Chapter 12
Smart Cities and Smart Regions—The Future of Public Services—Solidarity and Economic Strength Through Smart Regions and Smart Cities

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Introduction

Digitalization is permanently transforming the economy and our society. Although it poses a major challenge, it also presents an opportunity for cities and regions to become safer, more efficient, and more attractive for residents and businesses. Local public utilities are seizing this opportunity—without losing sight of the challenges posed by digitalization or other megatrends, such as climate change. The strategic course for the digital age is clear: cities and regions are becoming smart in order to improve quality of life. And many actors are already on the move. The large corporations of the digital world, which have already upended many markets in the analog world, are hoping for billions in business. The smart city market in Germany was valued at €20.4 billion in 2017, but it is expected to increase to some €43.8 billion in the near future. However, do large corporations really have to manage smart cities and regions? And is this even desirable—particularly in light of data privacy scandals and the concerns of the public? Shouldn't it be local and regional actors that actively strengthen public services—which, after all, are the basis for equal living conditions, economic success and social cohesion—with digital means, to make people's lives better?

Local public utilities are taking action. They want to contribute to the development of municipalities to become connected cities and regions. They aim to capture the economic and social opportunities offered by digitalization for the benefit of citizens. The first section of this paper examines the action areas and paths in which local public utilities can be active in the future. They face the challenges of four megatrends, primarily regarding infrastructure upgrades. The second chapter examines the opportunities digital technologies can offer them in practical terms; this also

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explains what we mean by smart cities and regions. But for this vision to become reality, local public utilities require an appropriate, reliable framework. This is discussed in the third chapter. The actions outlined here will enable them to capture the economic and social opportunities offered by digitalization for the benefit of citizens, thus creating a foundation upon which smart cities and regions can build.

Four Megatrends Will Shape the Future of Cities and Regions

Four megatrends will define the cities and regions of the future: demographic and social change, urbanization, climate change and, of course, digitalization. These long-term trends affect every area of society and the economy and will change them fundamentally. As such, they define the action areas and paths in which local public actors will move in the future (Quadriga 2017). These megatrends pose challenges for municipalities and the local public utilities, because they place new demands on the public services that they provide and, hence, on their infrastructure. At the same time, they also offer opportunities to supply energy, water/wastewater, telecommunications and waste management/municipal cleaning, which local actors can take advantage of, thus advancing toward becoming smart cities and regions. New services will also emerge, because the tasks of the local public utilities are not static—they focus on the needs and expectations of the residents as well as technological change.

Urbanization and Demographic Change Require Adaptation of Infrastructures

The trend toward urbanization is clear: population centers and their surrounding regions will continue to grow, while rural areas will shrink. The latter is already happening today in the eastern and central regions of Germany (BBSR 2017). These rural-to-urban migration flows require changes to the infrastructure for public services: in growing regions, infrastructures will have to be established or expanded— for example, water pipes and sewage conduits. In shrinking regions, in contrast, capacities will have to be cut back and new ways of utilizing them explored (Quadriga 2017). These rural-to-urban migration flows are being augmented by demographic change: life expectancy in Germany has been growing steadily for decades, while the birth rate has been declining. Germany is aging, and the excess mortality rate is another reason why the number of inhabitants of the country is shrinking. In 2060, Germany will have around 68–73 million inhabitants instead of the current 82 million (Statistisches Bundesamt 2015). These trends have consequences: Municipalities and their local public utilities have to adapt, plan and invest in the long term. The specific

local circumstances are decisive when assessing the exact needs for infrastructure-related construction projects and the associated costs.

The Energy Transition and Resilient Infrastructures Help to Protect Against Climate Change

Safe, economic and renewable: local public utilities aim to create a new energy world. Municipal utilities are following a two-pronged strategy: First of all, they are minimizing the emission of greenhouse gases, to contribute towards achieving climate targets. The energy transition is an important tool for achieving this. The transition to energy from renewable sources requires a complete transformation of the energy system: from a centralized to a decentralized energy infrastructure. The German government aims to increase the share of renewable energy to 65% by 2030 (decided by the fourth Merkel cabinet). To achieve the necessary infrastructure transformation, local public utilities are backing digital technologies such as smart grids and smart meters (see Chap. 3).

