



ROLE OF SMART CITIES FOR ECONOMIC DEVELOPMENT

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1. INTRODUCTION AND EXECUTIVE SUMMARY

1.1 ECONOMIC DEVELOPMENT AND SMART CITIES

Smart cities offer a wide range of benefits, from costs savings to livability, safety and security, resilience, and sustainability. However, the positive impact on economic development is another critical benefit, one which is not often mentioned and not well understood. It was only selected by 16% of respondents answering a poll question about the main benefit of smart city solutions in a webinar recently held by ABI Research. Economic development only came in fourth, after cost savings, livability, and safety and security. Only environmental benefits scored lower.

However, it is important to see economic development as a kind of “Uber” benefit, indirectly linked to cost savings, security, livability, and other factors that are conducive to attracting and maintaining economic activity within cities. In a way, economic development should be seen as sitting at the top of a hierarchy of benefits. On the other hand, economic criteria only represent “hard” benefits, not taking into account the many “soft” benefits related to citizen involvement, convenience, and overall satisfaction. Nevertheless, it

should be acknowledged that realizing soft benefits cannot be entirely disassociated from economic prosperity in the background as an overall condition for smart city development.

1.2 MAIN FINDINGS

The impact of smart city technologies on economic development and gross domestic product (GDP) growth in particular will materialize according to three dimensions or phases:

- **Open Data Policies:** Incremental GDP of close to US\$1 trillion over the next decade
- **Public Investments Multiplier Effect:** Incremental GDP of US\$10 trillion over the next decade
- **Structural Smart Urban Economy Growth:** Recurring, sustainable growth of 2.8% by 2026; 10 trillion incremental GDP generated in the next 10 years

1.3 RECOMMENDATIONS

A fine balance will need to be found between catering to economic needs, attracting businesses, and obtaining job growth *versus* considering the overall well-being of citizens and, in particular, the environmental impact. Another potential pitfall is the risk for extreme, cut-throat competition between cities to attract businesses and funding, which somewhat goes against the principle of sharing best practices and the aim to ultimately bring all cities to the same level of smartness and economic growth. Finally short-term quick wins will need to be balanced against long-term structural investments for sustainable growth.

From a practical point of view, cities need to start optimizing their smart cities strategies in view of the operationalization of these economic benefits based on detailed guidelines and checklist tools, which are listed here and described in detail in section 5:

- Define priorities and strategies based on an economic development strengths, weaknesses, opportunities, and threats (SWOT)
- Set up processes supporting frictionless interaction with supplier ecosystems
- Optimize based on economic variability according to regional and city size differences

1.4 THE RISE OF CITIES AS TECHNOLOGY, BUSINESS, AND POLITICAL CENTERS

Apart from the fact that an increasingly larger part of the global population will live in cities—from around 50% today to around 70% in 2050—the very role and importance of cities is also evolving fast:

- **Centers of Next-Generation Technology Deployments:** Deployments of almost all next-generation technologies are often exclusively targeted at urban environments driven by economic and return on investment (ROI) imperatives. Examples include 5G; low-power, wide-area (LPWA); roadside sensors; Internet of things (IoT), vehicle-to-Infrastructure (V2I), wireless EV charging, microgrids, and demand-response systems. Innovation is increasingly centered on UrbanTech and GovTech, which are drawing a growing interest from the venture capital (VC) community. Moreover, only cities offer the density and scale in which new technology-driven paradigms like the sharing economy and distributed energy and network topologies can be deployed and the efficiencies and economies of scale can be achieved.

Deployments of almost all next-generation technologies are often exclusively targeted at urban environments driven by economic and ROI imperatives

- **Growth Engines for the Economy of the Future:** Cities are increasingly responsible for an ever growing part of the economic output but at the same are also becoming the growth engines of the new smart economy of the future, closely linked to new technology-driven paradigms like the sharing, crowdsourced, and distributed economy. Blockchain-enabled smart contracts for eTrade and eFreight and crowdsourced and crowdfunded distributed renewable energy are just some examples of how smart cities are embracing the smart economy.
- **Centers of Growing Political Power:** Cities' emancipation from their former limited role of taking care of local operations is in full swing; they have begun addressing critical issues like sustainability and poverty and managing complex infrastructure. This coincides with growing political influence and power, either as a standalone entity or *via* associations between cities to avoid fragmentation. Increasingly the world is looking at cities as the only level of government which will be able to address the challenges of the future, with the local level increasingly replacing the national level. However, this increasing political power still has to result in wider access to tax revenues.

