August 2025

Expert Insights
PERSPECTIVE ON A TIMELY POLICY ISSUE

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China, Smart Cities, and the Middle East

Options for the Region and the United States

Since the 2017 National Security Strategy was issued, the United States has been explicit that it is engaged in a strategic competition with China in the political, economic, and military domains. The United States contends that issues at stake include a free and open international economic system, the free flow of information, and challenges to U.S. security and prosperity.[1] At the heart of this competition is technology—specifically, "competition to develop and deploy foundational technologies that will transform our security and economy."[2] This competition is multidimensional and can best be gauged using such metrics as commercial success, technology adoption, and the consequences of that adoption.[3]

Although much of that competition has focused on artificial intelligence, advanced semiconductors, and quantum computing, it has also involved deployment of information and communication technology (ICT). This competition is exemplified by bipartisan U.S. efforts to keep Huawei technology out of allied- and partner-country fifth-generation (5G) telephony systems.[4]

Within the broad area of ICT development, so-called smart cities present a valuable case study of this competition. *Smart city* is a term in increasing usage but for which there is no universally agreed definition. We adopt the definition put forward in a report for the European Parliament's Committee on Industry, Research and Energy, describing a smart city as "a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership."[5]

This paper focuses on China's involvement in smart cities in the Middle East and North Africa (to which we refer collectively as *the Middle East*) (see Figure 1). U.S. concerns about China's involvement in smart cities apply worldwide.[6] For example, the United States established a U.S.–Association of Southeast Asian Nations (ASEAN) Smart Cities Partnership in 2018 as part of the U.S. Indo-Pacific Strategy.[7]

The Middle East merits attention for several reasons.[8] From the U.S. point of view, the Middle East has emerged as a central site of great power competition: The United States, China, and Russia are all active there and vying for influence.[9] The United States is the leading security provider for the region. Additionally, it has identified Iran as a country meriting special attention when it comes to U.S. security.[10]

From the point of view of countries in the region, smart cities have the potential to improve the lives of residents of the Middle East. In this sense, the spread of smart cities could be helpful to the United States, which has wanted peace, stability, and development in the region.[11] But at the same time, China's involvement could complicate the relationship between the region and its primary security patron, the United States. Although some Chinese technologies might be attractive in terms of cost and functionality, Chinese companies also carry the risk of performing intelligence functions and exfiltrating data. Accordingly, Middle Eastern governments might have concerns about the security of their own data.

Furthermore, should Chinese telecommunication infrastructure have touchpoints to infrastructure involved in U.S. security cooperation with Middle Eastern partners, compromises to that infrastructure could put that cooperation at risk. This is certainly on the agenda of the U.S. armed forces. For example, in 2023, Lt Gen Alexus Grynkewich, then-commander of U.S. Air Forces Central and Combined Forces Air Component for U.S. Central Command, Southwest Asia, noted that, "if [smart city] infrastructure comes in and it starts to touch networks, you start to see a risk to U.S. forces and U.S. technical capabilities because of the collection capabilities that might come with that." He added, "We do watch that closely."[12]

In this paper, we first describe smart cities and then discuss the Middle East's approach to them. We next discuss China's approach to smart cities and involvement in smart cities in the Middle East. We conclude with policy implications for the United States in how it should approach China's involvement in smart cities in the Middle East while safeguarding and even improving its relations with Middle Eastern partners and the people of the Middle East. Research for this project concluded in July 2023, with updates of smart city ratings, World Bank data, and the Economist Intelligence Unit (EIU) Democracy Index.

FIGURE 1

The Middle East and North Africa

NOTE: These are countries we identified as being in this region for purposes of this paper. In 2020, the United States recognized Morocco's sovereignty over Western Sahara, but the United Nations does not recognize Morocco as the administering power over that territory (U.S. Central Intelligence Agency, "Morocco").

What Are Smart Cities, and Why Develop Them?

The United Nations has estimated that, by 2050, 66 percent of the global population will live in urban areas.[13] As a result of this, problems associated with urban areas, such as air pollution, traffic congestion, waste management, and crime, are expected to increase. Making a city smart enables city leaders to address the challenges urbanization poses.[14] Cities that have become smart did so to be more effective in their service delivery to residents.[15]

Smart cities rely on the Internet of Things (IoT) to provide the foundation on which their smart solutions rest.[16] *IoT* refers to the connection of ordinary, everyday devices to the internet so they can collect and transmit information and communicate with other devices connected to the internet.[17] This is made possible by fitting these everyday devices with sensors, transceivers, and other modern technology. Applications of IoT include wearable devices, connected cars, smart homes, smart cities, and the industrial internet.[18]

Smart City Information and Communication Technology Infrastructure

ICT is the mainstay of a smart city. Smart cities take advantage of communication technology, sensors, and computer applications to provide innovative responses to the needs of their people and businesses.[19] A smart city's ICT infrastructure consists of a sensing layer, a transmission layer, a data management layer, and an application layer (Table 1).[20]

TABLE 1

Description of Smart City Information and Communication Technology Infrastructure

Layer	Description	Example Technology and Tools
Sensing	Data capture devices collect relevant information.	Sensors, video surveillance cameras, GPS, loop detectors embedded in roads, smart electricity meters, and smart water meters
Transmission	Data collected by the sensors are transmitted to data management centers.	Bluetooth, 4G LTE, Wi-Fi, NFC, GSM, UMTS, machine to machine, 5G, ethernet
Data management	Data received are organized, analyzed, and stored. The design of this layer should allow real-time data analysis.	Data centers, cloud storage, integrated operation and control centers, information management platform, back-end servers
Application	Technology platforms and applications use the collected data for analysis and decisionmaking.	Transportation management platform, utility management platform, surveillance system

SOURCES: Authors' descriptions based on Harrison et al., "Foundations for Smarter Cities"; Silva, Khan, and Han, "Towards Sustainable Smart Cities," p. 702; and Zanella et al., "Internet of Things for Smart Cities."

NOTE: 4G LTE = fourth-generation Long Term Evolution; GSM = Global System for Mobile Communication; GPS = Global Positioning System; NFC = near-field communication; UMTS = Universal Mobile Telecommunications System, a third-generation technology.

Smart City Characteristics

In Table 2, we present ten characteristics of smart cities.[21] Having one or two of these characteristics does not necessarily make a city smart. Rather, having a combination of some of these characteristics *concurrently* begins to make a city smart. In addition, for a city to be truly

TABLE 2
Smart City Characteristics

Characteristic	Description
Smart economy	The ability to engage in commerce and e-commerce activities using ICT and without necessitating physical contact between the trading parties or the exchange of physical currency. Online retail businesses, online and electronic payment, and (smart) card payment are examples.
Smart governance	A government's ability to use ICT to interact with and provide services for people. Examples include government websites where people can obtain relevant information; pay fines, taxes, or for services; request services; vote; and access government data.
Smart energy	The ability to manage the process of generation, transmission, and distribution of electricity within a city. Modern technology via smart grids is used to observe demand patterns and meet people's electricity needs. Renewable energy also features prominently in smart cities.
Smart buildings and infrastructure	Intelligent buildings and infrastructure fitted with modern technology and automation. Smart buildings use renewable energy and match energy use to occupancy. Smart appliances and devices are fitted with sensors that allow people to interact with them. Other infrastructure, such as roads and bridges, has sensors, such as RFID detectors for tolls on roads, bridges, and tunnels.
Smart environment	Reducing pollution, sustainable management of resources, and smart waste management. Renewable energy sources are used to achieve this.
Smart mobility	The availability of ICT-supported and integrated transport and logistics systems. Shared mobility and smart traffic control systems are also features.
Smart technology	The availability of free Wi-Fi in public places, as well as high-speed internet in private spaces. This also involves the integration of innovative technology within the city.
Smart health care	The use of ICT-based solutions to provide public health services, as well as to monitor and manage the health outcomes of people within the city
Smart people	The availability of people who are well skilled in developing and operating the ICT-based solutions that are in place in the city. They have access to education and training and use this to create new innovations.
Smart safety	The use of ICT tools, such as surveillance cameras and drones, for predictive policing and a timely emergency response

SOURCES: Authors' descriptions based on Frost and Sullivan, *Strategic Opportunity Analysis of the Global Smart City Market*; Harrison et al., "Foundations for Smarter Cities"; Manville et al., *Mapping Smart Cities in the EU*; Mohanty, Choppali, and Kougianos, "Everything You Wanted to Know About Smart Cities," p. 62; van Dijk et al., *Smart Cities*; Vanolo, "Smartmentality"; and Woetzel et al., *Smart Cities*.

