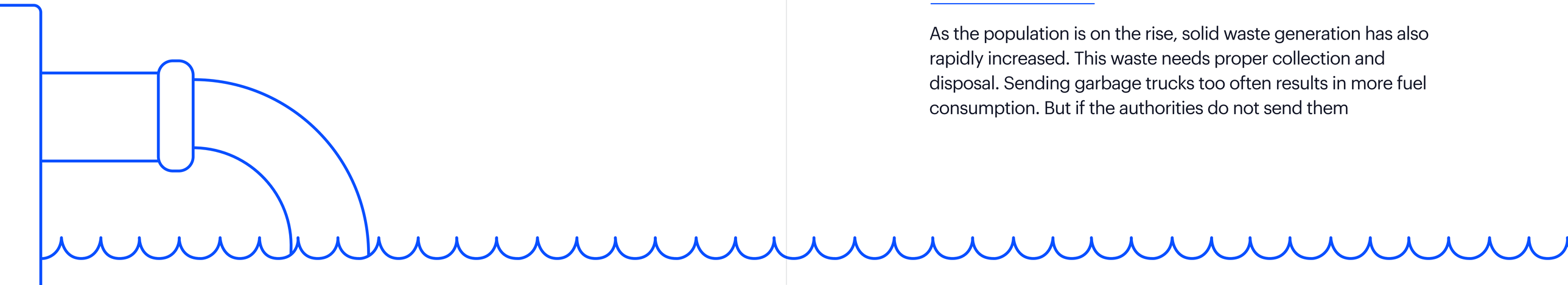


The system will only notify if there is a sustained drop in water pressure, irrespective of surges and dips in usage, making it easier for the Public Works Department to monitor and keep tabs on such instances on the fly. Combined with access to historical data, the system will also be able to perform predictive diagnosis of when a section of the system is bound to leak owing to wear and tear and usage patterns.

Swift updates on pollution levels

Desperate times call for desperate measures. Pollution of any kind threatens lives all across the globe. Traditional methods employed to track environmental degradation were a slow process, involving collecting samples and testing them. But with modern technologies, tracking, testing, and controlling pollution levels is more efficient than ever.

Companies and civic bodies already use physically-embedded sensors for a variety of purposes, ranging from particulate pollution monitoring to gauging noise levels. Many of these sensors though, do not provide real-time tracking, as well as remote redressal. The same physical sensors can be upgraded to newer ones connected to a central hub or gateway, feeding data into a cloud-powered app to monitor many areas at once, in real-time.



Peaks in pollution levels can trigger municipal authorities to resolve it urgently. Authorities can use these sensors to target large polluting actors and take a targeted approach to its resolution. This makes controlling adequate environmental conditions far more efficient.

Smart metering

The best way to control our energy consumption and conserve it is by efficiently metering it. An efficient way to track energy consumption is by implementing smart meters.

Smart meters can record electricity consumption in intervals of one hour or less and communicate this data to the utility company. This allows authorities to introduce dynamic pricing based on the season and the time of day and encourages citizens of smart cities to reduce their energy consumption, especially when demand is at a peak. Smart meters also provide data that help governing bodies monitor the health of the electric grid, restore service faster during outages, communicate information to customers on matters such as high usage alerts, and integrate distributed energy resources.

Smart waste collection

As the population is on the rise, solid waste generation has also rapidly increased. This waste needs proper collection and disposal. Sending garbage trucks too often results in more fuel consumption. But if the authorities do not send them

frequently enough, it results in waste accumulation. This waste accumulation can result in hygiene hazards.

Balancing between timely garbage collection and optimization of fuel consumption is easily possible with just-in-time waste collection, a regular feature of smart city solutions.

Instead of sending out garbage collection trucks at a fixed time, this solution relies on data. Sensors fitted on garbage cans transmit data to a centralized system. This data estimates when garbage containers are about to fill up. Using this data, trucks can schedule collection trips and stops. Additionally, we can merge historical and real-time data for future estimates.

Cutting down the number of stops and trips saves fuel costs and helps cities remain fuel-efficient, even while providing timely services.

Automating water for agriculture and municipal use

One of the leading urban challenges in the 21st century is efficient water consumption. While water plays a vital role in the survival of life forms, the major areas of consumption are agriculture and civic development. Agriculture uses over 70% of freshwater, while 60% of the remainder goes into urban landscape maintenance. In both instances, agribusiness companies often irrigate regardless of current conditions, risking overwatering.

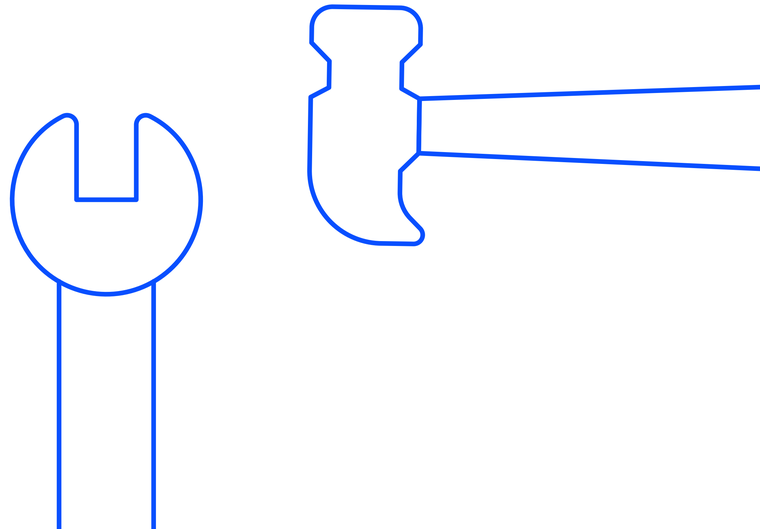
Civic bodies can deploy sensors that measure soil moisture, heat, humidity, and slope. This data is essential in understanding the watering needs of plants, and correspondingly regulating water supply. A centralized system would allow authorities to curb overuse, and increase water supply in areas seeing a deficit.

