White Paper

Almaty: 2021 Smart City Maturity Assessment

Sponsored by: Almaty Akimat

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1. INTRODUCTION

The city of Almaty is considered a trailblazer in Central Asia, when it comes to smart city investments. The level of digital literacy of the population is the highest in Kazakhstan - 86%. More than 10 thousand Almaty residents are trained in digital skills annually. Digital is becoming an economic engine for the city, also thanks to various science and innovation parks that are being built and expanded.

In 2017, with support from IDC and KBTU, the city conducted a detailed assessment of its smart city maturity that yielded a combined score of 1.7, as a result of a 1.4 score based on KBTU expert opinion and 2.4 score based on 56 self-assessment questionnaires. The 1.7 score corresponded to the maturity stage that IDC defines as "Opportunistic".

The purpose of this document is to update the assessment for the city of Almaty to identify areas for further improvement, development and scaling of Smart City services.

The first part of this report, this introduction will briefly summarize the socioeconomic situation of the city. The second part will introduce some of the key projects which are currently either being implemented or planned in Almaty that fall broadly into the purview of Smart City. Finally, the third part will provide a comprehensive Smart City maturity assessment and recommendations to continue to improve towards the next stage of maturity.

1.1 Socioeconomic background

The city's location, socioeconomic background and current level of development are all factors which should be taken into consideration while designing the Smart City strategy. For instance, the different priorities are important for cities depending on their demographic structure, with cities with more children preferring to concentrate on children-related policies, while cities with older demographic profile might concentrate more on support for seniors. The economic background plays a role as well, as the citizen's ability to leverage some technologies might be limited by their affluency, and the composition of industries in any given city can also play a large role in setting up priorities, influencing vast array of topics from transport to environmental issues. Last but not least, geographical make-up of the city is also important, as more dense cities face different problems from cities in which the population density is low. With that in mind, some basic information regarding Almaty needs to be mentioned, to frame the analytical part of this paper and provide necessary background.

Almaty is located in the southeast of Kazakhstan and is the largest city in the country. The area of the city is about 700 square kilometers with a population of 1.98 million people Almaty forms approximately 20% of Kazakhstan's GDP. The city's economy has a service structure, where the lion's share is accounted for by trade and services.

In terms of average wages, Almaty ranks fourth among the regions of Kazakhstan after Atyrau, Mangistau oblasts and Nur-Sultan.

In Almaty, the largest volume of deposits of individuals was formed - 3.27 trillion tenge (2019), in terms of one person it is 1.79 million tenge. Also, the southern capital is leading in terms of the balance of internal migration, which in 2019 amounted to more than 33 thousand people moving to the city. The World Bank ranked Almaty in first place among the regions of the country in terms of ease of doing business.

The main industries in the region are wholesale and retail trade, financial services, real estate, transport and warehousing.

The unemployment rate in Almaty is one of the highest in the country and is 5.2%. Youth unemployment is 5.4%

According to various studies and surveys of residents and experts, the key socio-economic problems of Almaty remain a low level of environmental quality, underdeveloped infrastructure in the suburbs, deterioration of housing stock and urban utilities, a high level of crime and road accidents.
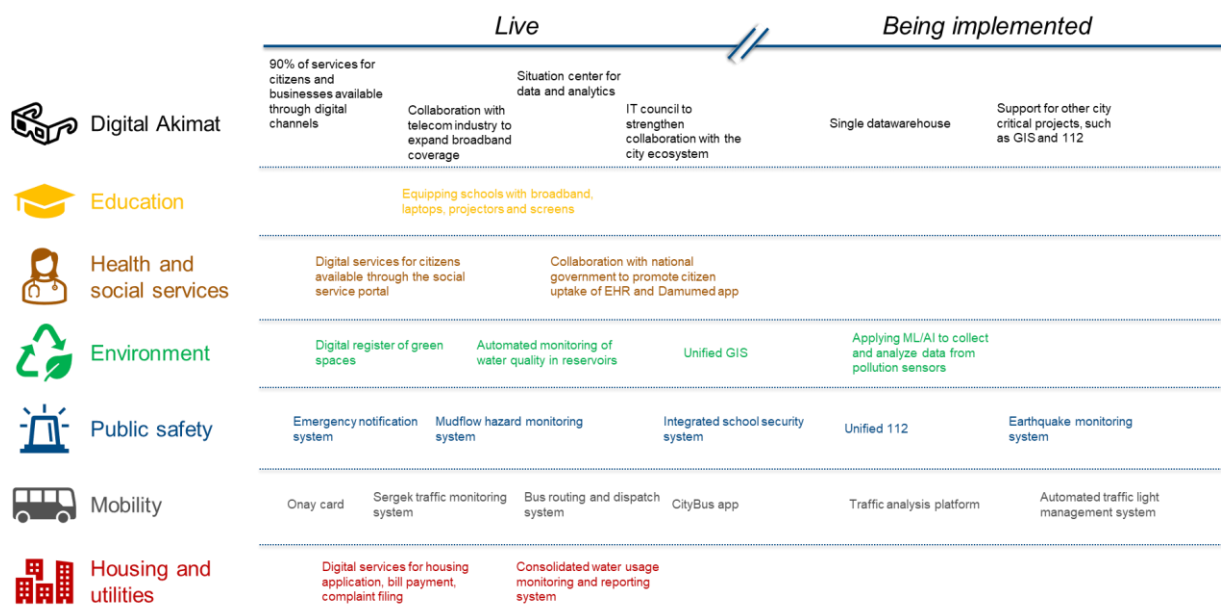
There are more than 220 public and 50 private schools in Almaty, each of which is equipped with the necessary equipment and sufficiently high-speed Internet. At the same time, there remains a significant shortage of places in schools.

2. OVERVIEW OF CURRENTLY IMPLEMENTED OR UNDERTAKEN SMART CITY PROJECTS

The city of Almaty is already implementing or planning multiple projects to execute on its Smart City endeavors (See figure 1). This part gives a brief overview of these project, with special focus on those which are not parts of nation-wide initiatives and in which the city has more leeway as to the way of implementation.

FIGURE 1

An overview of Almaty's smart city projects

	Live		Being implemented
Digital Akimat	90% of services for citizens and businesses available through digital channels; Collaboration with telecom industry to expand broadband coverage; Situation center for data and analytics; IT council to strengthen collaboration with the city ecosystem		Single datawarehouse; Support for other city critical projects, such as GIS and 112
Education	Equipping schools with broadband, laptops, projectors and screens		
Health and social services	Digital services for citizens available through the social service portal; Collaboration with national government to promote citizen uptake of EHR and Damumed app		
Environment	Digital register of green spaces; Automated monitoring of water quality in reservoirs; Unified GIS		Applying ML/AI to collect and analyze data from pollution sensors
Public safety	Emergency notification system; Mudflow hazard monitoring system; Integrated school security system		Unified 112; Earthquake monitoring system
Mobility	Onay card; Sergek traffic monitoring system; Bus routing and dispatch system; CityBus app		Traffic analysis platform; Automated traffic light management system
Housing and utilities	Digital services for housing application, bill payment, complaint filing; Consolidated water usage monitoring and reporting system		

Source: IDC, 2021

The Mayor's Office Department of Digitalization

The Department of Digitalization reports directly to the Mayor as the central agency responsible for planning and coordinating the execution of the Almaty smart city/digital strategy.