NOTE: RFID = radio-frequency identification.

smart, there needs to be some coordination of these smart characteristics between stakeholders to address public issues. Some cities provide good examples of multiple smart characteristics and applications (Table 3).

The Middle East and Smart Cities

Although there are no comprehensive lists of smart cities, there are efforts to list and compare them around the world. One such effort is the International Institute for Management Development (IMD) World Competitiveness Center's Smart City Index.[22] For its 2024 report, IMD ranked 142 such cities. Of those 142, 19 are in the Middle East, including some of those ranked in the top by IMD, specifically in the United Arab Emirates (UAE). The rankings, with 1 the best and 142 the worst, are based on ratings calculated from an average of responses from 120 residents of each city for 2022, 2023, and 2024.

TABLE 3
Examples of Smart Cities and Their Features

City	Smart Characteristic	Application
London	Mobility	Congestion and road management, shared mobility options, real-time bus and train schedules
	Technology	Wi-Fi connectivity on the Tube; City of London Wi-Fi network offers free and unlimited access to all users at 156 points across the Square Mile
	Safety	Security cameras, data on crime hot spots
	People	Skilled residents who can operate the deployed solutions. The city has a chief digital officer.
	Economy	E-commerce, online and electronic payment, contactless payment on all Transport for London modes of transportation
	Governance	iPad in the mayor's office that allows real-time monitoring of city performance
Singapore	Health care	Use of assistive technology and robotics in health care; the HealthHub portal, where people can access their health records; the National Steps Challenge and Healthy 365 app, which encourage a more active lifestyle; telehealth
	Mobility	Autonomous vehicles piloted in western Singapore
	Safety	Drones, quadcopters, and robots used by police
	Environment	Walk Cycle Ride initiative promoting sustainable energy use and reduction of pollution
	Governance	94% of government services said to be digital from end to end, data collected by public agencies available as open data

SOURCES: Features information from City of London, "WiFi"; Mayor of London, "Mayor Appoints London's First Chief Digital Officer"; Silva, Khan, and Han, "Towards Sustainable Smart Cities"; Smart Nation Singapore, "Transforming Singapore Through Technology"; World Economic Forum, "3 Reasons Why Singapore Is the Smartest City in the World"; and Zoria, "7 Technological Advancements That Make Singapore a Smart City."

These responses reflect perceptions of existing city infrastructure (referred to as the *Structures pillar* in the rating system) and technological provisions and services available to residents (referred to as the *Technology pillar* in the rating system) (Table 4).[23] Each pillar encompasses evaluations in five areas: health and safety, mobility, activities, opportunities, and governance.[24]

In a ranking of the number of smart cities by region, the Middle East finds itself in the middle, well behind Europe and Asia but ahead of Africa, Latin America, and even North America. In the 2024 rankings, Europe had 57 ranked cities, Asia and Oceania 36, the Middle East 19, North America 15, Latin America and the Caribbean ten, and sub-Saharan Africa five (shown in Figure 2).

This could be driven in part by national income. Europe, North America, and parts of Asia are the wealthiest regions in the world, and they dominate the top half of the rankings. Likewise, the UAE and Saudi Arabia are wealthy Middle Eastern countries. This could also be driven by technological capacity—much of the technology powering smart cities is designed and produced in North America, Europe, and Asia. However, technology can be sold, and China is making significant efforts to spread the use of its technology in smart cities worldwide. Again, much of this technology cooperation is taking place in the UAE and Saudi Arabia.

Benefits for the Middle East

In the Middle East, the need for improved urban environments is pressing. Among major regions of the world, the region defined by the World Bank as the Middle East and North Africa (MENA) is well above the world aver-

TABLE 4

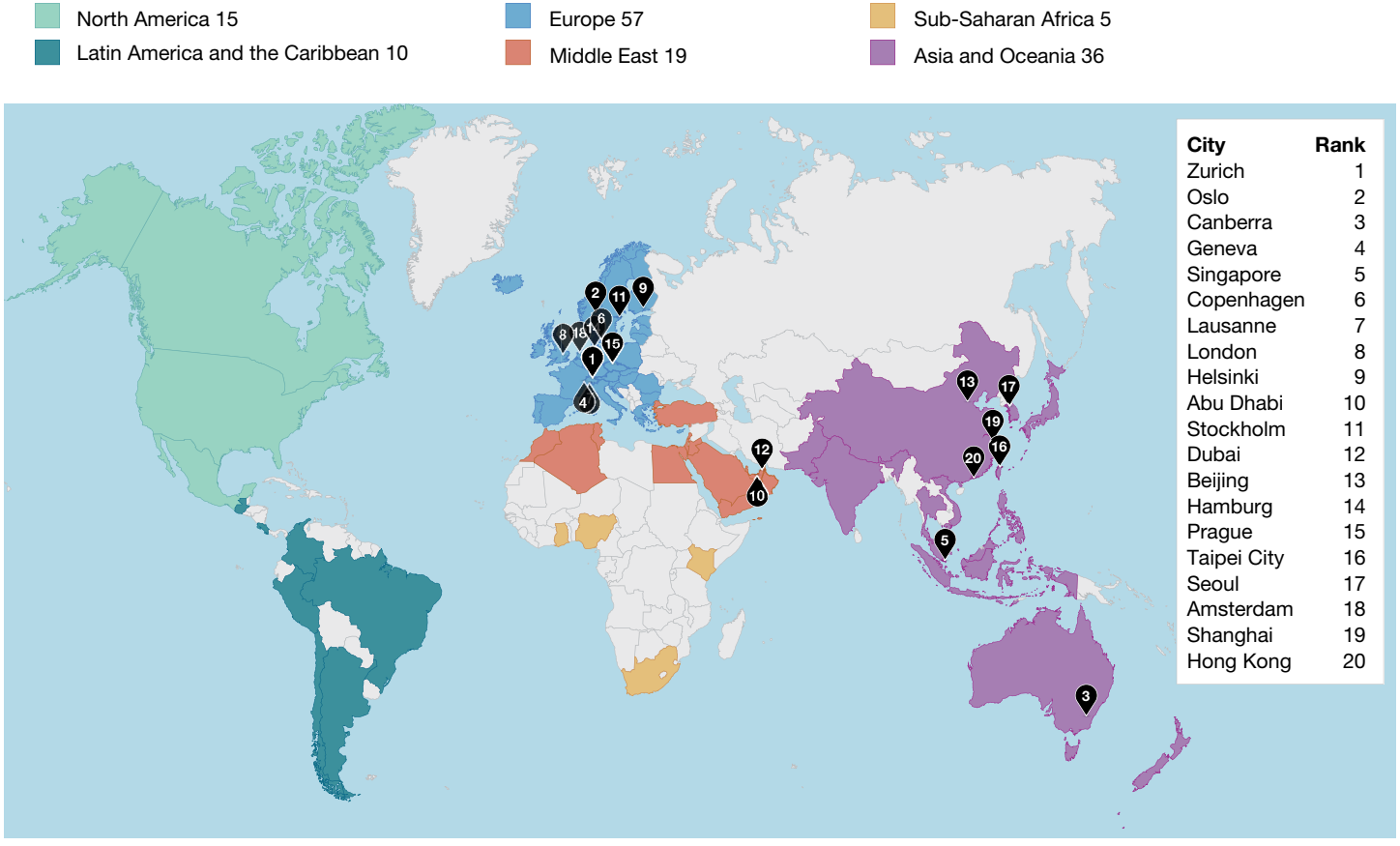
Middle East Cities in the 2024 IMD Smart City Index

City	Rank
Abu Dhabi, UAE	10
Dubai, UAE	12
Riyadh, Saudi Arabia	25
Doha, Qatar	48
Mecca, Saudi Arabia	52
Jeddah, Saudi Arabia	55
Medina, Saudi Arabia	74
Muscat, Oman	88
Tel Aviv, Israel	94
Ankara, Turkey	96
Al-Khobar, Saudi Arabia	99
Istanbul, Turkey	110
Cairo, Egypt	114
Algiers, Algeria	124
Rabat, Morocco	126
Amman, Jordan	128
Tunis, Tunisia	137
Beirut, Lebanon	140
Sanaa, Yemen	141

SOURCE: Features information from IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*.

FIGURE 2

The 20 Smart Cities Ranked Highest in the 2024 IMD Smart City Index



SOURCE: Features data from IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*.