Secondly, local public utilities are already facing the consequences of climate change, including extreme weather events. Heat waves increase energy consumption for air conditioning and refrigeration. The water and wastewater industry is adapting to extreme rainfall scenarios with new concepts for wastewater disposal and flood protection. The aim is to create flexible, adaptable structures that enable municipalities to respond to new climatic conditions. In case of an emergency, it must be possible to intervene quickly. Furthermore, the structures must remain operable even if individual elements fail. The overall goal is to strengthen the resilience of critical infrastructures, to prepare them for climate change (Rottmann and Grüttner 2016).

Social Change: The Desire for Security and a Change in Consumer Behavior

Those who wish to shape life in the cities and regions of Germany must include the people and actively address changes of the society. This is the only way changes will be accepted by the public. In addition to individualization, the need for security is growing. For example, according to a poll, three quarters of Germans said that security is increasingly important to them. Places two and three can be interpreted as the wish for stability and support in a familiar environment: values expressed in the poll, such as home (63%) and trust (58%), are gaining importance (GfK 2017). These desires likely have many sources. One possible explanation is the negative consequences of social change: a trend towards income polarization, a lack of educational opportunities and spatial segregation (Deutscher Städtetag 2015; Rottmann and Grüttner 2016).

Moreover, people are also changing in their role as consumers. Almost nine out of ten people in Germany (88%) can imagine lending things and utilizing sharing schemes (Verbraucherzentrale Bundesverband 2015). Their value system is clearly changing away from possession and toward usage. In addition, market research has shown that a familiar environment, regional origin, price-performance ratio and eco-friendliness are important factors in purchase decisions (Nielsen 2016).

Furthermore, experts predict that digitalization will change people's perception of their roles as customers or citizens; the first changes are already apparent. On the one hand, their market position is improving tangibly: Access to the internet, with search engines and comparison websites, as well as social networks and messaging services, are helping them become better informed and connected. Their quality standards are also rising: they expect individualized products, delivery within 24 h and free updates (Bundesministerium für Wirtschaft und Energie 2017). These demands also affect local public utilities—essentially, all service providers.

On the other hand, people know that they are no longer anonymous in the digital world. They pay with their data. But while individuals are becoming increasingly transparent (consciously or unconsciously), companies are keeping a low profile. Hardly anyone knows which data they are making available to whom and what they are doing with those data. Critics warn that, at the moment, customers have lost ownership of their data (Osburg 2017). In turn, the loss of transparency and privacy is causing a loss of trust, which is an essential precondition for the digital economy to function (Osburg 2017). In fact, Facebook and other internet giants are struggling with real confidence issues (see GPRA 2017), and a clear legal framework for handling data[1] would help to rectify the situation (see Chap. 3).

Furthermore, digitalization also poses other questions, including ethical ones. What rules should algorithms follow in their decisions? How are programming parameters decided? We will need transparent criteria for these questions in the future. This will also help to create acceptance for new products and services. One important prerequisite is that the practical benefits of digitalization be perceptible to the public. Local public utilities enjoy an advantage here, because their digital products and services are linked directly and closely to the places where people live and work. One example: sensors in water channels measure the rise in water levels after heavy rainfall. This means local transport companies can be alerted to the threat of flooding in underground stations. Their customers could also be notified of precautionary station closings, for example, via text message. This would reduce the risk of traffic chaos, and people would be able to look for other ways home in advance.

Societal change raises many questions in general. Local public utilities have answers, because they are deeply rooted in the region and understand the local situation. They are trusted by the public as a competent and reliable contact, with the technical expertise to resolve problems on site. They provide public services in a

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[1]With the General Data Protection Regulation, which came into force in May 2018, the European Union has shown that it intends to counter this loss of control. It is too early at the moment (May 2018) to assess the actual effects of the GDPR and people's perception of its effectiveness.

safe, reliable manner: 24 h a day, 365 days a year. As a recent survey showed, 72% of people trust municipal utilities—an excellent result, putting the utilities in fourth place on the trust barometer (Forsa 2018).

These characteristics undoubtedly set the local public utilities apart from internet companies in distant Silicon Valley. The former reflect the values of the people, who seek greater security. This is a decisive advantage that the utilities should and want to exploit in the competition for markets in smart cities and regions. When developing digital products and services, they have to consider the new market position of customers, their focus on usage and the importance of regional aspects in influencing people's decisions.