The key strategic priorities according to the strategy are:

- Creation of an innovation ecosystem

- Development of human capital

- Implementation of the "Digital Silk Road" (development of high-speed and secure infrastructure for transmission, storage and processing of data)

- Transition to a "Digital State" (automation of functions and public services)

- Digitalization of economic sectors (technological projects that will increase labor productivity and lead to the growth of each industry)

The COVID-19 pandemic accelerated demand for online services for citizens and businesses. And increased the need to expand the number of city employees that could work remotely. In fact, more than 90% of the types and 97% of the volume of services last year were provided to citizens and businesses through digital channels, such as the citizen portal and the citizen app.

The ability to expand the number of civil servants that could work from home is instead still limited; in fact, out of 1519 employees, only 219 could work remotely in 2020. Legacy document and records management systems were one of the main limiting factors.

The Department of Digitalization has also a strong focus on realizing the value of data as a strategic asset. The Almaty Development Center established a situation center that the city continues to invest in through:

- The integration of all location data into a unified GIS platform that can be leveraged across departments.
- The deployment of a single data warehouse; it currently integrates data from 20 different systems.
- The development of analytics and visual analytics applications. Since 2018, 30 dashboards were delivered to help the mayor's office and other departments make evidence-based policy and operational decisions.
- The open data portal, which however has experienced limited take up.

The Department of Digitalization also support other departments in the development and deployment of their IT programs and projects, such as the Unified Duty and Dispatch Service 112" that is being implemented to integrate all emergency services under a single contact and dispatch center.

The Department of Digitalization collaborates with the tech industry ecosystem to enhance citizen services and create new opportunities for digital innovation across the city of Almaty. For instance, during the COVID-19 emergency, it collaborated with telecom operators to expand high-speed internet coverage throughout the city, in response to increased demand for remote working and learning.

The Department critical technology and process bottlenecks are:

- Interagency cooperation.
- The level digital skills throughout the city administration.
- Legacy system modernization.
- Lack of personnel in the digitalization department.
- Complicated procedures for approving technology investment cases, which slows down procurement and implementation.

Education

In the education sector, the city administration needs to coordinate with the national government to deliver digital education services. For example, the national government Ministry of Education and Science portal makes available all the information about school curricula and courses, while the city delivers other digital services, including:

- The bilimalmaty.kz portal automates 37 types of services, such as obtaining duplicate documents, admission to schools, hiring and certification of teachers, an application for home education
- The private portal Kundelik.kz - whose usage is recommended by the Ministry of Education nation-wide and it is third most accessed website in the country - provides information for the students and the families. Some, such as average grades are available for free, additional services, such as ratings of schools by academic performance, educational content, for a fee.

The city is responsible for school digital equipment - All schools in the city are equipped with the Internet with a speed of at least 100 Mb / s, each classroom has laptops, projectors and screens.

More than 50% of the educational program is conducted using digital content, particularly in secondary schools.

During the COVID lockdowns there has been a rapid uptake of collaborative tools, such as Zoom and TEAMS, but also WhatsApp. Demand for distance learning also increased; some content is available on the bilimalmaty.kz portal. Other classes were also made available through broadcast television or private educational website that students accessed for self-study. However, the emergency signaled a lack of strategic coordination among these initiatives, between the city Department of Education and individual schools, as well as the need to better align with the national Ministry of Education and Science.

Health and social care

Today, more than 90% of public services in the social sphere are available in electronic form through the social service portal, which is designed to improve accessibility for the most socially vulnerable groups of the population.

More than 90% of Almaty residents have electronic health records, which include information about the patient, medical history, visits to doctors, test results. All clinics and hospitals are also fully equipped with the necessary computer equipment and the Internet. The Damumed mobile application allows citizens to make an appointment with a doctor, call a doctor at home, find a clinic, track personal health indicators, etc.

There is a need to better coordinate between the Almaty Department of Social Welfare and the national Ministry of Health to further accelerate the digitally transform health and social care services in the city, by using wisely the limited budgetary resources that are available for digital health and social care.

Environmental sustainability

The location of the city in a valley among high mountains, a large number of cars and a coal-fired thermal power plant make environmental sustainability a critical pain point for Almaty. Hence the ability to leverage digital technology and data to make better decisions and monitor environmental conditions has become a high priority in recent years. Projects include:

- The increased investment in sensors to be deployed throughout the city (from 17 to 450) and the analysis and display of data on selected city dashboards georeferenced through the unified GIS system.
- A unified digital register of green spaces with information about approximately 3 million trees.
- An automated monitoring of water quality in reservoirs.
- A planned system for collecting data from all sources of pollution and modeling various scenarios for reducing emissions based on artificial intelligence and machine learning.

Citizens have the possibility to monitor environmental conditions through indicators presented on the citizen portal, as well as to report a problem about fallen trees, or poor water quality. The City of Almaty participatory budget also allows citizens to suggest green improvements.

Public safety

In recent years, the crime rate in Almaty has been declining. Road traffic deaths decreased by 48% in 2020 compared to 2019. The response time for dispatching first responders was reduced by 20%. The number of flooded land plots in the city has decreased by 3 times.

Many digital transformation projects are contributing to those improvements:

- "Sergek" - an automated system for detecting traffic violations.

- A system for automated monitoring of mudflow hazard that leverages sensors installed in the mountains in areas of mudflow hazard.
- The modernization and integration of emergency contact centers into a unified contact center 112.
- An integrated security system in all schools of the city (220 public schools) that are being equipped with video surveillance with AI, alarms, smoke detectors, voice notification.
- An emergency notification system that facilitates one-way broadcasting of emergency messages through the city.
- An intelligent system for detecting the most flooded areas of the city.
- 102 mobile application of allowing to call the police by simply clicking one button; this is primarily aimed at helping deaf citizens and children.
- A unified command and control system for the fire brigades.
- An earthquake monitoring system that is being implemented to deliver early warning approximately 40 seconds before the event starts.
- A unified emergency situation center. This is an operating control room in the building of the Department of Emergency Situations, equipped with special communications, a large video wall, with the ability to control the city during major emergencies
- Citizens can also visualize crime statistics on the national portal of the General Prosecutor's Office: qamqor.gov.kz. All cases initiated by police officers are registered in the underlying database.

The Mayor's office and other departments also collaborate to collect, share and analyze data (both from qamqor.gov.kz and other sources) about crime rates by areas of the city, so that decisions can be taken to deploy appropriate measures to improve safety (e.g. deploy mobile police stations, improve lighting, increased patrolling).