NOTE: The number with each city name is its IMD ranking. The number with each region label is the number of smart cities that IMD ranked in that region. We designated all countries listed in the report into regions; the IMD report does not do so.

age of percentage of population living in urban areas (66.4 percent in 2023 for MENA versus 57.3 percent for the world).[25] It is also well above the world average in urban population growth (2.0 percent per year in 2023 for MENA versus 1.7 percent for the world). Finally, it has a younger population—29.5 percent of MENA's total population was between ages 0 and 14 in 2023, compared with 25.0 percent for the world—meaning that there will be rising numbers of people who will need jobs, start forming families, need housing, and need services for children, such as education, health, and recreation—all service areas that smart city infrastructure could improve.

Concerns for the Middle East

Such infrastructure can be used to improve services, including public safety, but it can also be used for population control, to limit public dissent, to violate privacy, and to strengthen authoritarian tendencies. This therefore makes smart cities a concern for people in the Middle East who would like to see an expanding space for civil society and personal and political freedom and for supporters of the region who would like the same for its hundreds of millions of residents. Except for Israel, nearly every country in the Middle East is rated in the 2023 EIU Democracy Index as an authoritarian regime, the lowest of four ratings.[26] Of the 20 countries and territories in the Middle East, EIU rated 16 as authoritarian; three as hybrid (Morocco, Tunisia, and Turkey), the third-lowest rating; and one as a flawed democracy (Israel), the second-highest rating; and no full democracies, the top rating.

Perspectives on Smart Cities in the Middle East

The Middle East smart city build-out will depend on choices made within the region. Accordingly, we provide Middle East perspectives on smart cities, addressing how smart cities feature in Middle Eastern governments' planning, how regional analysts have written about such issues as citizen rights, and how the public has expressed its opinion on issues related to smart cities.[27] This description is far from comprehensive but might provide a flavor of discussion and assessment within the region.

Why Middle Eastern Governments Want Smart Cities

Middle Eastern governments have incorporated smart cities in one way or another into their vision and economic strategy documents.[28] Generally, country vision documents and supplemental strategies present smart cities as working in service of a vision's broader goals: economic diversification and competitiveness; economic and environmental sustainability; increased government transparency and effectiveness; and social issues, such as equality, digital inclusion, and social cohesion. Certain countries, such as Oman, Saudi Arabia, Qatar, the UAE, Kuwait, and Bahrain, focus explicitly on smart cities, while others, such as Lebanon, Jordan, and Iraq, focus more on smart city characteristics, such as smart governance, e-commerce, and related infrastructure. Some countries do both: Some cities are built out as smart cities and others increase smart infrastructure.[29] Outside the government, experts, academics, and other knowledgeable writers have indicated a broadly positive view

Some experts have identified smart city initiatives as a potential solution to address such challenges as overcrowding, crime, poverty, weak infrastructure, traffic congestion, and weaknesses in urban planning.

of smart cities—that the benefits outweigh the costs and that, as cities continue to face mounting challenges, the implementation of smart city solutions will be necessary if not inevitable.[30] They have identified smart city initiatives as a potential solution, even a strategic necessity, to address such challenges as overcrowding, crime, poverty, weak infrastructure, traffic congestion, and weaknesses in urban planning.[31] They have also noted the association between smart cities and economic prosperity and increased government efficacy.[32] A discussion with one Middle East official repeatedly highlighted major transportation, logistics, telecommunication, and environmental and health issues that it was hoped a smart city build-out could mitigate, particularly during the coronavirus disease 2019 (COVID-19) pandemic.[33] Indeed, sources have framed smart cities as capable of improving people's quality of life through avenues as varied as crime reduction, increased accessibility of services and public participation in government, environmental and economic sustainability, and the potential to further transitions to knowledge-based economies.[34] Additionally, some sources have highlighted the ability of smart city development in the Middle East to attract foreign investment.[35]

Despite the generally positive depiction of smart cities, sources have identified several implementation challenges, such as cost; the necessity of partnerships between the public and private sectors; a lack of political will; gaps in required infrastructure, such as 5G; and the coordination required between government agencies.[36] Another source noted that increasing public awareness could help mitigate some of the challenges associated with privacy and cybersecurity.[37] Most sources we analyzed acknowledged these issues but do not seem to indicate an overwhelming preoccupation with them.

Taken collectively, discussions of benefits and challenges remained largely technologically and theoretically focused—news coverage only infrequently explored the political or human rights implications. The challenges identified focused on difficulties with implementation rather than ethical and legal concerns. Commentary occasionally mentions privacy but rarely has identified it as a primary concern. Furthermore, few commentators have drawn explicit connections between smart cities

and authoritarianism, instead focusing on such matters as potential cyberattacks and hacking.

Smart Cities and Political and Human Rights

Some sources were exceptions to this lack of focus on political and human rights. These sources were far from the dominant stream of discussion, yet they were also produced by organizations that could be considered at least part of the broader policy dialogue. Of the sources that did touch on political and human rights issues, discussions focused on the urban–rural divide, societal exclusion, the potential for censorship, and possible misuse of data.[38] Government-run or government-linked smart city information infrastructure containing the necessary databases for the functioning of the city have been framed as potentially increasing the threat of censorship or other types of infringements on digital rights.[39] Additionally, one source mentioned that Middle Eastern governments and local societies might not easily adopt the smart city tenets of open data, transparency, and freedom of expression—particularly in terms of citizen–government interactions—because these tenets remain contrary to the dominant political context in the region and traditions of local authority.[40]

Regional civil society organizations have suggested "that the pace of technological innovation and advances [has] outpaced the development of digital rights and human rights protections" in some Middle Eastern countries.[41] Issues raised include protection of digital rights, privacy and data protection, protection against the potential misuse of data, exemptions for the security services, lack of transparency about data use, and lack of a citizen role in helping shape data protection policies.[42] An opinion piece written by Saudi activist Lina al-Hathloul goes one step further in detailing the threats that Middle East smart city projects could pose to individuals' "fundamental rights and freedoms."[43] She warns that governments in Saudi Arabia and Egypt "are leveraging the vision of future cities that integrate the latest technology—using sensors, the Internet of Things (IoT), biometric surveillance, and artificial intelligence—to extend their power."[44] Her commentary appears to be unique in ascribing such specific intent to authoritarians in the region.

Views of the General Public on Smart City Technology Projects

There are indirect ways to infer how people in the Middle East may view different aspects of smart cities. The 2021 Arab Barometer survey of seven Middle East countries could indicate whether the public supports smart city initiatives. In surveys, respondents from Algeria, Iraq, Jordan, Lebanon, Morocco, and Tunisia most commonly cited "create more job opportunities" as the "most important issue the government should be focusing on to improve the economic conditions" in their countries.[45] Likewise, the majority of people surveyed in six of the seven countries included indicated that "a large extent" of corruption exists at the national level.[46] Middle Eastern leaders have, in part, advertised smart city initiatives and related infrastructure projects as a means of job creation and combating corruption through increased transparency. Therefore, although the public might be skeptical about whether government initiatives will successfully accomplish these aims, these surveys could indicate public support.[47]

The Middle East has become an object of competition among the great powers, including technology competition.

The Arab Barometer survey could also indicate public views of foreign smart city technology providers through their opinions on foreign infrastructure projects. In the 2021 Arab Barometer survey of seven Middle East countries, the question of which "country of origin [the respondent] would most prefer to get [awarded an infrastructure construction] contract" might provide some indication of the country of origin preferred for smart city infrastructure providers.[48] Respondents from the majority of countries included in the survey most indicated a preference for Germany; respondents from two of the remaining countries indicated most preferring the United States, and one indicated most preferring France.[49] Opinions about smart city–related infrastructure contracts specifically might have been different if the survey had offered a country-of-origin breakdown of popular smart city vendors; however, it asked only about more-general infrastructure construction vendors.