Digitalization: Creating Infrastructures to Capture the Economic and Social Benefits of Digital Transformation

Germany needs high-performance digital infrastructures for the gigabit society. In Germany, small and mid-sized enterprises (SMEs) are responsible for more than half of all value created (Federal Ministry for Economic Affairs and Energy 2018). To remain competitive in the future, SMEs in particular need access to high-performance digital infrastructures—independently of whether the company is located in a metropolis like Hamburg, or in a small village like Dingolshausen. Residents also need access to digital infrastructure, in order to ensure that they can participate in and benefit from the digital transformation.

Therefore, a prerequisite is to provide broadband coverage to all regions throughout the country. A fiber-optics broadband network is essential to giving everyone access to the internet and ensuring equal living conditions in the digital world. It will also help to strengthen social cohesion to a considerable extent. Therefore, the digital infrastructure itself must be considered a public service.

Rural areas must remain a focal point—for example, more than half of Germany's residents live there (definition and calculation by BMEL 2016). In rural areas, only fast internet access can provide the technical means of working from home. This would render stressful, time-consuming commutes obsolete and enable employees to spend more time with their families.

A lot remains to be done in rural areas. One hundred and fifty committed local public utilities in Germany are dedicated to building out the broadband network. Other providers still advocate for the outdated vectoring technology and are installing copper cables—even though the demand for broadband will continue to grow. The advance of the Internet of Things (IoT) alone—essentially, connected devices and machines—will increase data traffic by approximately 50% by 2025 (Boston Consulting 2018), in addition to the growing demand for mobile internet by other sectors of society. As such, the 5G mobile communications standard will play a key role. But for the high-speed network to develop its full potential, 5G transmitters must

be connected to the broadband network. This means the importance of a broadband connection cannot be ignored. At the same time, 5G offers thinly populated, difficult-to-reach rural areas the chance to bridge the last mile from broadband cable to households and businesses (Internet Economy Foundation/Roland Berger 2018). The infrastructure is supplemented by cloud computing, data centers and wireless solutions on different frequencies e.g. LoRaWan. As such, the highest priority at the moment involves creating a broadband infrastructure as the foundation for smart cities and regions. It is the key precondition for capitalizing on the economic and social advantages of digitalization (see Chap. 3).

Summary So Far: Smart Cities and Regions Must Build on the Right Infrastructure

To capture the opportunities offered to people by digitalization, the infrastructures for public services must be adapted. They are the foundation of smart cities and regions. The megatrends of urbanization and demographic change require infrastructures to be expanded or dismantled, while climate change demands increased resilience. The energy transition will require a complete retrofit. And only digital infrastructures can provide access to the digital world. They will decide on the competitiveness of companies and the social engagement of every resident. A ubiquitous broadband network is the key. Equal living conditions are decisive for social cohesion. These infrastructures will make it possible for cities and rural regions to seize the opportunities offered by digitalization: digital technologies will help to tackle the challenges of these megatrends and will improve the lives of people in smart cities and regions (see Chap. 3). What's more, the necessary adjustments to the infrastructures vary from place to place. The local public utilities have the required expertise in building and maintaining infrastructures and also know the local situation and needs. Social acceptance is an important prerequisite for the transformation—whether for smart cities and regions or the new products and services. It is a question of gaining people's trust in the digital world. As competent, reliable, local actors deeply rooted in their region, local public utilities have a clear advantage over internet corporations. Their vision of the digital transformation counters the digital disruption from Silicon Valley: actively shaping the digital transformation of cities and municipalities to the benefit of the locals.

How Smart Cities and Smart Regions Can Seize Digital Opportunities

Smart cities and regions are created by connecting people, administrations, businesses and public services in an intelligent manner. Together they make up the

smart nation of Germany—a cosmopolitan, socially lively, economically prosperous nation. It can successfully reduce the risks posed by megatrends and seize the opportunities offered by digitalization, as the following examples show.

Smart Cities and Regions Build on Efficient Processes

Digital technologies capture efficiency potential in all corporate processes, starting with internal HR and resource planning and the opportunity for intercommunity collaboration via platforms. Digital technologies will enable public utilities to perform better. This benefits residents, as well. After all, local public utilities provide a broad spectrum of public services.