Obviously, these new roles are mutually reinforcing each other, with, for example, important spin-offs of technology deployments on economic activity. Similarly, the increasing political influence and power allow cities to engage in large-scale projects, thereby attracting both businesses and citizens. In some regions, cities are taking the lead in creating sustainable environments. At the same time, this kick-starts a green economy, attracting environmental technology players and investors and laying the foundations of future sustainable economic growth.

1.5 ECONOMIC INEQUALITY WITHIN AND COMPETITION BETWEEN CITIES

One of the major challenges international, national, and local governments are facing, is the growing inequality in terms of economic welfare and prosperity. This inequality manifests itself in two ways in the context of cities:

- **Inequality within Cities:** Most large cities contain poor and unsafe areas which are often excluded from the benefits of technology-fueled economic development. It is one of the key concerns of city governments to take care of all citizens and strive for a more level playing field through the digital and economic inclusion of disadvantaged minorities and communities. Initiatives like smart kiosks and public-private partnerships, whereby the benefits of the sharing economy are spread across entire city, are just some examples of how this can be accomplished. Cities can work with private ridesharing providers like Uber to guarantee new mobility offers are also available in remote suburbs, either through incentives like subsidies or overall win-win agreements benefiting both parties. Subsidizing new technologies and economic paradigms will save money as compared to building out rail or other public transport infrastructure.
- **Inequality between Cities:** A secondary effect of optimizing smart city approaches in view of stimulating economic activity is increasing competition between cities to attract businesses, often even involving favorable tax incentives and creating an overall favorable climate for enterprises, hereby creating imbalances in the growth across cities within countries. This especially impacts smaller cities which are often disadvantaged due to limited financial resources and a lack of technical or other expertise. On the other hand,

Subsidizing new technologies and economic paradigms will save money as compared to building out rail or other public transport infrastructure

coalitions between cities are starting to appear, pulling a larger number of cities into the economic benefits of smart city practices by sharing and replicating best practices and avoiding duplication of efforts. At the same time, it should be mentioned that a healthy level of competition between cities is actually beneficial for accelerating interest in and deployment of smart city paradigms.

1.6 THE OLD AND THE NEW ECONOMY: LEGACY *VERSUS* SMART BUSINESS

The traditional economy, centered on employment in the manufacturing and services industries by large enterprises, is starting to give way to new models aimed at increasing efficiencies, increasing utilization rates of assets, and creating more scalable approaches heavily linked to “as a service” shared, crowdsourced, and distributed models supporting new forms of (self-)employment and microbusinesses. This new smart economy is made possible by a range of technologies including IoT, artificial intelligence (AI), robotics and automation, ecommerce, and blockchain for micropayments and eGovernment, which collectively are in the process of not just reorganizing and restructuring the economy but actually transforming, redefining, and reinventing it. This is where the largest opportunity for smart cities resides in terms of stimulating technologies and sector innovation that will drive the creation of employment in the future.



2. CRITERIA AND CONDITIONS FOR ECONOMIC DEVELOPMENT IN SMART CITIES

The level of economic development and availability of employment in smart cities is directly related to the overall quality of life and citizen satisfaction. Hence, economic “health” is a key dimension of smart city policies, though one not often explicitly mentioned. It relates, directly or indirectly, to smart infrastructure for energy, office buildings, and transportation (road, railway, and air) but also to “soft” capabilities like smart health and smart funding. Ultimately, it comes down to businesses being able to operate at the lowest cost level, having access to reliable services and utilities, being able to conduct business efficiently (minimizing time lost in traffic congestion or bureaucratic processes), and having access to skilled workers and flexible financing. Ultimately, smart city technology will be a main contributing factor to the overall economic competitiveness of cities.

2.1 ECONOMIC GROWTH CRITERIA

While cities have always been centers of economic activity, the degree to which they can attract businesses and investments and create employment depends on the following key elements:

- **Business-Friendly Environment:** Favorable taxation, flexible financing, the absence of administrative burdens, and flexible regulation and legislation are determining factors for businesses to relocate to specific cities.
- **Innovation-Friendly Climate:** The presence of and access to research and development (R&D) facilities like innovation incubation centers, VC funding and risk capital, and partnerships with universities and research centers allows for the attraction of external and/or creating local startups. This can be clearly observed in the greater Boston area (MIT technology spin-offs) and Silicon Valley (Stanford), regions characterized by a large number of VC firms.