China and Smart Cities

China has been strongly involved in smart city development, both in China and worldwide. China is certainly not the only country or organization working to develop smart cities. For example, the World Bank runs a Global Smart City Partnership program, which includes projects in Damman and Medina in Saudi Arabia, Gaza, and 80 municipalities in Morocco.[50] And the U.S. government has noted, in remarks by then–Secretary of State Michael R. Pompeo, that smart cities in the Middle East are an opportunity for U.S. companies.[51]

However, China has been developing a well-articulated strategy for smart city build-outs both in China and around the world. And the Middle East has been ripe for Chinese involvement. In broad terms, the Middle East has become an object of competition among the great powers, including technology competition.[52] In narrower terms, some Middle Eastern countries, particularly those along the Persian Gulf, have been developing strong technology links with China while maintaining their security and economic relations with the United States.[53]

We considered the current state and direction of development of smart cities (智慧城市) in China, including China's prospects for exporting the model.[54] In 2013, China announced pilot smart city programs in 90 cities, districts, and towns. It announced a second wave in 2014, designating 103 pilots. And it announced a third wave in 2015, designating an additional 84 locations in China.[55] By January 2020, it had almost 800 pilot projects underway—more than half of all smart city projects worldwide.[56] Of the cities that IMD ranked, China (11,

including Hong Kong) and the United States (ten) have the most smart cities.[57]

Just as it has domestically, China has made support for the development of smart cities abroad, including in the Middle East, a goal not only for Chinese technology companies but for the national government.[58] The policy context for doing so is the Belt and Road Initiative, which has noted smart cities as a strategic opportunity and which was written into the constitution of the Chinese Communist Party (CCP) in 2017.[59] Even before that, China announced the so-called Digital Silk Road as part of the Belt and Road Initiative in 2015.[60]

In 2017, China's leader, Xi Jinping, identified smart cities as part of the effort to turn the Belt and Road Initiative "into a road of innovation."[61] China then magnified the idea of the Digital Silk Road further in 2019 at the second Belt and Road Forum.[62] The policy report produced in coordination with the forum noted that "all parties involved in the Belt and Road Initiative" should "intensify cooperation in frontier areas such as . . . smart cities, so as to turn them into a digital Silk Road of the 21st century."[63] One analysis identified smart cities as one of the three main areas of the Digital Silk Road.[64] The international policy advisory body for the Belt and Road Initiative has noted that, with some countries wary of costly, large projects and with international technology competition increasing, "priority could be given to cooperation on smart cities, including holding forums and sharing experience and practices among cities of partner countries, to explore ways to harness the benefits of digitalization and achieve better development."[65]

China's Past and Present Models of Smart Cities

Since 1995, China has had five distinct policy-supported plans for informatization of its urban areas, each of which has been supported by policy language in China's five-year plans for development (Table 5). The first of these plans was 1995's "Eight Gold Plan," focused on building foundational information infrastructure. In the 2009 iteration, one important component of China's goals for smart city development was establishing pervasive mobile networks. By 2015, the "New Smart Cities" plan focused on developing the IoT, cloud computing, and big data capabilities.

The most recent plan, the sixth, advanced in 2022, encompasses the concept of the digital twin city (DTC), a highly futuristic vision of building and managing a city such that every person, object, vehicle, and building can be tracked in real time, and each digitally modeled entity can also be simulated in a computer program for purposes of modeling whole-city scenarios. This vision has not yet been realized because of substantial technological, manufacturing, staffing, and security challenges.

China's Track Record on Smart Cities

Tracking China's smart city development is a layered problem, for two reasons:

- The first is the massive disparity between levels of development in China's first-tier and lower-tier cities.
- The second is China's shifting definition of *smart city*.

Accordingly, assessment of the smart city build-out must necessarily take into account both urban–rural develop-

TABLE 5
Chronology of China's Urban Informatization Policies

Year	Development Stage		Key Technology	Primary Implementation Period
	English	Chinese		
1995	Eight Gold Plan	八金计划	Foundational nationwide information infrastructure	9th Five-Year Plan
1998	Digital Cities	数字城市	3S technologies (i.e., geographic information systems, GPS, remote sensing)	10th Five-Year Plan
2006	Information Cities	信息城市	ICT	11th Five-Year Plan
2009	Smart Cities	智慧城市 ("智能城市" and "感知城市" are less used alternatives)	New-generation information technologies, such as the IoT, cloud computing, pervasive mobile networks, and big data systems	12th and 13th Five-Year Plans
2015	New Smart Cities	新型智慧城市	Primarily the IoT, cloud computing, and big data	13th Five-Year Plan
2022	Digital Twin Cities	数字孪生城市	Maximalist digital modeling of physical spaces, people, objects, and vehicles; real-time tracking of all entities; scenario simulation for planning; and city brains	14th Five-Year Plan

SOURCES: Entries for 1995 through 2015 are drawn from Atha et al., *China's Smart Cities Development*, pp. 14–15, citing Jin, *Leading Cadre Reader for Network Security and Informatization*, p. 20. The entry for 2022 is the assessment of the authors.

ment disparities and the shifting definitions of *smart city* as each wave of goal-setting has come and gone.

If we consider smart cities to be DTCs, the count is zero in China and globally. However, if we count cities where mobile networks have become pervasive (which, per the 12th and 13th Five-Year Plans, is one of the core components of a smart city), the number of smart cities in China is in the thousands: China has made it a priority to expand 5G coverage across the nation and was on track to have 2.9 million 5G base stations by the end of 2023.[66] That would put China's 5G coverage at more than 90 percent.[67]

Or, if we consider the development of China's digital economy, as measured in penetration of the Alipay and WeChat Pay active user bases, China is leading the way in economic digitization. By the end of 2021, more than 900 million residents of China were using mobile payments.[68]

Similarly, China's smart city development based on IoT penetration (a goal of the 12th, 13th, and 14th Five-Year Plans for smart cities) shows monumental progress: In December 2022, the Ministry of Industry and Information Technology (MIIT) reported 1.8 billion connections for cellular IoT services in China, about 70 percent of the world's total (Table 6 presents end-user numbers).[69] By the numbers and under China's own definitions, China leads the world in smart city development.

However, these numbers do not tell the whole story of smart cities as urban entities in China. Much of

TABLE 6

China's Internet of Things Users, by Type, December 2022

User Type	Millions of Users
Public services	496
Vehicles	375
Smart retail	350
Smart home	192

SOURCE: Features information from Weissberger, "China Is Global IoT Superpower with 1.8 Billion Connections as of Dec 2022."

the mobile connectivity detailed above serves underdeveloped villages or rural counties; the smart homes accounted for represent only 20 percent of China's 921 million urbanites, and, for residents of fourth- and fifth-tier cities, the digital payment numbers aggregated by UnionPay indicate that the poorest mobile users earn well below the Chinese government's definitions of *middle class* (below US$7,250 per year).[70] There are also roughly 500 million Chinese residents unaccounted for in this digital-payment transformation; they are, presumably, the poorest of Chinese citizens, whether urban, rural, or part of the estimated 375 million "floating population" of urban-to-rural temporary migrant workers.[71] That is to say that China's policymakers have accurately identified the descriptors and attributes of smart cities (e.g., smart cities would have pervasive 5G IoT connectivity), and China has amassed these descriptors and attributes but not the smart cities themselves.

This assessment is validated, to some extent, by recent research on the progress (or lack thereof) of China's smart city pilot projects. A 2021 research project funded by two grants from the National Natural Science Foundation of China included a survey of 2,080 smart city pilot projects in 136 cities in China and assessed the progress of each smart city development plan (SCDP) along five dimensions. The aggregated data from the study suggest "that, in most cases, pilot projects included in the SCDPs have merely been set up to show a future possibility and without actual progress."[72] Furthermore, the researchers found that

> although the Chinese government has spared no effort to provide universal Internet access in rural areas, the urban–rural digital gap has widened during e-development efforts . . . . This article confirms that there is no dominant smart city development model even within a country . . . . [M]ost pilot projects remain an "empty slogan" in the plan in China.[73]

Smart Cities, Technology Integration, and Digital Twin Cities

According to the U.S.–China Economic and Security Review Commission's research report *China's Smart Cities Development*, the iterations of models for smart cities have "been inclusive of the technologies emphasized in the previous phase rather than supplanting them."[74] That is certainly the case for the DTC model, the newest iteration, which relies heavily on integration of mature technologies domestically produced in China and on predicted capabilities yet to be developed or matured, such as increases in supercomputer processing power and cultural standards for information security and cybersecurity. Furthermore, CCP policy documents

China's policy has explicitly called for exploration and development of DTCs as the most cutting-edge vision of smart cities.

have explicitly called for exploration and development of DTCs as the most cutting-edge vision of smart cities while calling for more fundamental support of basic digitization in less-developed areas of China.