City Mobility

The city of Almaty Transport Holding made significant investments in recent years to reduce congestion, improve traffic safety and pollution (traffic still generates an estimated 60 to 70% of greenhouse gas and other harmful emissions). Digital was a key enabler, for instance:

- The Onay system - digital payment for public transport fares - helped increase the volume of legal fares by 2.6 times.
- Public transport dispatching system along with the modernization of the bus fleet enabled to increase the regularity of public transport from 60% to 87% since 2016.
- The number of road accidents decreased by almost 2 times after the implementation of the Sergek traffic violation video surveillance system.
- Journey convenience and public transport accessibility was enhanced through the public transport website and CityBus mobile app that provide information on schedules, arrival times, and multi-modal journey planning applications, such as Yandex and 2Gis that leverage city data.

Further investments are expected to speed up traffic by another 10-15%:

- A system for traffic analysis (using data from public transport trips) including taxi, cars and pedestrian data that builds on the existing capabilities of the city situation center.
- An automated traffic management system (combining all 450 traffic lights in the city into a single intelligent network with automated control, by 2024).

Housing and Communal Services

Digital housing and communal services are progressing slowly in Almaty. Citizens can:

- Submit an online application for the allocation of an apartment from the public housing stock.
- Pay utility bills online.
- File a complaint about quality of service, power outage or building renovation online.

However, the fragmented governance, the lack of a coordinated strategy, the immaturity and siloed nature of legacy systems leads to duplication of efforts and inability to efficiently manage energy, water (with the exception of a system for a consolidated water usage reporting and a unified control system for pumping stations), building maintenance and occupancy optimization. This is an area where there are a lot of opportunities to share and analyze data to make better capital investment and operational decisions that could improve citizen experience and reduce costs for the city.

3 ANALYSIS OF ALMATY MATURITY ASSESSMENT

3.1 Introduction and Goal of Section

The purpose of following maturity assessment analysis is two-fold: to understand the current state of Almaty Smart City maturity, and to assess the hierarchy of needs as perceived by government officials to prioritize the next steps.

The assessment is organized along both the lines of Smart City MaturityScape methodology (see below) and by the domains, outlining the particular challenges which city of Almaty faces in individual domains (e.g. Safe City, Transport, Utilities, Healthcare, Education).

To do so, IDC collected 120 self-assessment questionnaires and interviewed both individually and in groups key stakeholders in Almaty administration, gathering inputs from all relevant departments.

This outline of As-is analysis is as follows: first it examines the IDC Smart City Maturity Model; second, it assesses Almaty's overall maturity via benchmarking analysis; third, it provides some key insights on challenges which city of Almaty faces in various particular domains (Transport, Environment, Public Safety, etc.).

3.2 Methodology of Assessment

IDC combined information from other models (CPMM), government, academia and vendors to develop the MaturityScape. IDC validated the model with over 700 benchmark surveys and database of over 500 Smart City projects globally. The model provides a framework of stages, measure, actions, and outcomes required for organizations to effectively transform.

The MaturityScape was created with the following objectives in mind:

- Have a common definition of a Smart City and consistent methodology for determining maturity to assures quality of measurement.

- Have a transparent methodology to objectively compare and contrast cities with one another.

- Provide city executives with a structured framework for HOW to develop a complex system, like a Smart City, over the long-term.

As such, the goal of the MaturityScape is not the maturity score itself. The goal is to identify areas of strengths and areas of weakness to enable the city executives to make objective decisions on where to invest to progress along the maturity curve. In this framework, the maturity score is a

mean to that end, because it provides a concise indicator to measure progress. By focusing on the maturity score (or other international benchmarking indexes) as the primary objective, Almaty city executives would reverse the logic of strategic planning (http://balancedscorecard.org/Resources/Strategic-Planning-Basics), whereby goals (outcomes) are chosen, resources (means) are mobilized to achieve them, and control mechanisms, such as key performance indicators (KPIs) are put in place to monitor progress and, if necessary, take corrective actions. The maturity score is a summary KPI or control mechanism, it cannot be the goal or the mean. Also, the summary maturity score by itself, is a standard elusive goal that does not take into account local strategies and context. The IDC MaturityScape, by taking into consideration 5 dimensions and 19 sub-dimensions, is able to capture the nuances of the local context, and to provide granular analysis and advice on HOW to progress along the roadmap to becoming a smart city. The summary maturity score will improve as a result of executing those next steps by dimension and sub-dimension.

The overall maturity score is calculated as the average of the five dimensions. In turn, each dimension is calculated as the average of all sub-dimension it contains. That means each of the five dimensions has equal weighting on the total score, and each of the sub-dimensions has equal weighting within their dimension. So for instance: Vision accounts for 20% of the total maturity score, and within that dimension: strategy, leadership, business case and budget, each account for 25% of the score of Vision.

The MaturityScape questionnaire, based on the model, is built as a self-assessment tool. Self-assessments may suffer from cognitive bias, such as Dunning-Kruger effect, where certain respondents, particularly less expert ones, tend to overestimate their good points in comparison to others around them; while other people, usually the most knowledgeable on the topic, do the opposite. To compensate for these possible biases, IDC interviews a large sample of respondents (in this case 120 executives, managers and employees of the city of Almaty) and applies a correction factor based the combination of two questions: a maturity self-perception question and a benefits realization self-perception question.

3.2.1 The IDC Smart City Maturity Model

Cities around the globe have been dipping their toes into smart cities initiatives and trying new technologies for almost ten years, but outcomes were not always satisfactory. The result was often a plethora of fragmented pilot projects that earned an award at some event but did not scale from a corridor or neighborhood to the entire city. They excluded segments of the resident population from the intended benefits. They did not allow tech suppliers to easily re-sell the same capabilities to other cities, thus generate the solid basis of revenues that can be re-invested in further innovation. However, after so many attempts, smart city strategies and action plans are reaching a tipping point.

Technology suppliers and city leaders start to understand how to cross the chasm between early pilots and a more mature implementations that realize the benefits of digital as an accelerator for city transformation. To do so, they are focusing investments less on technology centric projects and more on citizen-centric and outcome-oriented programs. Long-term visionary outcomes, such as those set by the UN Sustainable Development Goals and the Global Happiness Council, are becoming the guiding principles for smart city strategies and action plans. Designing and delivering citizen centric cities and services requires understanding expectation of different groups of citizens, investors, tourists. It requires considering multiple factors that impact on how these groups perceive and experience life in a city, based on their values, beliefs, attitudes, opinions, personal circumstances and life events.

In IDC's definition, a Smart City is "a city-state, county, city, town, or other non-national government organization that embraces data-driven urban transformation to meet social, financial, and sustainability goals." It is this focus on *transformation* that makes creating a Smart City both exciting and complex.