In general, every digital tool serves a variety of use cases, as demonstrated by the Internet of Things and AI, for example. Waste management companies and water companies can both benefit from the Internet of Things. Sensors can measure the fill levels of waste bins for waste management companies and send a signal when the bins have to be emptied, thus saving unnecessary trips. As a result, route planning can be optimized to save costs. Consequently, the general traffic levels decrease, thus protecting the environment and the climate. The water and wastewater industries, in turn, can install sensors in pipes and digital meters, to enable smart management of the water supply and wastewater disposal, using the data collected. This will help to deal with periods of heavy rainfall.

Artificial intelligence (AI) is also promising. Testing AI is likely to reap benefits in the long term. It could be used to optimize gas turbines autonomously, to ensure better monitoring of smart electricity grids and for predictive maintenance of plants and equipment. It is likely to play a key role in the supply and disposal industries, in particular—for example, using smart waste-sorting robots. They will not only save companies time, money and effort, but also improve the recycling economy in general, helping to save the environment.

These examples might cause some readers to fear job losses. But in fact, many new digital technologies require two things of employees in local public utilities in particular: new skills and qualifications. New jobs that demand new skills will also be created. That is why it is important to prepare today's trainees, students and employees to handle the tasks of tomorrow. Digital education will undeniably become a key task in the future for businesses, regional governments and, of course, local public actors.

Smart Cities and Regions Are Developing New Services and Products

Like all other sectors of society, local authorities and the municipal utilities have to cope with the stronger market position of well-informed, connected customers: digital services, the orientation of local administration to online services, as well as energy and logistics solutions are in demand (Eco 2017). In smart cities and regions, people and businesses communicate with local authorities digitally and will obtain services via their user accounts. In this respect, local government administrations in Germany have a lot catching up to do. The broad opinion was that city administrations in Germany were a "digital services wasteland" (EFI 2016). Local public utilities must also adapt their portfolios of products and services, along with their business models, to their customers' wishes if they hope to remain competitive. Their new or improved products and services should offer people genuine added value that improves their quality of life. That is what characterizes smart cities and regions.

Two examples from the transport sector illustrate the benefits of digital technologies and how they can help to counter the megatrends of climate change and urbanization.

IoT technologies are useful instruments for intelligent traffic control to suit various needs. The German public utility Stadtwerke München is already testing sensors installed in road surfaces, which can direct people to free parking spaces via an app. The time-consuming search for a parking space has thus become a thing of the past, while also reducing traffic congestion and environmental pollution. After all, 30–40% of urban traffic is caused by people searching for parking spaces. But that is only the beginning. Sensors in the road or in street lamps can also record the volume of traffic and warn traffic control centers and drivers of possible traffic jams in advance. The former can then take action—either automatically or manually—while alternative routes can be proposed to drivers. This is how the Internet of Things can improve the control of all traffic flows. Smart sensors offer other potential use cases, as well: they can make street lamps shine brighter when pedestrians, cyclists or cars approach. This lowers energy costs for municipalities. Or they can record environmental data and report excess particulate pollution or emissions—two problems that are likely to worsen in population centers in light of the trend toward urbanization. In general, this technology can help protect the climate, the environment and individual health, thus improving the quality of life. People in population centers, in particular, will benefit from intelligent traffic control.

Self-driving vehicles will also open up new possibilities. German cities, such as Berlin and Duisburg, are already using autonomous shuttle buses to boost local public transport. The public utility companies in Arnsberg and Menden in the Sauerland region of the country develop various mobility concepts, including self-driving vehicles to improve local public transport. This will open up new prospects for the automotive supply industry with its 43,000 employees in the rural region of southern Westphalia. The technology harbors potential for rural areas most of all, since it can individualize local public transport. People in rural areas could take a self-driving

bus even late at night. Autonomous driving on-demand transport schemes are also conceivable. The public utility company Stadtwerke Augsburg is testing self-driving electric buses. In general, autonomous driving schemes can offer an additional service that is currently not available in many rural areas, due to the lack of demand. Local people would gain mobility, and rural areas would become more attractive. And in the best case, it would also be cost-efficient.[2]