We can track the CCP's policy backing for the DTC model of urban development through several threads:

- First, we can observe direct support for DTC development in high-level policy documents.
- Second, we can track the authorship of a detailed report on DTC functions and features to the China Academy of Information and Communications Technology (CAICT), a think tank subordinate to the CCP's MIIT.[75]
- Third, we can map CAICT's descriptions of ongoing DTC challenges in 2022 to a list of problems with smart city development articulated in 2016 by Li Weisen, a senior central government policymaker.[76]

Key Policy Document Support for the Digital Twin City Model

The 14th Five-Year Plan (March 2021, covering 2021 through 2025) has a paragraph dedicated to smart cities.[77] The stated policy intention is as follows:

> We will use digitalization to promote urban and rural development and governance model innovation and comprehensively improve operational efficiency and livability. We will promote the construction of new smart cities based on different levels and categories, incorporate IoT perception facilities and communication systems into the unified planning and construction of public infrastructure, and promote IoT applications and intelligentized transformations such as in municipal public facilities and buildings. We will improve the city information model platform and operation management service platform, build a city data resource system, and promote the construction of city data brains (城市数据大脑). We will explore the construction of digital twin cities. We will accelerate the construction of digital villages, build a comprehensive information service system for agriculture and rural areas, establish inclusive service mechanisms for agriculture-related information, and promote the digitalization of rural management services.[78]

In this policy document, the key attributes of smart cities highlighted for research and development support include "IoT perception facilities," "IoT applications and intelligentized transformations such as in municipal public facilities and buildings," "information model platform and operation management service platform," "a city data resource system," "city data brains," and

"digital twin cities." However, the 14th Five-Year Plan's list is not actually a list of discrete aspects of smart cities. Rather, CAICT's 2022 report on the DTC model makes clear that the DTC model incorporates—and in fact relies on—all the previous items in the list.[79]

The *14th Five-Year Plan for National Informatization* has specific guidance on smart cities and the DTC concept:

> **Advance the high-quality development of new kinds of smart cities.** Advance the integrated development of smart city-clusters by suiting measures to local conditions; promote the coordinated joint action of a batch of smart application regions focusing on public transport, express delivery and logistics, medical appointments, school attendance, urban operational management, ecological and environmental protection, licensing management, market oversight, public security, emergency response and management, and other such focus areas, and promote the informatized and coordinated development of regional informatization. Encourage information sharing in the Guangdong–Hong Kong–Macau bay area. Steadily advance the construction of urban data resource systems and data brains; forge interconnected, open, and enabling smart hubs; perfect urban information model platforms and operational management and service platforms; explore the construction of digital twin cities.[80]

So, these two national policy documents of China, published in March and December 2021, called for exploring the construction of DTCs and identifying digital twinning as a "strategic advanced technology." It is clear that, for the CCP, modernizing China's urban environments is one of many priorities. It is also clear that the CCP specifically supports exploring the concept of the DTC and implementing this concept as feasible. But what does this mean, exactly, and how feasible is implementation?

A Cutting-Edge Vision of Smart Cities: The China Academy of Information and Communications Technology's "Digital Twin Cities"

In April 2022, CAICT published a report called "Digital Twin Cities: Framework and Global Practices" ("数字孪生城市：框架与全球实践").[81] Although CAICT is directly subordinate to the MIIT, CAICT chose to publish this report through a third party: the World Economic Forum, a Swiss-founded nongovernmental organization best known for hosting an annual, invitation-only meeting in Davos.[82] This decision to publish in English in addition to Chinese was a departure from CAICT's previous publications exploring the aspects of smart city development, including its jointly authored December 2021 white paper on DTCs.[83] That 2021 white paper, coauthored with the MIIT-founded China Communications Standards Association (中国通信标准化协会) and the Chinese nongovernmental organization Internet Society of China (中国互联网协会), showed that DTCs were a concept in progress because of both the ongoing development of its underpinning theories and the complexity of the technology involved.[84] Not much about this wishful status appears to have changed between December 2021 and the publication of the April 2022 report.

The primary content of the report is a detailed description of the DTC model of smart cities. This vision of smart cities is, essentially, that an entire Chinese city

be administered digitally via an integrated computer model that represents all people, buildings, vehicles, and everyday objects within the city, in real time. The DTC model therefore requires all of the above to be *twinned*—that is, all buildings and roads are mapped, all moving entities (such as people and vehicles) are live tracked, and all IoT-capable devices continually feed their data streams to the digital twin program.[85] This massive amount of data about millions of entities would flow back to a central administrative city brain that compiles millions of digital twins from the city into a single computer program, thus representing the DTC to CCP administrators. This administrative and control tool would be like the computer games SimCity or the Sims, but each entity would be a real-time representation of a real-life person, vehicle, or object. According to the CAICT report, such a DTC simulation would have high-enough fidelity to permit not only real-time administration but also predictive, interactive modeling of disaster scenarios and other hypothetical events—that is, the administrators could pause real-time monitoring and control and run what-if scenarios in the digital twin world by altering such factors as traffic, civil unrest, or natural disasters.[86]

The report details the multiple goals of real-time information-monitoring across virtually all aspects of the city.[87] Improving services and facilitating development are clearly important and in line with China's policies since reform and opening in the late 1970s. But this technology also allows an end state of continuous digital monitoring of the physical state of a city, in real time, enabling the government to increase control by maintaining order over its citizens and over the citizen–government relationship.

The State of Digital Twin City Model Development

There are several obstacles to implementing the DTC vision of a smart city:

- The first hurdle is the DTC concept's complexity; modeling so many entities in real time within a single computer program requires that each of the real-world entities be linked to an IoT network. This, in turn, requires that everyday objects be manufactured with IoT capabilities baked in, which means that the digital twin concept of smart cities cannot reasonably be developed as a bolt-on municipal administrative tool: That would require such monumental efforts as replacing all televisions and refrigerators with smart televisions and smart refrigerators and digitally mapping the interiors of all buildings constructed or renovated prior to the digital age. Rather, the DTC lends itself to cities constructed from scratch.
- The second challenge to implementation is that the processing power necessary to run such a complex program is massive and would require, in each city, a supercomputer cluster of capacity perhaps unavailable with current technology. Even if such computing power is technically feasible as a one-off, China has an urban population of approximately 900 million, so the total volume of demand for DTC integration is very large.[88]

- Third, creating such a network and database poses a tremendous cybersecurity challenge: The attack surface of the network would be massive and complex, and the city would be at tremendous risk of sabotage if an adversary breached or corrupted its databases or networks. Simply put, tracking and monitoring all entities within a city enables highly sophisticated levels of administrative and governance control, but it also puts the entire city's privacy and security eggs in one basket.

China's vision of smart cities appears to be at a threshold. Until very recently, China was focused on catching up with the information infrastructure standards established by developed nations. As of the 2020s, Chinese think tanks have developed a vision for what the next generation of smart cities might look like (DTCs), but China lacks both the technological and systemic capabilities to implement or export that model. Nonetheless, both at home and in the Middle East, China is forging ahead on developing smart cities with the technology available.

China and Smart Cities in the Middle East

The Middle East is a location where China wants to advance its plans for smart cities.[89] This is especially in the context of the 2023 normalization agreement between Saudi Arabia and Iran that China brokered. After rail networks, smart cities are portrayed as a key element in developing regional integration networks and

> The DTC vision is that an entire city be administered digitally via an integrated computer model that represents all people, buildings, vehicles, and everyday objects within the city, in real time.

"to boost industrial development, create enough jobs, and hedge other risks."[90]

To gain a finer-grained understanding of China's involvement in smart cities in the Middle East, we drew on the database created by the Australian Strategic Policy Institute as part of its Mapping China's Technology Giants project.[91] The database is meant to be a living document, although the last major update took place in June 2021.[92] Nonetheless, given the long lead time of smart city projects, the data appear to give a good indication of patterns throughout the Middle East. We drew observations from the database for which the primary, secondary, or tertiary topic was *smart cities* or for which the overseas presence category (listed as "infrastructure

Of China's 36 smart city projects in the Middle East, 13 involve surveillance.

type" and "secondary infrastructure type") was listed as "smart city—public security project."[93]

Under these criteria, there were 36 China-involved smart city projects in the Middle East between 2014 and 2021. The first project recorded was one by the Chinese telecommunications firm Huawei in Yanbu, Saudi Arabia, focusing not just on smart city infrastructure but also on surveillance infrastructure. From one project in 2014, four projects started in 2016, the year after the Digital Silk Road was announced. Seven new projects were then started in each of 2017, 2018, 2019, and 2020, with only one recorded as starting in 2021 (perhaps because of the shutdowns related to the COVID-19 pandemic, or perhaps because the database has not been updated). Of these 36 projects, 13 are listed as involving surveillance either as topic or as infrastructure. Seven involve artificial intelligence as the topic of the collaboration, and an additional six involve a research and development lab, a research partnership, or training.