Smart City initiatives must be outcome-driven. They are designed to achieve noticeable and measurable changes and improvements to the quality of life of residents, tourists and businesses within a city. At a high level, Smart City best practices begin with leaders that and initiative which:

- Tie IT investments to city-wide outcomes
- Ensure compliance with already adopted decisions
- Leverage synergies between individual projects
- Focus on impact on citizen experience
- Deliver measurable results

Cities must undergo transformative change, or digital transformation (DX), and navigating this digital transformation is a long-term and complex process. The Smart City transformation integrates technologies and business/operational processes and brings together a broad ecosystem of advisors and suppliers to the table. The resulting complexity and change management can be a daunting task for city leaders trying to manage their risk while testing new and innovative ideas. From sharing data to IoT, edge computing, AI, blockchain, and AR/VR solutions to working with emerging companies in the sharing economy, Smart City solutions can be disruptive and potentially distracting to city leaders. Having a framework by which to deconstruct this broad movement can reduce risk and provide a focused approach to this disruption.

The IDC Smart City MaturityScape is designed to enable city leaders to capitalize on these opportunities, by providing a **best practices framework** by which to assess and structure successful initiatives. The IDC Smart City MaturityScape framework provides the key best practices areas within its five dimensions and 19 criteria.

IDC's Smart City MaturityScape enables an organization to assess its Smart City competency and maturity; prioritize Smart City technology investments, data policies, governance structures, and other related decisions; and uncover maturity gaps among business units and between business and IT groups — all in the quest to improve data-driven decision making and achieve desired financial, social, and environmental outcomes based on citywide goals.

3.2.1.1 The five stages

IDC's Smart City MaturityScape includes five stages. Based on IDC's years of research, IDC has identified the common stages most cities progress through as they moved towards the idea end stage, the Optimized stage. Each stage's description and expected business outcomes are described in the sections that follow. Note that each stage builds on the capabilities of the one before it (see figure 2).

FIGURE 2

IDC's Smart City MaturityScape Stage Overview
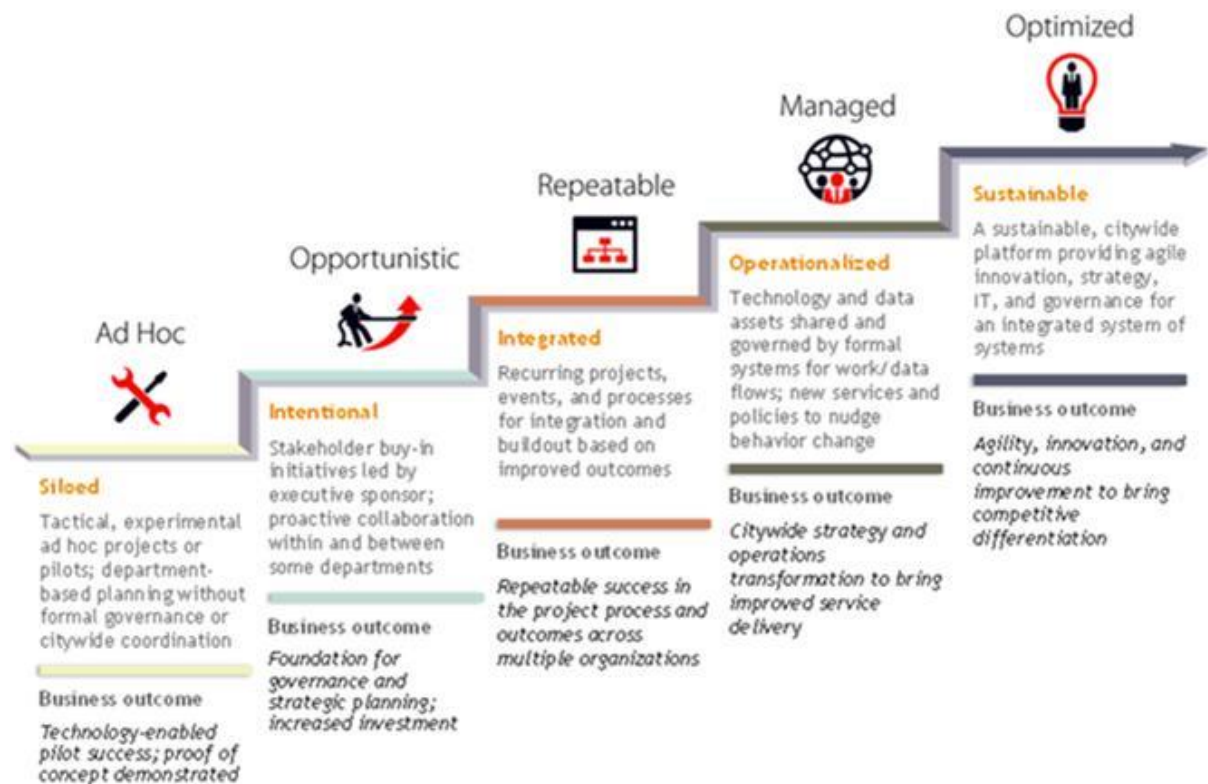
Source: IDC, 2016

Ad Hoc

Cities or departments in the ad hoc stage have few projects or initiatives that are identified as transformational or Smart City, and those that do exist are tactical, ad hoc, and department based without attention to broader strategic issues around governance structures or citywide coordination.

Business Outcome

The goal of the ad hoc stage is to begin to prove the value of the Smart City concept and develop the business case via demonstrated success from pilot projects. The success of these projects is largely based on the technologies used as opposed to changes made in organizational structure and/or processes such as how projects are justified, budgeted for, and governed/controlled.

Opportunistic

Cities and departments at the opportunistic stage ramp up their Smart City efforts as executive sponsors and key stakeholders buy into the concept and start to provide leadership and some strategic direction. Success from initial pilots provide lessons learned and may result in some proactive collaboration between some departments with key stakeholders aligning around developing a strategy, developing a common language, and identifying the barriers to adoption.

Business Outcome

The goal of the opportunistic stage is to engage key stakeholders and get their buy-in as the strategy and road map for Smart City initiatives are developed. At this stage, the foundation is laid for sustainable governance and organizational structures, which provide the business case to help incrementally increase the Smart City budget.

Repeatable

Cities and departments in the repeatable stage are increasingly driven by a consolidated multiagency Smart City strategy built on recurring projects, events, and processes identified for integration and buildout based on improved outcomes. The city's vision, mission, strategic goals, and investment priorities have become more formalized across a select subset of organizations but are inconsistently implemented at the enterprise level.

Business Outcome

The goal of the repeatable stage of maturity is improved outcomes and service delivery as a result of repeatable, standard processes for Smart City projects, better use of information, and the coordination of initiatives beyond the department level and with outside partners (i.e., national government agencies, academia, and the private sector).

Managed

At the managed stage, Smart City strategy is accepted citywide and formalized with documentation, KPIs, and timelines for achieving specific goals. Strategy is implemented by a formal Smart City team that has its own funding and supports budgeting for programs across departments. Outside of local government, an ecosystem of other levels of government, academia, citizens, and private suppliers support the Smart City vision with sustainable business models.