Smart Cities and Regions Are Fighting Climate Change

Smart cities and regions can utilize digital technologies to accelerate the energy transition, in order to contribute toward fighting climate change. The switch to renewable energy technologies is in full swing. But the volatility of energy from sun, wind and biomass remains a challenge. Structural change—from centralized to decentralized energy supply—must also be reflected at the grid level. This change can be achieved by digitalizing electricity grids: intelligent energy networks, or smart grids, ensure that local production facilities, networks and storage facilities, together with consumers, interact in optimum fashion through intelligent control systems, thus compensating for the volatility of renewable energy technologies. Hence, smart grids are the necessary prerequisite to harmonize the aims of security of supply, economic efficiency and environmental sustainability.

Public debate often focuses on the major transmission lines that transport the electricity generated from renewable sources over long distances at low losses. Distribution grids are all too often forgotten in such cases, even though they transport electricity directly to businesses and consumers. There are currently 25,000 km of transmission lines, compared with 1.7 million km of distribution grids. They will play a major role in the structural transformation to smart grids. Expansion, modernization and digitalization lie in the hands of the operators of local public distribution grids. If distribution grids were used more efficiently, the need for expansion could be more than halved, representing a financial savings of €400 million (Federal Ministry for Economic Affairs and Energy 2014).

Smart grids help smart cities and regions to increase flexibility in their electricity grids. In combination with smart metering technology, they enable commerce and industry, as well as general consumers, to tailor their consumption to the electricity supply. If a lot of electricity is available, SME manufacturers can ramp up production, while at home, the washing machine starts its daily routine. Both consumer groups would be rewarded financially for their flexibility, and the grid load would be reduced, in turn improving the stability of the electricity supply. These types of solutions are already being tested in SINTEG (Smart Energy Showcases—Digital Agenda for the Energy Transition) model regions.

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[2]This is the concept for self-driving schemes for smart cities and regions. Of course, this vision currently presupposes further technical and pre-commercial development, which would result in a reduction in procurement and maintenance costs.

Furthermore, smart grids are essential for a breakthrough in e-mobility and, therefore, will be decisive for the success of the transport transformation, which in turn will be decisive for the success of the energy transformation. Public debate should concentrate more on expanding the charging infrastructure and the required number of charging stations. However, it is just as important to ensure that charging stations are connected to the distribution grid. Therefore the expansion of both should go hand-in-hand. Grid overload, which could occur by charging a large number of cars at the same time, would be balanced out in a smart grid. In addition, inductive charging would be a good bet. Electric cars could not only be charged with electricity from charging points in the roads, but could also feed electricity back into the grid when needed. They would become mobile electricity storage devices that could contribute to the security of supply.

These approaches show that local public utilities are creating the foundation for the energy transition with smart grids. Smart cities and regions will supply people with electricity, heating and mobility by linking e-mobility, power plants and storage facilities in a smart energy grid. Initial approaches have already demonstrated the integrated solutions developed by public utility companies in the construction or renovation of residential areas. Here, district heating, power generation from renewable sources, power storage facilities, landlord-to-tenant electricity, smart homes, e-mobility, car-sharing and virtual power stations are all interconnected intelligently. People are able to enjoy the benefits of this new energy world and take advantage of safe, economical and clean energy generation, which also contributes to climate protection.

Implementation: Smart Cities and Regions Need Legal Certainty and a Consistent Strategy

To turn the vision of smart cities and regions into reality, we need more than just a digital infrastructure. The diversity of our cities and communities demands diverse solutions. Regional digital strategies identify specific needs and strengths on the ground, thus helping to develop appropriate solutions—for the specific site and to deal with the consequences of megatrends. Cooperation is essential to develop and implement solutions. It allows cities and communities to combine their relative strengths. Through cooperation, they capture synergies that benefit all parties. This is the reason why smart cities and regions need the possibility to build networks, exchange and cooperate with local public actors, startups, the businesses, researchers and, of course, the people themselves. That is also why discussion and experimentation spaces and platforms are important: they connect the knowledge of stakeholders with data from cities and regions. Therefore innovation centers are important meeting places.