- **Education and the Availability of a Skilled Workforce:** High-quality schools across the entire spectrum of skills and industries is critical for many businesses, for which finding qualified employees is often the main barrier to expansion. In turn, this is linked to other smart city benefits like livability and cost of living, which attract citizens and employees.
- **Availability, Quality, and Affordability of Basic Services:** Flexible transportation; seamless mobility; available real estate for both offices and manufacturing plants; low-cost utilities like energy, water, gas, and communication; financial services; and accessible healthcare are critical for both business and their employees in terms of their impact on profitability and cost of living.
- **Safety, Security, Sustainability, and Political Stability:** While these criteria are not directly or immediately influencing economic activity or output, ultimately cities which are not able to maintain a safe, secure, clean, and stable environment will inevitably face an exodus of businesses and a decline in economic activity, something which was most recently observed in the city of Barcelona in the wake of political upheaval.

Few cities will be able to fulfill all criteria, some of which are to some extent even mutually exclusive; for example, cities benefitting from very strong economic growth will inevitably face growing security, poverty, and environmental challenges. However, cities which fall short in two or more of the above categories will struggle to maintain economic development. In fact, cost alone is resulting in many businesses relocating from California to Texas.

2.2 TECHNOLOGICAL DRIVERS FOR ECONOMIC GROWTH

While not all of the criteria mentioned in section 2.1 are exclusively linked to technology, it is increasingly obvious that smart city technology will be instrumental in creating a favorable business climate, especially in terms of reducing costs, making affordable utilities and services available, and improving security and resilience against catastrophes. Moreover, investment in technology itself has an indirect impact on economic growth in terms of the economic multiplier effect on employment and investment. Key smart city technologies driving economic development include:

- **Connectivity Platforms:** A range of connectivity technologies including 5G, fiber, LPWA, and vehicle-to-everything (V2X) allow important cost savings through smart grids, smart street lights, and smart bins, as well as enable safer transportation and improved health.
- **Sensors:** Both embedded and mobile sensors, in combination with connectivity, allow for the optimized use of assets through better access to real-time information, in addition to monitoring environmental metrics to control air and water quality.
- **Analytics:** Advanced analytics allow extracting actionable intelligence, from condition-based monitoring to advanced preventive and predictive maintenance, resulting in significant additional cost savings as well as the provision of reliable, uninterrupted services.
- **Open Data Platforms and Policies:** Unlocking the economic value of technological innovation is accelerated through standardized platforms, opening access to real-time data to an ecosystem of smart city suppliers developing a wide range of applications, holding the promise of creating a smart city revolution not unlike the social revolution created by the smartphone application paradigm. The mere availability of free, accurate, and real-time open data represents significant economic value in terms of efficiencies, innovation, and job creation.



Cities can play a key role beyond traditional economic development by redefining and restructuring the economy itself through the deployment or stimulation of new economic paradigms (e.g., smart contracts for trade, distributed microgrids for energy, and shared mobility for automotive and transportation)

3. THE NEW TECHNOLOGY-DRIVEN SMART URBAN ECONOMY

Cities can also play a key role beyond traditional economic development by redefining and restructuring the economy itself through the deployment or stimulation of new economic paradigms like smart contracts for trade, distributed microgrids for energy, and shared mobility for automotive and transportation. These new approaches are focused on achieving higher utilization rates of existing assets, unlocking value through new use cases, and achieving an overall step change in efficiency. This can result in the introduction of new growth engines for the economy of the future based on IoT, information technology (IT)/operational technology (OT) convergence, AI, blockchain, and other next-generation technologies. This represents the smart cities “end game.” This is how the smart cities conundrum of reconciling scalable, sustainable, and continued economic development will be able to be addressed.

3.1 A NEW URBAN ECONOMY

This section explores new economic paradigms related to on-demand services, asset sharing, decentralized production and manufacturing, trade automation, and new financial services. These new economies are interdependent, in many cases mutually reinforcing each other. Critically, the new economy can only flourish within dense urban environments enabling economies of scale and demand-response dynamics for optimizing sharing and distributed approaches. It comes down to the “power of the numbers” combined with advanced technology to achieve step changes in efficiency (and therefore dramatic drops in the cost of services) and unlock value through a large ecosystem of innovative startups and established enterprises.