Companies

Of all the Chinese technology giants involved in smart city projects in the Middle East, Huawei is by far the most dominant, with involvement in 28 of the 36. Huawei is China's leading ICT company, with operations around the world, a leading role in deploying 5G telecommunication infrastructure, and a strong record of innovation.[94] For example, as of 2022, Huawei had the most patent applications of any company under the Patent Cooperation Treaty for six years in a row.[95] The Patent Cooperation Treaty provides an avenue for seeking patents in multiple countries.

However, there is another side to Huawei. Western governments widely view the company as cooperating with China's intelligence agencies in electronic monitoring and in the exfiltration of data. It has also been accused of intellectual property theft and unethical conduct, including fraud and deception.[96] In 2021, Huawei chief financial officer Meng Wanzhou entered into a deferred-prosecution agreement with the U.S. Department of Justice on charges of "conspiracy to commit bank fraud and conspiracy to commit wire fraud, bank fraud and wire fraud."[97] Under the terms of the agreement, she agreed to a statement of facts that detailed her false statements.[98]

This has led a variety of countries to ban Huawei completely or partially from their 5G systems, including Australia, Canada, New Zealand, the United Kingdom, and the United States. In June 2023, the European Commission said that the 27 members of the European Union were justified in banning both Huawei and another Chinese telecommunication giant, ZTE, from their 5G systems and encouraged them to do so.[99] As of

that date, ten of the 27 members had restricted Huawei in some way.

Huawei's involvement has also limited some projects' ability to interact with the United States. Huawei has established OpenLabs in the Middle East, designed to enable Huawei to work with industry partners to "enable digital transformation, while promoting industry ecosystem development."[100] There are three in the Middle East (in the database): one each in Dubai, Istanbul, and Cairo. All three are also on the U.S. Department of Commerce entity list with a "presumption of denial" for export licenses, meaning that they do not have access to a variety of U.S. technologies.[101] Technologies that are restricted are generally those that are dual-use, meaning they have both military and civilian applications, but regulated items are not limited to dual-use items.

Beyond Huawei, several other Chinese companies are involved in smart city projects in the Middle East. Three companies involved in two projects each include telecommunication company China Mobile; Alibaba, which is working on artificial intelligence–related projects; and drone maker DJI. Two companies involved in one project each starting between 2014 and 2021 are the state-owned China Electronics Technology Group Corporation (CETC), one subsidiary of which is video surveillance manufacturer Hikvision; and artificial intelligence software company SenseTime.

Countries and Cities

Mirroring the smart city rankings produced by IMD, the dominant countries for China-involved smart city projects in the Middle East are the UAE (with 11) and Saudi Arabia (with seven). In fact, 23 of the 36 projects are in the wealthy Cooperation Council for the Arab States of the Gulf (also known as *the Gulf Cooperation Council*) countries of Bahrain (one project), Kuwait (one project), Oman (two projects), Qatar (one project), Saudi Arabia, and the UAE. Outside the Gulf Cooperation Council, Turkey—also a wealthy country for the region—has the most: five. The remainder are spread throughout the region: two each in Algeria and Egypt and one each in Iraq, Iran, Morocco, and Tunisia.

Numerous projects are identifiable by city. In keeping with above patterns, Dubai is the city with the most identified China-involved smart city projects, with eight (see Figure 3). Two other cities are listed as having more than one project—Istanbul shows three, and Abu Dhabi is listed with two.

A U.S. Approach to Smart Cities in the Middle East

Like other regions, the Middle East has embarked on a smart city build-out. Although smart cities are concentrated in wealthier countries, likely declines in technology costs and increased experience with smart city build-outs are likely to enhance their spread across the region. Smart city vendors from around the world are involved in the four layers of smart city build-out: sensing, transmission, data management, and application. Among these companies, Chinese companies (especially Huawei) are active in building out telecommunication systems—the transmission layer—as would be expected given the level of technology, these companies' cost competitiveness, and China's overall globalization strategy.

FIGURE 3

China-Involved Smart City Projects up to 2021

SOURCE: Features data from Cave et al., *Mapping China's Technology Giants*.

The value to a country of being involved is that it receives advanced technology at what it assesses to be an attractive price. The challenge is that, from what one can see in the findings and actions of many Western countries, Middle Eastern countries face the risk of intelligence activities and data exfiltration. This is especially true of Huawei because it is Huawei's telecommunication infrastructure over which the data collected by smart city sensors travel.

Given the close relationship between the United States and Middle Eastern countries and the Middle East's centrality in strategic competition, this build-out has policy implications for the United States and its allies.

The Stakes for Middle Eastern Partners of the United States

The United States remains the main security provider for numerous countries in the Middle East. It has also gone through strenuous efforts to get its closest allies to not use Huawei infrastructure in 5G build-outs, stressing a security threat and noting that security and intelligence cooperation could be limited if they do. Although the United States has not been successful at getting reductions in Huawei usage in the Middle East, it has been successful in communicating to those countries that the use of Chinese infrastructure could limit security cooperation.[102]

In a question-and-answer session during a presentation at the International Institute for Strategic Studies 2022 Manama Dialogue in Bahrain, then–U.S. Under Secretary of Defense for Policy Colin Kahl discussed U.S. views toward other countries cooperating with China: "Can countries have relations with all sorts of other countries? Of course," he said. He continued,

> Our national defense strategy defines China as our pacing challenge. The United States has lots of relationships with China. Our economy is highly intertwined with China . . . . It's not our policy that countries have to choose. This is not some new Cold War in which it's our way or the highway.[103]

But then he focused on security cooperation:

> But there's another variable, and here's where the choice is something in our national interest. At a certain point, across a certain threshold, if our closest allies and partners cooperate too deeply with China on the security side, it'll create security risks for us . . . . It won't be safe for us to partner as deeply or as broadly.[104]

For Middle East policymakers, the implications are clear: If they value their security relationship with the United States, they need to ensure that any ICT or smart city infrastructure they install meets U.S. standards for not creating risks for U.S. forces or security. This might mean keeping separate networks, if that is possible, or, in some cases, it could mean not using Chinese infrastructure. Or it could mean using Chinese infrastructure and accepting a lower level of security provision by the United States.

Policy Implications for the United States and Its Allies

Although Middle Eastern countries might face a choice between preferred technology providers and security, the United States faces choices as well. The U.S. government would like to see U.S. and Western vendors more generally succeed in the market. And yet, the United States does not have a system that allows it to compete head-on with China's subsidies and government support.

However, the United States does have the means to compete in this market. It can provide limited amounts of financial or risk-mitigation support, such as through the U.S. International Development Finance Corporation.[105] U.S. and Western vendors can also offer quality and security. And they could find themselves more competitive in some of the four layers, even if not in all. Even where Western products might not be able to compete, Western countries can offer technical support for choosing vendors, tracking contracting, and generally ensuring that technology decisions are in the best interests of the host country and made without corruption or the influence of nonbusiness factors.

If the smart city build-outs are effective, there will be secondary and tertiary opportunities that could be more lucrative than the initial build-out. These could include health services, environmental technology, educational services for the young population, or even increased business opportunities if the smart city build-out has a positive effect on economic activity. Finally, beyond these positive inducements, there is the negative inducement noted above: The United States can stress firm redlines for security cooperation and adhere to them rigorously.

Notes

1 White House, *National Security Strategy of the United States of America*, p. 2.

2 White House, *National Security Strategy*, p. 7.

3 Schmid, "Rethinking Who's Winning the U.S.–China Tech Competition."

4 Lin, Woo, and Huang, "The U.S. Wanted to Knock Down Huawei"; Woo and O'Keefe, "Washington Asks Allies to Drop Huawei.

5 Manville et al., *Mapping Smart Cities in the EU*, p. 9. See also RAND, "Mapping Smart Cities in the EU."

6 Atha et al., *China's Smart Cities Development*; Panepinto, "People's Republic of China Likely to Become a Global Leader in Smart Cities Development in the Next Ten Years."