Local data are merged in a shared local platform—the urban data room. Data include geographical, cadastral, mobility, energy and environmental data, as well as

social and economic data. The aim is to provide, exchange and utilize local data securely, transparently and independently for the development of new products and services. Data should resolve problems on the ground and, hence, offer genuine real value. In addition to interfaces, clear governance rules that follow the principles of data security and data sovereignty are important. Data are only shared when necessary; there are sensible, comprehensible and—above all—transparent rules as to who is allowed to access which data (see Quadriga 2017).

This requires a consistent legal framework that clearly regulates how data are used and handled, such as the data local public utilities use to create new products and services. A "Data Act" should classify both open data and fee-based data. Not all data should be available free of charge. The ultimate aim of a Data Act would be to create legal certainty for people and businesses, thus ensuring planning reliability for decision-makers in local public utilities. For example, a Data Act would have to regulate how local public utilities can use data to develop new products and services (see Quadriga 2017).

Local public utilities see digitalization as a transformation, not a disruption. Digital progress needs to serve people. Innovations are accepted when users perceive their benefits. Digital products and services must add tangible value for the residents. Local public utilities in smart cities and regions must always develop products, services and business models with a focus on how they benefit the people and whether they resolve local issues or improve people's lives.

In general, local public utilities are using digital tools to offer their services more efficiently and more competitively. With a view to climate change, urbanization and demographic change, their solutions should also be as resilient as possible, universally applicable and scalable. They must work independently of population density and also take sustainability into account. The needs of future generations must not be forgotten. Citizens will be able to experience the benefits of products and services created from local data first hand, for their local region and their daily lives. Local public utilities can help them gain trust in the digital transformation.

Summary

Four megatrends pose a challenge for cities and regions: demographic and social change, urbanization, climate change and, of course, digitalization. To mitigate the negative effects of these megatrends and capitalize on the opportunities offered by digitalization, local public utilities need to adapt their infrastructures for public services and, above all, upgrade the digital infrastructure.

Firstly, a sound digital infrastructure will ensure the competitiveness of businesses and the social participation of every resident in the digital age. Its quality is decisive: comprehensive access to broadband, the aim of local public utilities, is essential to ensuring that everyone has equal access to the digital world. In turn, this equal access is decisive for social cohesion. Therefore, the digital infrastructure itself must be seen as part of the public service.

Digital infrastructures will create the prerequisites for smart cities and regions, enabling them to capture the economic and social advantages offered by digitalization for local residents. They link citizens, government administration, local businesses and public services. Innovation centers for interchange, experimentation and cooperation are important, as is the urban data room where all local data are collected. This can be distinguished from private providers through clear rules of governance and the principles of data ownership and sovereignty. With this approach, smart cities and regions can create a solid foundation for encouraging people's trust in the digital world—a trust that is being shaken by the loss of privacy and lack of transparency. Generally speaking, people place a high value on security. This poses an opportunity for local public utilities, since they are able to cater to the residents' desire for reliability. In fact, the majority of people place great trust in them. As competent, reliable local partners rooted in the local region, they have a clear advantage over often-suspect internet corporations.

Data will also help local public actors to develop regional digital strategies, for example by identifying local challenges and strengths and finding solutions that fit the local scenarios. This means local public utilities can improve their products and services or even create new ones. They can utilize the opportunities offered by digital technologies to solve problems on the local level and give local people genuine added value: savings of time, energy and costs, as well as greater efficiency, and this will make the energy transition a success. The new world of energy in smart cities and regions is based on smart power grids that link e-mobility, power plants and power storage facilities intelligently, to supply local people with electricity, heating and mobility generated from renewable energy sources. Residents will enjoy safe, economical and clean energy generation, which will also contribute to climate protection. With an eye to the megatrend of urbanization, this will help cities the most.

Smart regions can use digital technologies to create new products and services. One example: autonomous vehicles to improve local public transport. Mobility would improve, and rural areas would be more attractive, thanks to their improved accessibility. Smart cities and regions can employ new, digitally-based products and services to mitigate the negative consequences of megatrends—provided that digital infrastructures and clear data laws are in place. At the same time, smart cities and regions can use them to improve Germany's competitiveness, as well as increase social cohesion. Local public utilities are countering the digital disruption from Silicon Valley with a digital transformation on their own terms. They are shaping the digital transformation by seizing the social and economic opportunities presented by digitalization for the benefit of their citizens.

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