With every drop of water saved, we make way for a brighter future.

Predictive maintenance solutions

A stitch in time saves nine. So does predictive maintenance of waterworks, roads, street lights, and other infrastructure. By analyzing the data obtained via various sensors on smart devices, authorities understand when a pipe is just about to leak, when roads begin to tear, or when the lights are going out. By identifying these issues in the early stages, authorities can fix them, saving additional cost, time, and effort.

Some systems like electric grids can "heal" themselves by reducing human intervention if diagnosed soon enough.



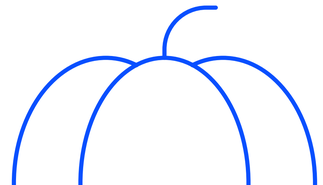
IoT for food supply chain management

Farmers often find it hard to monitor the conditions of their produce while gathering and transporting it. Additionally, over-harvesting or illegitimate harvesting can cause worry. Luckily, IoT has an efficient solution to this problem.

IoT-based sensors can help farmers monitor the temperature of their produce while shipping them to the market. This helps suppliers keep it fresh throughout the journey.

Besides keeping produce fresh till it hits the market, consumers can directly benefit from keeping track of the food supply chain. For example, tagging and tracking fish helps consumers understand its origin and if it has been sustainably sourced. Using technology in food management can promote healthy consumption habits, as well as add value to the producers. IoT sensors can be used to keep track of where goods are in the supply chain, and if they are in transit, it also allows for keeping tabs on their precise location and whereabouts.

Physical sensors can also be used to estimate the date and time of arrival of items being transported, better allowing businesses to calibrate their sales and turnover windows. Warehouses can be equipped with IoT-enabled sensors to monitor storage conditions, how near perishable goods are, and the state and size of unsold inventory. This helps businesses recalibrate repeat purchase orders and make more cost-effective decisions. In short, IoT helps farmers balance the food supply chain.



Robots for operations management

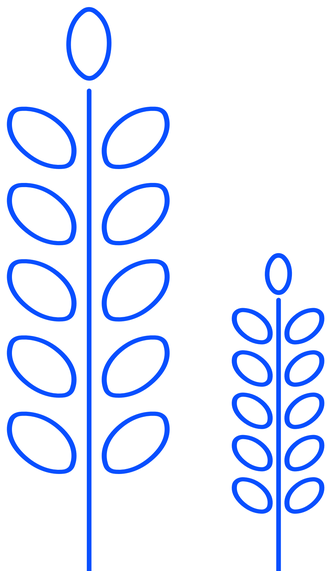
Robots are increasingly becoming a part of our daily lives. Name any sector, and chances are AI-powered bots play a crucial role. Self-driving cars, as well as fully autonomous public transport systems (such as a city's metro rail being manned by robots), would greatly reduce the operational load on the city authority's part, while also reducing transit time. Public park upkeep and maintenance can be handled by robots, with sweeper bots and trash-collecting robots operating throughout the day. Even a city's postal service can be handled by robots, from mail sorting and delivery route optimization, to last-mile delivery as well as returns. Autonomous vehicles and anthropomorphic robots make for an important piece in the puzzle that is improving a city's operational efficiency.

Warehouses and storage areas in department stores can be manned by autonomous robots, ensuring the speedy delivery of items, as well as effective management of inventory. Centralized systems will allow for inter-store communication, supplying data for keeping track of real-time consumption in different areas, making it easier to address demand surges.

Agriculture IoT

With the growing human population, the demand for innovative ways to boost agricultural output is high. As the need to fill

more stomachs rises, IoT plays a key in creating efficient solutions. IoT sensors can be used to identify features of the soil, including its water and nutrient content. This data gives farmers the ability to choose the type of crop that will provide the best yield for their soil type, as well as discern the amount of water and fertilizer required for the crops. Sensors connected to a cloud-based app can be used to identify weather conditions in nearby areas, and make predictive analyses in real-time to notify the farmers to prepare accordingly. Using historical data, these devices will also help farmers in finding the best time for planting crops and harvesting them. Farmers can use AI-powered apps to gauge the health of their crops, using pictures and live feeds.



Concluding Thoughts

The implementation of technology solutions in urban spaces represents a paradigm shift in the journey of a city towards being smart. Starting with implementing one smart solution, cities take a step towards adding to a technological spectacle, which will be visible in the years to come.

In the long run, data collected by various sensors becomes an integral part of bettering the everyday lives of citizens. Smart cities are an integral piece in the puzzle that is the progress of civilization. They represent a shift in societal operations, from a sectarian one to a truly global and inclusive community. They are the first step towards an inclusive, equitable, and technological society, one where people are given ample safety nets and comforts.

Small steps towards creating smart cities are sure to culminate towards the progress of human civilization.

Source for statistics - UN reports

PiServe specializes in building smart city solutions that leverage the latest technologies and data-driven insights to optimize urban infrastructure and enhance the quality of life. Our cutting-edge solutions utilize IoT, AI, and cloud computing to optimize urban infrastructure and enhance the quality of life. With our help, you can reduce energy consumption, improve public safety, and boost citizen engagement.

Transform your city with our smart city solutions!

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