In this way, technology not only impacts microeconomic parameters but also the economy on a macro level in terms of GDP growth, but not necessarily in terms of employment due to increasing automation and the deployment of AI. Ultimately, this will require new economic policies including concepts like universal income and self-employment.

From a regional perspective, this will allow for strong growth in developing regions, for example, by maintaining mobility and the continuous provision of utilities, while resuming the growth the old economy will ultimately no longer be able to support in developed regions.

- **Sharing Economy:** This is based on consumers and enterprises abandoning asset ownership and instead using pooled assets in a more efficient, “as a service” manner. It is aimed at displacing the current economy based on asset ownership and achieving step changes in asset utilization rates and lower associated costs. Examples include future driverless car sharing.
- **Peer-to-Peer Economy:** This can be seen as a special case of the sharing economy, the latter being organized through traditional corporations, while peer-to-peer models link consumers with each other directly, in a disintermediated way. Examples include car sharing as well as home and office space sharing. Other examples include parking space and electric vehicle (EV) charging station sharing. Peer-to-peer models are still based on private asset ownership. Consumers and small enterprises can also engage in peer-to-peer lending as well as investing in each other’s projects, practices explored by startups like MyBit.

- **Crowdsourced Economy:** Citizens can collectively contribute to information services (actively or passively), engage in city project crowd funding initiatives, and send back surplus energy locally generated through microgrids. This paradigm is closely linked to the distributed economy principle.
- **Service Economy:** The service economy is directly linked to offering shared assets as a service as a replacement for an economy based on asset ownership. In a more narrow meaning, the servitization paradigm relates to suppliers and vendors selling services linked to their physical products as a way to derive additional and incremental revenue streams. Examples include over-the-air (OTA) software updates and real-time cyber security monitoring.
- **On-Demand Economy:** The on-demand characteristic of many new services like near real-time delivery for eCommerce purchases (Amazon Prime's one-hour delivery guarantee), mobility-as-a-service, and eFreight are addressing a growing need for instant gratification within a real-time economy increasingly organized around offering services immediately whenever or wherever they are required. Accomplishing this necessitates fundamental changes in generating and sourcing assets and services as well as decentralized demand-response approaches.
- **Decentralized, Distributed Economy:** New industrial practices like microgrids and additive manufacturing hold the promise of moving to a more decentralized manufacturing and service delivery economy which will be critical for realizing on-demand and crowdsourcing models.
- **Autonomous and Intelligent Economy:** To fully realize many of the new economies outlined above, various forms of automation will be required, ranging from driverless cars to AI-driven, holistic demand-response energy networks.
- **Networked Economy:** This does not only refer to everything becoming connected but also verticals cooperating and leveraging market adjacencies driving further efficiencies across the transportation, energy, and buildings industries through IT/OT integration.
- **Green, Sustainable Economy:** The main objective is to organize the economy around sustainable and scalable practices such as recycling to achieve a net-zero ecological footprint. Cities are currently the largest polluters, but they hold the promise of becoming eco-oases due to their scale and density achieving very low ecofootprints per inhabitant.
- **Digital Economy:** Technologies like blockchain are also driving a revolution in trade and financing. Examples include the deployment of smart contracts and eFreight brokerage for eTrade, virtual currencies, and crowd- and peer-to-peer funding.

Clearly, these new economic paradigms are transforming every industry and vertical, allowing higher output at reduced costs as well offering a wide range of innovative services.

3.2 TECHNOLOGY REDEFINING ECONOMICS

The new urban economy paradigms outlined above are closely linked to next-generation technologies over and beyond the traditional “holy trinity” of connectivity, sensors, and analytics, though these are of course still foundational capabilities without which none of the economic paradigms could materialize. However, key technologies such as demand-response, AI, and blockchain will be needed to unlock the additional potential of the new economies.