7 U.S. Department of Defense, *The Department of Defense Indo-Pacific Strategy Report*, p. 6.

8 Within the Middle East, Israel has been a site of U.S.–China competition (Efron et al., *The Evolving Israel–China Relationship*). Because Israel is the most economically and technologically advanced country in the region, and one that heavily depends on the U.S. security umbrella, the United States could have reason for concern about China's smart city activities there. However, in part because of U.S. diplomatic and defense discussions with Israel, and in large part because of China's stance toward Israel following the October 7, 2023, Hamas terrorist attack, Israel has more firmly made clear that it is in the U.S. camp in U.S.–China competition (Grossman, "China Is Burning All Its Bridges with Israel"; Lipkind, "Fickle Friends"; Singh, "Why China Is Taking Sides Against Israel"). In addition, although Israel can improve its socioeconomic standing, the development challenges for which smart cities might provide solutions are far more serious elsewhere in the Middle East. Accordingly, this report focuses largely on the Middle East beyond Israel.

9 Wasser et al., *Crossroads of Competition*.

[10] White House, *National Security Strategy of the United States of America*; White House, *National Security Strategy*.

[11] Bondy, "President Biden Reaffirms U.S. Commitment to Bright Future in the Gulf Region"; White House, "President Donald J. Trump Is Promoting Peace and Stability in the Middle East."

[12] Garamone, "General Says Middle East Is a Theater for Strategic Competition."

[13] United Nations, *World Urbanization Prospects*.

[14] Ahvenniemi et al., "What Are the Differences Between Sustainable and Smart Cities?"

[15] Woetzel et al., *Smart Cities*.

[16] Silva, Khan, and Han, "Towards Sustainable Smart Cities."

[17] Zanella et al., "Internet of Things for Smart Cities," p. 22.

[18] Goldman Sachs Group, *The Internet of Things*, p. 3.

[19] Bouskela et al., *The Road Toward Smart Cities*, p. 14.

[20] This follows Silva, Khan, and Han, "Towards Sustainable Smart Cities."

[21] Singh, "Smart Cities"; van Dijk et al., *Smart Cities*; Vanolo, "Smartmentality."

[22] IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*.

[23] IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*, p. 31.

[24] IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*, p. 31.

[25] All data in this paragraph are from World Bank, World Development Indicators. Urban population is the variable "Urban population (% of total population)," series code SP.URB.TOTL.IN.ZS; urban population growth is "Urban population growth (annual %)," series code SP.URB.GROW, and young population is "Population ages 0-14 (% of total population)," series code SP.POP.0014.TO.ZS.

[26] EIU, *Democracy Index 2023*. The other three are full democracy, flawed democracy, and hybrid regime. The ratings are calculated from scores on electoral process and pluralism, functioning of government, political participation, political culture, and civil liberties.

[27] To do so, we draw on Arabic-language news articles, regional think tank reports, strategic guidance documents, and public opinion polling. There are four limitations to our analysis:

- Regarding the written documents, limitations are
  - circumscribed discussion of the more-contentious aspects of smart cities, potentially because of the limits of press freedoms in some countries
  - the inability to capture regional perspectives at large because of an absence of polling on this topic
  - the inability to capture unstated or potentially coercive aims when considering government perspectives and goals
- A fourth limitation is that we talked directly with only a limited number of officials or others from these countries, and a greater number of interviews might have provided different information from what is available in writing.

[28] We drew on the following sources:

- Abu Dhabi General Secretariat of the Executive Council, Department of Planning and Economy, and Council for Economic Development, *The Abu Dhabi Economic Vision 2030*
- Bahrain, *From Regional Pioneer to Global Contender*; Bahrain Information and eGovernment Authority, "Bahrain Launches Telecommunications, ICT, and Digital Economy Sector Strategy"
- Egypt Ministry of Communications and Information Technology, "Egypt's ICT 2030 Strategy"; Egypt Ministry of Planning and Economic Development, "Egypt Vision 2030"
- Iraq Ministry of Planning, *"The Future We Want"*
- Israel Ministry for Social Equality, "The Digital Israel National Initiative"
- Jordan, *Jordan 2025*; Jordan Ministry of Digital Economy and Entrepreneurship, *National Digital Transformation Strategy and Implementation Plan*
- Korea Development Institute, *Establishment of Algeria's National Vision 2030*
- Kuwait General Secretariat of the Supreme Council for Planning and Development, *Kuwait National Development Plan 2020–2025*; Kuwait Ministry of Foreign Affairs, "Kuwait Vision 2035 'New Kuwait'"
- Lebanon Office of the Minister of State for Administrative Reform, *Lebanon Digital Transformation*

- Morocco Ministry of Industry, Trade and New Technologies, *Digital Morocco 2013*; Morocco Special Commission on the Development Model, *The New Development Model*
- Chen, "Enabling ICT Talents to Support Oman's Digitally-Driven Future" (about e.Oman 2030); Oman, "Oman Vision 2040"
- Qatar General Secretariat for Development Planning, *Qatar National Vision 2030*; Qatar Ministry of Communications and Information Technology, TASMU
- Advanced Electronics Company, Vision 2030 Saudi Arabia, and Ministry of Municipal and Rural Affairs, "Smart Cities"; Saudi Arabia, *Vision 2030*
- Tunisia, *Tunis 2035*; Tunisia Ministry of Communication Technologies, "Tunisia Digital 2020"
- UAE Ministry of Energy and Infrastructure, "Strategic Plan Ministry of Energy and Infrastructure 2020–2021."

[29] Middle East official, discussion with the authors, May 2023.

[30] For instance, see Abu Najim, "The Advantages and Disadvantages of Smart Cities"; el-Hamamsi, "Smart Cities Are a Necessity Dictated by the Fourth Industrial Revolution"; and Mikhail, "Towards Smart and Democratic Cities."

[31] Belfalah, "Smart Cities"; Mikhail, "Towards Smart and Democratic Cities"; el-Hamamsi, "Smart Cities Are a Necessity Dictated by the Fourth Industrial Revolution"; Karoumy, "Smart Cities"; Makhlouf, "The Need for Smart Cities to Achieve Sustainable Development"; Massad, "The New City."

[32] "Arab Smart Cities Need to Prepare Highly Trained Personnel"; Karoumy, "Smart Cities."

[33] Middle East official, conversation with the authors, May 2023.

[34] Abdullah, "Bahrain and the Transformation from the Oil Economy to the Knowledge Economy"; "Arab Smart Cities Need to Prepare Highly Trained Personnel"; el-Hamamsi, "Smart Cities Are a Necessity Dictated by the Fourth Industrial Revolution"; Hamed, "The Future of Smart Cities to Solve Urban Problems in Egypt," p. 418; Karoumy, "Smart Cities"; Mikhail, "Towards Smart and Democratic Cities," p. 5.

[35] Hamed, "The Future of Smart Cities to Solve Urban Problems in Egypt," p. 418; Karoumy, "Smart Cities."

[36] Abu Najim, "The Advantages and Disadvantages of Smart Cities"; el-Hamamsi, "Smart Cities Are a Necessity Dictated by the Fourth Industrial Revolution"; Karoumy, "Smart Cities."

[37] Mikhail, "Towards Smart and Democratic Cities."

[38] El-Sherbiny, "Developing the Digital Future of the Arab World."

[39] "Arab Smart Cities Need to Prepare Highly Trained Personnel"; Mikhail, "Towards Smart and Democratic Cities," pp. 8–10.

[40] "Arab Smart Cities Need to Prepare Highly Trained Personnel."

[41] Salha et al., *Mapping Digital Rights in MENA*, p. 86; Mikhail, "Towards Smart and Democratic Cities."

[42] Mikhail, "Towards Smart and Democratic Cities," pp. 4–5, 8–10; Salha et al., *Mapping Digital Rights in MENA*, p. 86.

[43] Lina al-Hathloul is a Saudi activist and the sister of Loujain al-Hathloul. Loujain al-Hathloul was imprisoned for her role in the Saudi activist movement to legalize driving for women. At the time of this research, Lina al-Hathloul was based in Belgium and was the head of monitoring and communications at ALQST, an advocacy organization for human rights in Saudi Arabia based in Saudi Arabia and London.

[44] Al-Hathloul, "Dictators in Egypt and Saudi Arabia Love Smart Cities Projects."

[45] Arab Barometer, AB Wave VI-C-2021.

[46] The six countries were Algeria, Iraq, Jordan, Lebanon, Libya, and Tunisia; Morocco was the seventh (Robbins, "Fragile Popularity").

[47] Although privacy concerns are not reflected in the survey, they could outweigh perceived benefits, particularly for people living in the Middle East who have low confidence in their governments' ability to implement smart city initiatives in a way that would allow them to reap benefits.