Business Outcome

The goal of the managed stage is to have a citywide Smart City strategy and operations transformation in place, resulting in improved service delivery and the achievement of environmental, social, and financial goals and desired outcomes.

Optimized

A sustainable citywide platform is in place to provide agile strategy, IT, and governance, which allows for autonomy within an integrated system of systems. A process focused on continuous improvement delivers superior outcomes and differentiation. The formal group of city leaders with support for shared outcomes from an ecosystem of partners supports Smart City strategic execution with a program management office that oversees projects across departments.

Business Outcome

The ultimate goal of the optimized Smart City is competitive differentiation that drives sustainable economic development or revitalization by creating jobs and attracting investment. Mature Smart Cities will attract business investments, visitors, tourists, and citizens because they provide high-quality citizen services, are easy to do business with, and offer a higher quality of life. These cities achieve these outcomes by having institutionalized digital transformation, agility, and an innovation process for continuous improvement.

The Five Dimensions: Best Practice Areas for Success

At each stage of IDC's Smart City MaturityScape, organizations should consider five dimensions, each of which contributes to the ability to advance toward higher levels of Smart City competency and maturity (see Table 1).

Successful deployment of Smart City initiatives and the use of related technologies depend on a multifaceted approach guided by a strategy that accounts for not just technology but also human and capital resources, organization culture, business and IT processes, and the data. Based on extensive primary and secondary research, IDC has identified these dimensions as vision, culture, process, technology, and data. The key attributes within each are as follows:

- Vision includes attributes such as Smart City strategy, leadership and sponsorship, how the business case for projects is made and articulated, and how budgeting and investments are managed.
- Culture includes attributes such as the culture of innovation and the process of innovating in an organization, the ways in which citizens and community groups are engaged with projects and organizations, and the culture and policies around transparency.
- Process includes attributes such as how Smart City initiatives are governed, the performance indicators and metrics by which they are measured, the partnership ecosystem that is developed and leveraged, and the organizational structure to support Smart City initiatives.
- Technology includes attributes such as the adoption of the Internet of Things and innovation accelerators (which includes technologies such as robotics, 3D printing, natural language interfaces, and cognitive computing) and the architecture for the 3rd Platform and citizen data.
- Data includes attributes such as how citizen data is protected, the analytical tools used for processing data, open data initiatives, and the process for data sharing within a city. Data sharing is differentiated from open data; open data is a subset of a data sharing continuum that includes open source IoT and APIs.

Table 1 shows how each of the attributes in the five best practice dimensions behave depending on the maturity level of a city or department/ organization within a city.

TABLE 1

IDC MaturityScape: Smart City — Overview of Stages, Dimensions, and Sub-Dimensions

Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
Vision					
Strategy	No strategy or vision exists.	Individual strategies are at the departmental level. Strategy documentation is inconsistent.	There is a common multiple department strategy. Vision, mission, and strategic goals are documented but are still siloed	Strategy involves all departments and is accepted citywide. Documentation shows consistent vision, mission, and strategic goals and	Strategy defines a consistent citywide view of the future. All aspects, including strategic planning and governance processes and

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Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
			and/or inconsistent.	includes clear KPIs and associated timelines.	principles, are documented.
Leadership	Departments or agencies rely on decentralized, uncoordinated leadership for strategy execution.	There is a citywide executive sponsor for the vision. There is project-based, sporadic collaboration for strategy execution.	The executive sponsor coordinates multiple organizations for strategy execution. An informal team is placed in charge of major projects.	Stable joint committees bring together high-level officials to agree on strategic decisions with a formal project management team.	A formal group of leaders actively supports strategy execution with a program management office team that oversees projects and strategic planning.
Business case	No formal investment justification is required for projects or initiatives.	Investment requires a defined business problem at the project level. Metrics are focused mainly on cost savings.	Investment requires a defined business problem across projects or departments. Metrics include economic development or quality of life outcomes.	Citywide standard guidelines, tools, and processes are used to justify investment. Metrics include a formalized triple bottom-line (social, environmental, and financial) assessment.	Citywide investments are driven by consistently applied standard guidelines and processes. Metrics include continuous progress on triple bottom-line outcomes.
Budgeting	Budgeting is characterized by siloed process and decentralized decision making.	Some multidepartment budgets and decision making are based on projects.	Leadership discusses sustainability of funding for initiatives across departments.	There is annual and multiyear planning and budgeting for common programs, services, and infrastructures.	Budgets allocation is based on the impact on the whole city and heavily reliant on business case metrics and analysis.
Culture					
Innovation	There is little innovation within a risk-adverse culture.	There is opportunistic innovation with department-level support.	Departments participate in innovation initiatives supported by	Systematic innovation leverages certain ideas from government workers and	Innovation is encouraged, institutionalized, and managed for all departments with established

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Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
			iterative, risk-taking processes.	those outside of government.	incentives for rapid iteration of trial and error.
Citizen engagement	Departments use traditional methods — typically via public meetings or static Web sites — to engage with those outside of government	Some departments experiment with citizen participation via social networks, hackathons, and mobile apps.	Citywide efforts to engage citizens use partially personalized, direct communications and gamification.	All citizen-facing departments use multiple channels to engage citizens based on their needs.	A formalized, citywide engagement model enables ongoing, inclusive, personalized, interactive collaboration with citizens.
Transparency	Information on projects and initiatives, data use, data collection, privacy guidelines, and security are unavailable to the public.	Information on projects and initiatives, data use and collection, privacy guidelines, and security are departmentally specific, piecemeal, and sporadic.	Open government is a stated city objective; information is proactively provided on initiatives, data use and collection, privacy, and security.	Open government is a priority; data use, privacy, and security guidelines are publically available and used to approve projects.	Open government is central to service delivery; there are regular reviews of privacy and security guidelines and timely public updates.
Process					
Partnership ecosystem	Traditional client-commercial-supplier relationships exist based on contracts. State and national governments are a source of funding via grants.	The city begins to be active in developing an ecosystem of state/national government organizations, academia, foundations, nonprofits, utilities, and business groups around specific issues; however, organization and collaboration are fragmented. Alternative	Ecosystem collaboration with a wider set of partners becomes consistent for broader Smart City goals. Management processes are documented for alternative delivery models, including PPPs and performance-based contracting.	An ecosystem model that involves all levels of government, academia, citizens, and suppliers is applied to the majority of Smart City initiatives. An expertise center is set up for collaborative services delivery models.	An ecosystem model that involves local, state/regional, and national government, academia, citizens, and suppliers develops new products and services that are guided by shared outcomes.