Intelligence-driven automation will become the main engine for future economic growth, redefining, transforming, and revolutionizing the economy into a cognitive, self-governing entity

- **Smart Infrastructure 2.0:** Within a smart city context, smart platforms unlocking value from existing and new infrastructure *via* demand-response, closed loop, and holistic approaches leveraging cross-vertical synergies will bring unseen efficiency gains, cost reductions, and higher service reliability levels.
- **AI and Automation:** From driverless vehicles to passenger carrying drones, surveillance cameras, cyber security protection, and demand-response management, AI-based automation will be deployed across all verticals. Intelligence-driven automation will become the main engine for future economic growth, redefining, transforming, and revolutionizing the economy into a cognitive, self-governing entity.
- **Blockchain, eGovernment, and FinTech:** New financial instruments like distributed ledgers will be critical for organizing trusted interactions between an increasing number of actors in the new economies, especially when it relates to decentralized, disintermediated peer-to-peer transactions, meshed environments, and frictionless cross-vertical collaboration and commerce, which will require massive amounts of automated micropayments subject to dynamic pricing, often between physical systems to which identities will be assigned. Examples including wireless EV charging and driverless vehicle sharing. Blockchain will enable seamless participation of all citizens in a networked, all-in economy, driving innovation, unseen levels of activity, wealth, and growth. Blockchain will change the very nature of enterprises, ecosystems, trade, money and financial services, and the economy as a whole with real-time and reliable information exchange driving global market transparency.

In this context, the development of open platforms and advanced standards will be even more critical. On the other hand, these new, smart economies will be even more vulnerable to cyber security threats against which effective protection measures will have to be put in place, a detailed description of which falls outside the scope of this white paper.



4. ECONOMIC DEVELOPMENT METRICS FOR SMART CITIES

This section aims at providing quantitative measures of the impact of smart city technology deployments on economic development, both for an individual city and for the total number of cities.

4.1 ECONOMIC INDICATORS FOR SMART CITIES

The following economic metrics can be considered:

- **GDP:** Monetary market value of all final goods and services produced in a given year. Global GDP amounted to around US\$78 trillion in nominal terms in 2016. A typical mega city of 10 million inhabitants in developed regions has a GDP of around US\$500 billion but with large variations between countries. For comparison purposes, median *per capita* income is a useful metric.
- **Employment:** This has traditionally been seen as a key indicator of economic development, especially for cities in which the economy is mainly organized around labor-intensive service industries. However, considering upcoming disruptions as described in section 4, economic development will start to become disassociated from employment, or at least lose its one-to-one relationship. For city governments, this will require creating alternative opportunities outside the official economy, for example, jobs in elderly care or other social

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activities possibly combined with new universal income systems, however controversial these might still be. On the other hand, in light of new distributed and peer-to-peer economic paradigms, the percentage of self-employed will be a valuable metric to track economic development in the future.

- **City Development:** Synchronized development across neighborhoods, minorities, and communities in terms of reducing inequality by homogeneous economic development, ensuring no citizens are excluded from participating in the economic activity. This closely relates to crime prevention, improved education and healthcare, and the reduction of poverty.

Secondary metrics include:

- Private investment of industry-oriented R&D at universities
- Investment in local infrastructure
- Level of VC investment
- Rate of new businesses set up
- Presence/number of global companies
- Level of international travel and tourism

The focus of this paper is on GDP growth as the key metric for smart city economic development.

4.2 METHODOLOGY AND ASSUMPTIONS

The below estimates on incremental GDP growth generated by various smart city deployment strategies are based on the following assumptions, modeling, and data points:

- **Public Data on Global GDP Levels and Anticipated Growth Assumptions:** Global GDP expected to reach US\$100 trillion by 2026.
- **Assumptions on the Share of GDP Generated by Cities:** 68% of GDP generated by cities by 2026
- **ABI Research IoT Technology Supplier Revenue Forecasts:** Hardware, connectivity, applications, platforms, analytics, security and professional services revenue forecasts across key verticals including commercial building automation, digital signage, intelligent transportation, smart kiosks, EV charging stations and microgrids, smart bins and environment sensors, smart grids, smart meters, smart parking, smart street lighting, video surveillance, and water and gas meters.
- **GDP Growth Effect from Open Data Platforms:** Reported metrics on GDP growth by cities such as London; Transport for London (TfL) claims its free open data policy has a net yearly effect on the city's economy of up to US\$171 million; while the effect is small, less than 0.25% of the total GDP, it is immediate and represents a quick for both large and small cities
- **Multiplier Effect of Smart City Technology Investments:** ABI Research forecast modeling predicts a multiplier effect of up to 10 by 2026; this is corroborated by well-documented research on economic multipliers. For example, economist Enrico Moretti states each new high-tech job in the United States creates five additional jobs in the service economy.