[48] Robbins, "Fragile Popularity."

[49] Robbins, "Fragile Popularity."

[50] World Bank, "Global Smart City Partnership Program"; World Bank, "Global Smart City Partnership Program (GSCP) Projects Map."

[51] Pompeo, "Remarks at the Virtual Launch of the Inaugural U.S.–UAE Strategic Dialogue."

[52] Wasser et al., *Crossroads of Competition*.

[53] Narayanan, "Saudi Arabia's Residential Landscape Changing as Smart Cities Rise"; al-Sudairi, Hai, and Alahmad, *How Saudi Arabia Bent China to Its Technoscientific Ambitions*.

[54] This section draws from secondary research on China's smart cities, China's policy documents that mention smart cities and the contexts within which the country promotes smart city development, and other public-facing, China state–sponsored documents that address smart city development.

[55] Verdict, "History of Smart Cities."

[56] Atha et al., *China's Smart Cities Development*, pp. 1, 20.

[57] IMD World Competitiveness Center and World Smart Sustainable Cities Organization, *IMD Smart City Index Report 2024*.

[58] Ekman, *China's Smart Cities*.

[59] Atha et al., *China's Smart Cities Development*; "'Belt and Road' Incorporated into CPC Constitution."

[60] Xiao and Ding, "Evolution of China's Belt and Road Initiative."

[61] China Ministry of Science and Technology, "Xi Jinping."

[62] Xiao and Ding, "Evolution of China's Belt and Road Initiative."

[63] China Office of the Leading Group for Promoting the Belt and Road Initiative, *The Belt and Road Initiative Progress, Contributions and Prospects*.

[64] Xiao and Ding, "Evolution of China's Belt and Road Initiative."

[65] Advisory Council of the Belt and Road Forum for International Cooperation, *High-Quality Belt and Road Cooperation*, p. 64.

[66] Tomás, "China to End 2023 with 2.9 Million 5G Base Stations."

[67] "Nation's 5G Penetration Rate to Hit 90% in 2023, Thanks to Rapid Networking Efforts."

[68] Daxue Consulting, "Payment Methods in China."

[69] Weissberger, "China Is Global IoT Superpower with 1.8 Billion Connections as of Dec 2022."

[70] ChinaPower, "How Well-Off Is China's Middle Class?" For the UnionPay numbers, see Fou, "Mobile Payment Usage Passes 80%."

[71] China National Bureau of Statistics, "Communiqué of the Seventh National Population Census."

[72] Wang, Loo, and Huang, "Becoming Smarter Through Smart City Pilot Projects," p. 12.

[73] Wang, Loo, and Huang, "Becoming Smarter Through Smart City Pilot Projects," pp. 18–19, 20, 21.

[74] Atha et al., *China's Smart Cities Development*, p. 14.

[75] Triolo and Webster, "Profile."

[76] China National Geographic Survey Information Administration, "Deputy Minister Li Weisen Answers Media Questions About the Division of Labor for Xiong'an New Area Construction and Basic Infrastructure Construction," cited in Atha et al., *China's Smart Cities Development*, p. 20.

[77] China, *Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035*.

[78] This appears in Article XVI, "Accelerate the pace of digital society construction" (加快数字社会建设步伐), Section 2: "Build smart cities and digital villages" (建设智慧城市和数字乡村) of China, *Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035*, p. 41.

[79] Chen et al., "Digital Twin Cities."

[80] China Central Commission for Cybersecurity and Information, *14th Five-Year Plan for National Informatization*, p. 36. Elsewhere, the plan states, "**Deploy strategic advanced technologies.** Strengthen strategic research deployments and scalable technological innovation in critical and advanced areas such as . . . digital twinning . . ., etc." (p. 25).

[81] Chen et al., "Digital Twin Cities."

[82] China Academy of Information and Communications Technology, "About Us."

[83] CAICT, Internet Society of China, and China Communications Standards Association, "Digital Twin City White Paper."

[84] CAICT, Internet Society of China, and China Communications Standards Association, "Digital Twin City White Paper," p. 3.

[85] Chen et al., "Digital Twin Cities," p. 18.

[86] Chen et al., "Digital Twin Cities," p. 43.

[87] Specifically, the authors wrote,

> [An implemented DTC would require] open access to urban spatio-temporal data; this includes the continuous integration of multisource data such as that relating to buildings, bridges, roads, municipalities and other traditional infrastructure, as well as the real-time collection of IoT-sensing data. At the same time, . . . geographical data [would be] acquired through oblique photography and laser scanning, and 3D data [would be] automatically extracted through AI technologies such as deep learning. All of these measures help form an integrated, highly precise urban digital twin that projects the physical city in all aspects (e.g. above and below ground, indoors and outdoors), which provides data support for the orderly development of the city, and convenient services for citizens. (Chen et al., "Digital Twin Cities," p. 18)

[88] China National Bureau of Statistics, "Communiqué of the Seventh National Population Census."

[89] Harbor Overseas, Institute for Global Cooperation and Understanding, and Hong Kong Institution for International Finance, "How to Better Build Smart Cities in West Asia as Saudi Arabia and Iran Reached Agreements in Beijing?"

[90] Harbor Overseas, Institute for Global Cooperation and Understanding, and Hong Kong Institution for International Finance, "How to Better Build Smart Cities in West Asia as Saudi Arabia and Iran Reached Agreements in Beijing?" p. 2.

[91] Cave et al., *Mapping China's Technology Giants*; International Cyber Policy Center, "Data Listing."

[92] International Cyber Policy Center, "What's New?"

[93] For topic, *smart cities* is defined as follows:

> This overseas presence item encompasses topics related to smart city, public security/public safety projects. This may include collaborations, a purchase or sale of equipment related to smart cities such as Internet of Things (IoT) sensors that collect data used to manage assets and resources like cameras or air quality sensors, surveillance cameras and number plate recognition software in public security projects, research projects on safe or smart cities, etc. (International Cyber Policy Center, "Glossary")

For overseas presence, *smart city—public security project* is defined as follows:

> Any smart city or public security/public safety projects or agreements. Smart city is defined as a building or city that has implemented equipment and sensors that collect data and that data is processed and outputted into a system. This overseas presence may include collaborations, a purchase or sale of equipment related to smart cities such as Internet of Things (IoT) sensors that collect data used to manage assets and resources like cameras or air quality sensors, surveillance cameras and number plate recognition software in public security projects, research projects on safe or smart cities, etc. (International Cyber Policy Center, "Glossary")

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Abbreviations

5G	fifth generation
CAICT	China Academy of Information and Communications Technology
CCP	Chinese Communist Party
DTC	digital twin city
EIU	Economist Intelligence Unit
ICT	information and communication technology
IMD	International Institute for Management Development
IoT	Internet of Things
MENA	Middle East and North Africa
MIIT	Ministry of Industry and Information Technology
UAE	United Arab Emirates

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About This Paper

Since the introduction of the 2017 U.S. National Security Strategy, the United States has been explicit that it is engaged in a strategic competition with China. At the heart of this competition is technology. Within the broad area of technology development and deployment, so-called smart cities present a valuable case study of this competition. This paper focuses on China's involvement in smart cities in the Middle East and North Africa (referred to in this paper as *the Middle East*). The Middle East has emerged as a central site of great power competition: The United States, China, and Russia are all active there and vying for influence. Smart cities have the potential to improve the lives of people in the Middle East, but Chinese involvement could complicate the relationship between the region and its primary security patron, the United States. This paper should be of interest to Middle East policymakers aiming to navigate the competition among the great powers, to U.S. policymakers engaged in both the Middle East and technology competition, and to people interested in the Middle East and its role in the world. Research for this paper concluded in July 2023, with modest updates made through 2024.

Funding

This work was conducted in the former RAND Center for Middle East Public Policy and funded by generous gifts from RAND supporters.

Acknowledgments

We thank the RAND Center for Middle East Public Policy for supporting this research; former CMEPP director Linda Robinson for getting this research started; Robin Meili of RAND for ensuring progress to completion; Jon Alterman, Timothy R. Heath, and Jared Mondschein for detailed and useful reviews; Jeffrey Martini of RAND for help with Arabic-language translation; and Andrew J. Tabler for support with regional expertise. We also thank Sean Mintus for piloting the paper through the RAND publication process, Lisa "Mitch" Bernard for expert editing, and Rachel Magee and Carol Ponce for creating the maps. All errors of fact and interpretation are those of the authors.

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PE-A2809-1