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Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
		models such as cloud and co-innovation are tested.			
Governance /controls	There is no common governance.	Guidance and principles are shared but not enforced.	There are formally accepted principles and a standardized approach and framework.	A flexible approach customizable to 3rd Platform needs and speed is developed and implemented.	A fully automated approach with fast learning and growing capability is implemented.
Measurement	KPIs are not defined.	Measurements are poorly defined and/or qualitative.	KPIs measure the success of a technology initiative, but overall, organizational outcomes are still inconsistently tracked.	Metrics for evaluating process quality, results of analysis, and business outcomes success have been established.	Ongoing quantitative assessment, iteration, and learning are built into decision and business benefits and are tied directly to initiatives.
Structure/organization	There is no centralized Smart City team or centralized team with a limited role.	A centralized team is focused on technology, governance, and standards.	Centralized roles define accountability and interaction between cross-functional/departmental teams; transition toward a federated model begins.	A federated operating model takes care of enterprise commonalities as well as departmental differences.	A collaborative approach and organizational structure support flexible roles and agile resource allocation.
Technology					
3rd Platform architecture	Fragmented, siloed architecture fosters high costs and duplication.	Core systems are consolidated into one or a few suites.	SOA is used to reduce cost of integration across core systems and the deployment of new services at the periphery.	SOA principles are complemented by event-driven architectures that are interoperable and agile.	A citywide Open Platform leverages cloud-based technology across the entire enterprise.

TABLE 1

IDC MaturityScape: Smart City — Overview of Stages, Dimensions, and Sub-Dimensions

Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
Internet of Things adoption	There are limited or basic levels of wireless broadband, sensors, cameras, and advanced devices in strategic, localized areas.	There is a focused buildout of wireless broadband, sensors, cameras, and advanced devices for specific projects and outcomes by department.	Large-scale deployment of wireless broadband, sensors, cameras, and advanced devices are leveraged for multiple projects and organizations.	Large-scale deployment of wireless broadband, sensors, cameras, and advanced devices are leveraged citywide for multiple projects and goals.	Ubiquitous wireless broadband coverage and sensors, cameras, and advanced devices on city assets deliver exceptional outcomes and service delivery.
Citizen data architecture	Data entities and attributes are specific to legacy transactional applications and records requirements.	Front-end contact data is disconnected and sometimes inconsistent with back-office applications and across channels.	Basic citizen data is integrated into a master record.	Redundancy and duplication are reduced but sometimes accepted for speedier response and more open interactions. Data quality is inconsistent.	Data is decoupled from applications to predict citizen needs, react to events in real time, and proactively offer services.
Innovation accelerator adoption	There is no adoption of innovation accelerators.	Departmental pilots are carried out, such as 3D printing for zoning and/or drones for public safety.	Citywide policies are developed to regulate the usage of robots, 3D printing, the Internet of Things, and cognitive computing.	All innovation accelerators are taken into account when formulating a citywide strategy.	Expertise and policies in innovation accelerators are leveraged to achieve triple bottom-line objectives across all city operations.
Data					
Citizen data protection	Authentication of personally identifiable information is carried out offline at most points of interaction.	Siloed electronic identifiers are in digital channels.	A unique electronic identifier is used to authenticate for multiple services and channels.	A government-built, federated ID bus authorizes and administers multiple electronic identifiers, including those provided by	Each citizen owns a data wallet/dashboard to control personal data and its use. Authentication is done by

TABLE 1

IDC MaturityScape: Smart City — Overview of Stages, Dimensions, and Sub-Dimensions

Dimensions/ Sub-Dimensions	Stage Names				
	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
				private sector entities.	combining multiple factors.
Data discovery and analysis	Data specialists use analytic methodologies for ad hoc requests and standard reporting. Limited automation is in place for data analysis.	Focus on data blending to analyze data from multiple sources. Some tools are open to nonspecialists via visual analytics and user-friendly UIs.	Automated analytic techniques are used by specialists and non-specialists to explore data from multiple sources and provide interactive reports.	Analytics support workflows in near real-time detecting patterns, root causes, and predicting events. Algorithms are built to continuously enhance decision automation.	Analytics are embedded in everyday workflows in real time. Automated tools apply metrics to KPIs for strategy execution.
Open data	There is no open data policy or data sets open to the public.	Open data policy is under development, and limited data sets are open to the public.	Open data policy is approved and an open data portal is created with data sets being regularly added.	An inventory of data assets is completed, and contacts from each department contribute data sets to the portal.	The open data portal is a key channel for citizen engagement, replacing legacy FOI processes, and is a hub for interdepartmental information sharing.
Data sharing	Data access is limited to single organizations because of issues with data integrity, privacy/security, and integration.	Data sharing across departments is dependent on bilateral, sporadic collaboration.	Guidelines, policies, and data standards start to be developed at the city level.	Guidelines, policies, and data standards are documented and communicated citywide.	Guidelines, policies, and data standards are automated through the citywide open platform to support real-time collaborative decision making.

Source: IDC, 2015

3.3. Assessment and Maturity by Dimension

The result of the above explained analysis yields a standardized score of 2.7, as a result self-assessment questionnaires and standardization of answers based on control questions (note: all results are rounded to one decimal place).

The 2.7 score corresponds to a maturity that indicates steady progress from the "Opportunistic" to the "Repeatable" stage.

Cities and departments at the repeatable stage:

- Formalize collaboration by creating cross-departmental work groups for services delivery beyond emergencies, events, and disaster management.
- Document city-wide strategies, processes and define specific outcomes. Define how successful outcomes will be measured.
- Promote a culture of innovation and move beyond one-off contests to engage citizens on a continuous basis via personalized apps, direct communication via social media, and using gamification models. Hold in-person and online meetings to discuss new project ideas and ways to leverage existing data and systems.
- Data integrity must be a priority as information sharing across organizations becomes a reality. Continue to expand the availability of and to integrate internal multistructured data sources. Be aware that data governance policies and procedures will be difficult to implement at single-business-unit level.
- Budget for scaling out of projects. Perform costs-benefit analysis for Smart City projects to determine resource allocation.
- Set up formal collaboration discussions with partners, such as the city business community, on business models. Define what return partners will get by putting "skin in the game."
- Develop a skills pipeline. Work with academic institutions to use students to intern on projects to augment staff but also to mentor potential new hires.