ABI Research forecast modeling predicts a multiplier effect of up to 10 by 2026

- **Structural Incremental GDP Growth of Smart Urban Economy:** Increasing to 2.8% by 2026, driven by next-generation technologies like AI and blockchain gaining momentum; this is corroborated by various independent research data points such as a survey conducted the World Economic Forum indicating 10% of global GDP may be stored with blockchain technology by 2027; similarly PWC claims US\$10 trillion of the global GDP will be on blockchain by 2030, representing 10 % of global GDP. While not all of this blockchain-enabled activity will constitute incremental economic growth, ABI Research anticipates at least around 10% will represent incremental GDP.

4.3 IMPACT OF OPEN DATA PLATFORMS ON ECONOMIC GROWTH

At the most basic level, simply opening up free access to city-related real-time data to third-party developers, startups, and global brands *via* open application programming interface (APIs), represents a first step toward economic development in cities by supporting the design of innovative services and creating jobs. According to ABI Research modeling, open data policies directly generate incremental economic activity to the tune of up to US\$500 million for a typical megacity in a developed region.

Table 1 shows the opportunity in GDP growth across all cities globally in both absolute and relative terms. While limited in terms of percentage of total GDP, accumulated incremental GDP of almost US\$1 trillion can be achieved over the next decade. This growth can be achieved without any major investments in physical infrastructure.

Open Data Policies	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2017 - 2026
Incremental GDP as % of total GDP	0.14%	0.15%	0.16%	0.17%	0.18%	0.19%	0.20%	0.21%	0.22%	0.23%	
Incremental GDP (\$Trillions)	0.05	0.06	0.07	0.07	0.09	0.10	0.11	0.12	0.14	0.16	0.96

4.4 MULTIPLIER EFFECT OF SMART CITY IoT INVESTMENTS ON GDP

According to well-documented research in public financing, for every dollar spent on IoT for public infrastructure and services, a multiple materializes as incremental economic growth. This multiplier or spin-off effect is important, not only in terms of justifying investments in technology but also because in terms of magnifying the relevance of IoT and smart city technology by linking it to key concerns and political objectives of city governments, economic welfare, employment, and prosperity.

This multiplier effect can be very important with factors ranging from 5 to 15. Table 2 shows projections for the total number of cities globally. Over the next decade, the incremental impact on GDP growth amounts to close to US\$10 trillion, with yearly incremental GDP evolving from 1.2% to 2.4% of total GDP

Investment Multiplier Effect	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2017 - 2026
Smart City IoT Investments (\$Billions)	61.69	70.37	79.91	89.87	98.74	112.29	120.41	130.08	141.59	154.69	
Multiplier	7.00	7.50	8.00	8.50	9.00	9.40	9.70	10.00	10.50	10.60	
Incremental GDP (\$Trillions)	0.43	0.53	0.64	0.76	0.89	1.06	1.17	1.30	1.49	1.64	9.90
Incremental GDP as % of total GDP	1.2%	1.4%	1.6%	1.7%	1.9%	2.1%	2.1%	2.2%	2.4%	2.4%	

4.5 OLD VERSUS NEW ECONOMY: FROM TACTICAL TO STRUCTURAL GROWTH

As outlined in sections 2 and 3, it is important to distinguish between the impact legacy smart city technologies can have on established economic practices on the one hand and the instrumental role next-generation technologies will play in generating structural growth by enabling new economic paradigms. In terms of efficiency improvements, the first approach only allows moderate, incremental improvements and cost savings, while the second can accomplish step changes.

An obvious example is how traffic congestion is addressed in cities: providing traffic information allowing citizens to avoid congested areas *versus* deploying smart mobility as a service *via* driverless car sharing to structurally remove congestion altogether by dramatically reducing the total number of vehicles on the road. Moreover, mobility and freight services available at price levels more than an order of magnitude lower than today (10 cents per mile) or even offered as a flat monthly fee, will by itself drive economic growth. In a similar vein, redeploying superfluous downtown parking real-estate for different purposes represent economic benefits. Other effects include sharp rises in real estate prices in remote areas previously out of reach for commuters through ridesharing. More generally, low-cost mobility allows for the pulling in of larger parts of the population into the economy, often concentrated in and around metropolitan areas.

Another fundamental difference lies in the fact that new economic paradigms will allow sustainable economic growth, not relying on the multiplier effect of investments but instead maintaining growth even in the absence of further investments.

However, as can be seen in Table 3, the impact of these new paradigms will increase gradually, reaching 2.8% in terms of relative GDP growth, and it will start reaching its full potential by 2030, by which time many of the technologies and paradigms mentioned in section 3 will start becoming mainstream, especially driverless vehicles, drones, and blockchain. Over the next decade, the accumulated incremental GDP growth will exceed US\$10 trillion.

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Structural Growth Smart Urban Economy	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2017 - 2026
Incremental GDP (\$Trillions)	0.35	0.45	0.57	0.71	0.85	1.02	1.21	1.41	1.64	1.90	10.12
Incremental GDP as % of total GDP	1.0%	1.2%	1.4%	1.6%	1.8%	2.0%	2.2%	2.4%	2.6%	2.8%	



5. IMPLEMENTATION GUIDELINES AND OPERATIONALIZATION CHECKLISTS

It is critical city governments take into account the economic development opportunity when planning and deploying smart city projects. While they need to develop an in-depth understanding of the dynamics involved and the interaction between technology and economy (as outlined in the sections above), they also need to adopt a pragmatic attitude in terms of prioritization and implantation practices.

5.1 DEFINE PRIORITIES AND STRATEGIES

City governments need to follow the following process to optimize the benefits of economic development:

- **Assess Economic Sector Strengths:** Perform SWOT analysis to identify sustainable competitive advantages (role as global trade hub, tech innovation center, financial services, *etc.*)
- **Identify Main Inhibitors of Economic Development:** Assess which of the economic growth criteria below are underdeveloped:
 - **Basic Services:** Mobility, energy, water , gas, communications
 - **Skilled Workforce:** Education, city attractiveness, cost of living
 - **Innovation and Business-Friendly Climate:** R&D climate, taxation, VC funding, eGovernment, *etc.*
 - **Safety, Security, and Resilience:** Inclusion programs for communities, enforcement, surveillance
 - **Stability:** Long-term strategies beyond political mandates
- **Formulate Quick-Win Strategies to Address Pain Points**
 - **Set Up Private-Public Partnerships (PPPs) with Private Sharing Economy Players:** For example, partner with ridesharing operators to serve disadvantaged neighborhoods and unlock poor areas for economic development
 - **Adopt Open Data Policies:** Fast way to unlock innovation and stimulate economic development at minimal incremental cost
 - **Citizen Participation:** Solicit (real-time) feedback from citizens on security hazards, service outages, infrastructure issues, *etc.*

Allocate Funding for Structural Programs: This needs to be aimed at unlocking structural economic growth through investments in next-generation technologies enabling the new smart economy paradigms outlined above: smart infrastructure, automation, and blockchain

- **Prioritize Resources:** Dedicate resources to priority projects formulated in previous steps
- **Focus on Execution:** Optimize request for proposal (RFP) processes, project management, budget control, accountability, and evaluation of effectiveness

5.2 INTERACT FRICTIONLESSLY WITH SUPPLIER ECOSYSTEM

A key dimension of the cities' operationalization strategy is their working relationship with the technology and other suppliers, currently still a source of frustration due to very complex RFPs, long decision cycles, and fragmented responsibilities. Cities can address these concerns *via* streamlining processes and organizational structure:

- **Redefine Government Outsourcing Practices:** Remove friction between city governments and suppliers by streamlining and simplifying tendering processes, something which some cities have already started to work on. Cities need to become "easy to do business with" and form an integral part of the overall smart city and/or GovTech ecosystem.
- **Horizontalize the Organizational Structure:** Transform city organizations from fragmented, departmentalized, siloed organizations into agile, horizontalized structures, enabling them to take advantage of optimization across industries and functions and to engage with the ecosystem in a more efficient and holistic way.

5.3 OPTIMIZE BASED ON ECONOMIC VARIABILITY

While every city is unique and requires a customized approach for optimizing economic development, some general trends can be observed with regard to recommended strategies in function of regional and size differences.