Business Outcome – The goal of the Repeatable stage of maturity is improved outcomes and service delivery as a result of repeatable standard processes for Smart City projects and their coordination beyond the department level. More formalized processes develop measures of both outputs and outcomes to determine success of the initiatives. Specific initiatives begin to be scaled and integration begins. Better use of information and the processes in place to respond to events drives improved outcomes and service delivery.
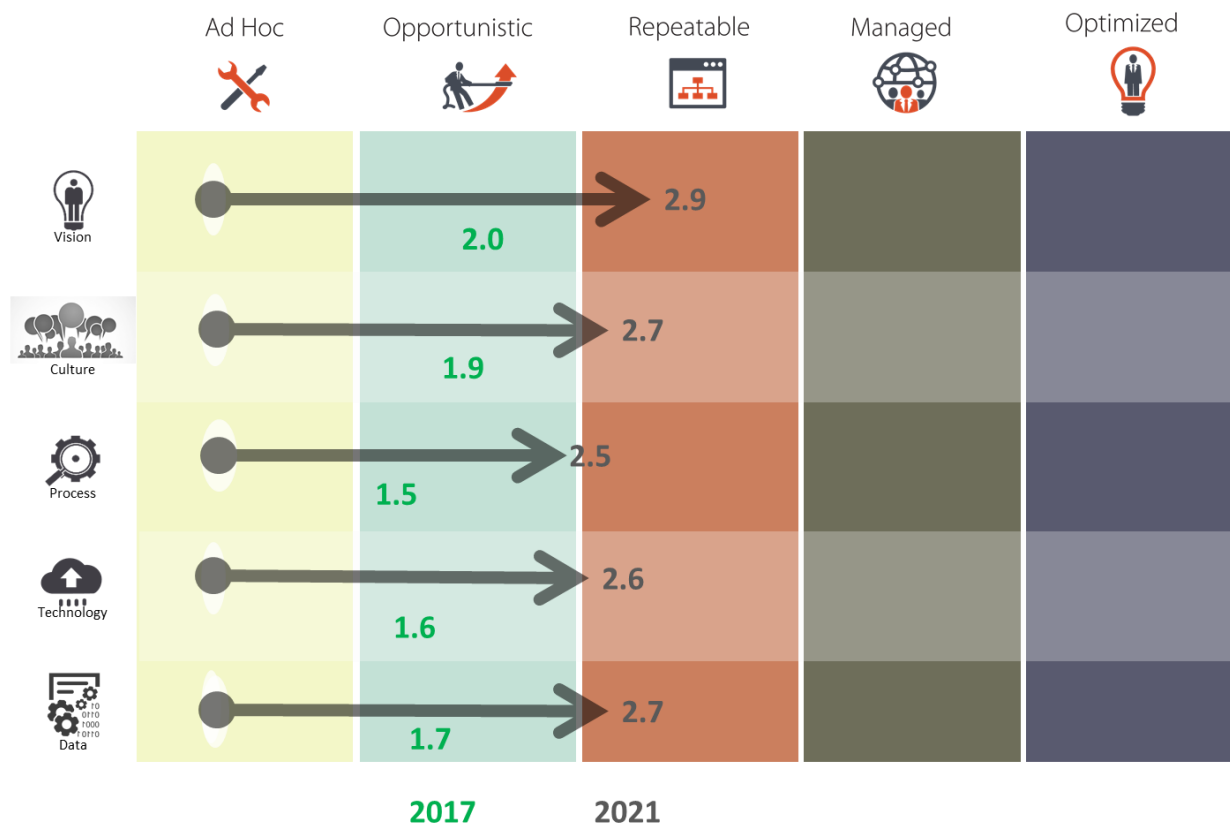
3.3.1. Summary of Findings by Dimension

The assessment shows progress in all dimensions, compared with the 2017 results (See figure 3):

- Vision and Strategy = 2.9

- Culture = 2.7

- Process = 2.5

- Technology = 2.6

- Data = 2.7

FIGURE 3

Maturity Score

	Ad Hoc	Opportunistic	Repeatable	Managed	Optimized
Vision		2.0	2.9		
Culture		1.9	2.7		
Process		1.5	2.5		
Technology		1.6	2.6		
Data		1.7	2.7		

2017   2021

Source: IDC Government Insights, 2021

The high score on Vision and Strategy indicates a clear aspiration by the Mayor's office and some departments to make Almaty a smart city and an understanding of how to align key success factors like:

- The need to justify the investment based on the ability to solve real-life problems, such as traffic congestion, or public safety, quality and accessibility of education, health and social services and environmental sustainability.
- The impact of technologies such as Internet of things, video surveillance, digital payments and artificial intelligence
- Executive leadership
- Provision of unified and optimized IT infrastructure

The above average score on data shows the ability to realize the benefits of:

- Integrating data across departments.
- Building the situation center as a unified competence center for data management and delivery of compelling visual analytics dashboards that are used to make evidence-based policy and operational decisions.

Average or slightly below average scores on Process, Culture and Technology indicate challenges in efficiently executing the smart city aspirational goals, because of lack of:

- The accountability processes which would minimize the occurrence of failures during the implementation phases of the projects.
- Clear governance that ensures transparent, compliant and innovative technology investment decisions.
- Organizational structures that foster collaboration across city service domains, while ensuring clear lines of accountability. And coordination with national government initiatives, particularly in domains like health, education, and public safety.
- Lack of comprehensive PR which would make citizens and business community aware of the innovative projects and help them to more efficiently use these to their benefit, such as the limited success of the open data portal.
- Lack of skills, not just in terms of ability to use technology, but fluency to imagine service innovation through the usage of data and technology.

The following parts of the analysis provides more detailed guidance on all 5 aspects of the evaluation.

3.3.2 Vision

The Almaty Akimat improved significantly his score to 2.9, compared with the 2017 IDC assessment, when the Vision dimension was at 2.1. This is the result of the strategy document that sets a clear vision, not only of how the city administration plans to transform itself, but more broadly of how the whole city can realize the benefits of investing in digital infrastructure to prompt digitally-enabled innovation for the entire economy. The strategy is also aligned with the national government digital agenda, particularly in domains where the collaboration among levels of government is most important, such as health and social services, education, and public safety.

The detailed distribution of *standardized* responses can be seen in Figure 4; this figure gives information on how the situation is perceived inside the administration.

FIGURE 4

Vision scoring (percentage of standardized responses)
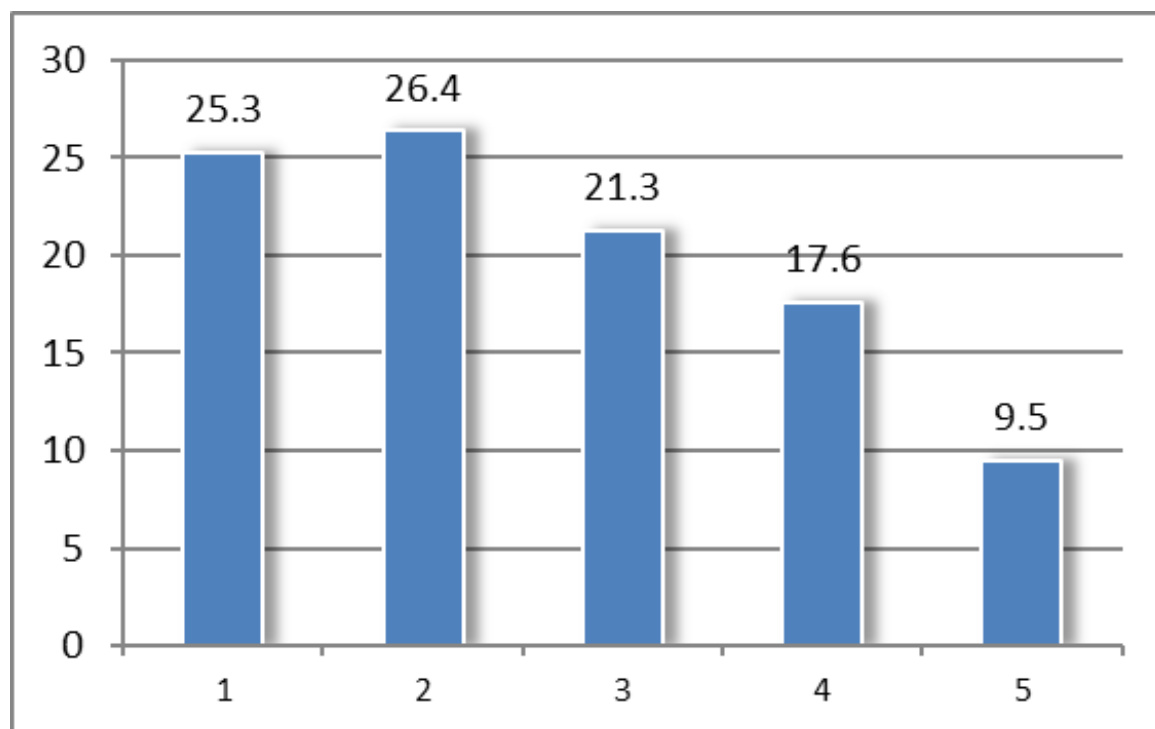
Source: IDC Government Insights, 2021