- **Region Variability: Developed Regions**
 - **Optimize the Management of Aging Infrastructure:** A key concern of cities in developed regions is how to maintain and/or upgrade often century-old infrastructure (roads and bridges, energy grids, buildings, water distribution, and sewage). While technology can go a long way in reducing maintenance costs, for example, using sensors for water leak detection, ultimately infrastructure upgrade or replacement programs need to be put in place to address growing consumption levels. However, if and when new infrastructure is built, it is mandatory to take into account future requirements of new economic paradigms, not only in terms of how much infrastructure is needed (for example, share mobility will require fewer roads and parking garages) but also in terms of which smart features need to be in place (embedded wireless EV charging, roadside V2V systems, etc.).
 - **Achieve High Levels of Inter-City Competitiveness:** In developed regions, which are characterized by limited growth, competition between cities is fierce; it is aimed at increasing the share of a limited economic pie, not only on a national but also a global level. As a consequence, no city can afford staying behind, with economic development quickly becoming a top priority, especially as it relates to creating a business and innovation-friendly climate.

A key dimension of the cities' operationalization strategy is their working relationship with the technology and other suppliers, currently still a source of frustration due to very complex RFPs, long decision cycles, and fragmented responsibilities

While technology can go a long way in reducing maintenance costs, for example, using sensors for water leak detection, ultimately infrastructure upgrade or replacement programs need to be put in place to address growing consumption levels

With high levels of economic growth, cities in developing regions are less concerned about inter-city competition and more concerned about maintaining the rate of development

- **Region Variability: Developing Regions**

- **Maintain Economic Growth:** With high levels of economic growth, cities in developing regions are less concerned about inter-city competition and more concerned about maintaining the rate of development. Investment in mobility and basic utilities is paramount in avoiding declining growth. However, for megacities there is no time for investing in the expansion of traditional models; the only way forward is tapping into the sharing economy for quick wins. This explains China's focus on (driverless) car sharing and new forms of mobility.
- **Build Smart Infrastructure:** Developing regions have the opportunity to expand cities with infrastructure built from scratch, designed to cater to the new smart economy or even in certain cases build cities from scratch according to futuristic urban concepts based on out-of-the-box thinking.
- **Prioritize Sustainability:** Many fast-growing megacities in developing regions have developed at the expense of huge ecological deficit. This is no longer politically defensible on a national or global level, and ways need to be found to explore sustainable, environmentally friendly development. China's strategic focus on electrification and renewable energy is a good example of shifting attitudes.

- **City Size Variability: Large Megacities**

- **Maintain High Levels of Inter-City Competitiveness:** As mentioned above, large cities, especially in developed regions, face high levels of competition and should prioritize the creation of a business- and innovation-friendly climate as a short-term tactical measure. However, they also need to plan for the longer term by engaging in more structural economic development based on new economic paradigms. Good examples include cities like Dubai and Singapore, with both engaging in early deployments of next-generation technologies like driverless cars, passenger carrying drones, platooning, and blockchain-based smart trade contracts to maintain and strengthen their leadership position as trade hubs.
- **Address Threat from Mid-Sized Cities:** In developed regions, the population in very large cities of more than 5 million inhabitants has been declining for a number of years, in favor of mid-sized cities with populations between 250,000 and 5 million, which are pulling in economic activity due to lower cost of living and less congestion. In the United States, according to the National League of Cities, mid-sized cities such as Knoxville, Tennessee; Longmont, Colorado; and Raleigh, North Carolina are booming with economic performance driven by both new businesses and expansions often linked to local universities or other R&D organizations. At the same time, they do not yet face the issues related to poverty and lack of inclusion of megacities while maintaining cultural links with rural "hinterlands."

- **City Size Variability: Small Urban Centers**

- **Leverage Limited Resources through New Paradigms:** Limited funding and technological expertise mandate smaller cities to prioritize low-cost approaches based on informational platforms (open data policies) and the sharing economy (mobility, housing, security), allowing them to demonstrate a faster ROI and paving the way for structural investments in the longer term.
- **Prioritize Inter-city Cooperation:** Similarly, for the same reasons of financing and expertise deficits, it is important for smaller cities to cooperate by setting up coalitions or aligning themselves with larger cities.

Limited funding and technological expertise mandate smaller cities to prioritize low-cost approaches based on informational platforms (open data policies) and the sharing economy (mobility, housing, security)

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