While the Vision is in general the most advanced dimension, there are some likely shortcomings which city of Almaty would do well to address and advice for increasing the level of maturity:

- Executive leadership. The mayor should sponsor the strategy through official communications. Successes should be highlighted within the city administration, at the national government level and with the broader Almaty ecosystem.
- Budgeting. Incremental resources should be dedicated to the Department of Digitalization to orchestrate projects so that they apply consistent methodologies and standards and consider the interdependencies among them; the latter is very important, because cities are systems of systems[1] and they cannot be run in isolation. In turn, it will be important that the Department of Digitalization assesses in a transparent manner the public value[2] generated by the smart cities projects that it coordinates.

3.3.3. Culture

The city of Almaty improved the culture dimension from 2.1 in 2017 to 2.7 in the current assessment. This is likely to be caused by the shortcomings of current communication channels

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[1] http://www.dimap.ufrn.br/~everton/publications/2016-SmartCities.pdf -
https://www.researchgate.net/publication/284995107_Cities_Systems_of_Systems_of_Systems
[2] https://journals.sagepub.com/doi/abs/10.1177/0894439315618890 -
https://onlinelibrary.wiley.com/doi/abs/10.1111/padm.12161 -
https://eprints.whiterose.ac.uk/172605/1/beyond_coproduction_full_text.pdf -
https://www.researchgate.net/publication/273302258_Research_evaluation_and_the_assessment_of_public_value

with citizens and business community. While there are some open government initiatives, such as participatory budgeting, there is space for improvement in this domain.

FIGURE 5

Culture scoring (percentage of standardized responses)
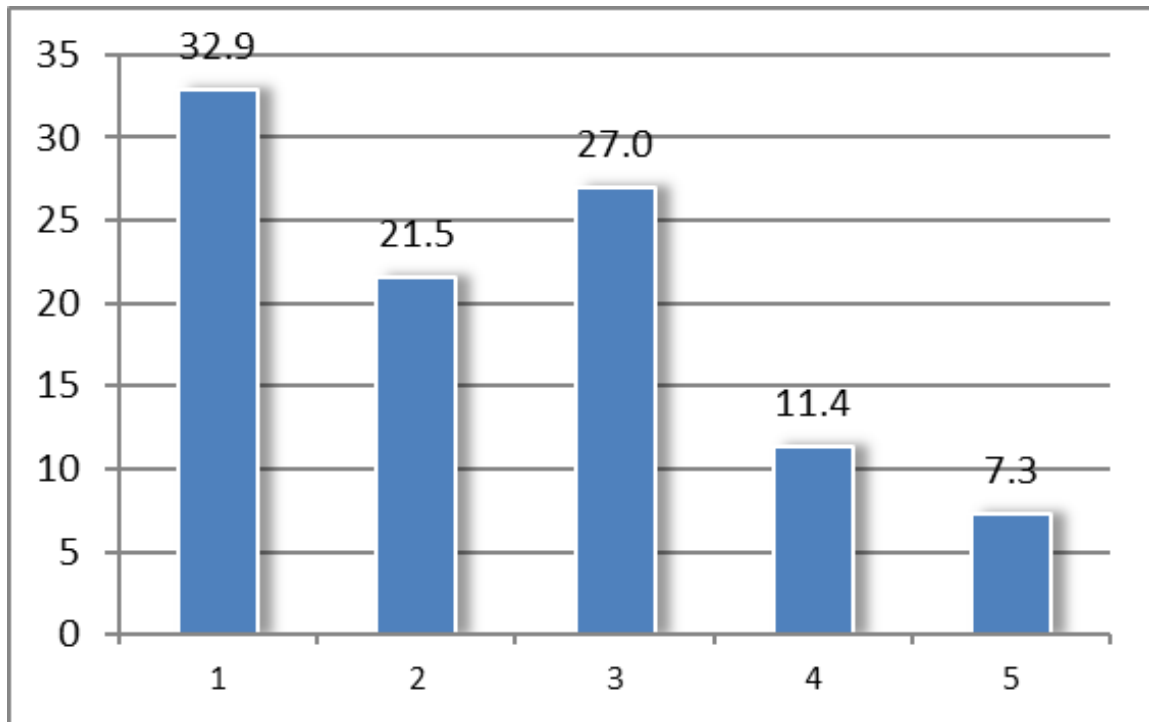
Source: IDC Government Insights, 2021

The information about new initiatives on which Akimat is working and which can help citizens and businesses should be disseminated in more active manner, using the mix of traditional (municipality newsletters) and online channels (social networks). The administration should also consider initiatives to actively engage citizens in city planning and operations through community projects that rewards citizen for their active participation; various cities in Europe are for example rewarding citizens for contributing to maintaining public spaces or volunteering for social care and cultural activities[3]. Consider that interest in participating can vary by age, profession, personal beliefs, so engagement plans should consider how different groups would like to participate, what channel they prefer, what type of initiative and so forth[4].

Also, while awareness about the benefits of smart city innovation is high across all departments, a culture of innovation is not yet fully institutionalized. City workers should be incentivized by processes and leadership that favor risk taking, learning from failures and using lessons learned to continuously improve.

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[3] https://www.uia-initiative.eu/en/news/weserviceheerlen-wesh-journal-1 - https://www.cascais.pt/citypoints
[4] https://www.researchgate.net/publication/305695165_Testing_multidimensional_models_of_youth_civic_engagement_Model_comparisons_measurement_invariance_and_age_differences - https://www.reinforceeu.eu/sites/default/files/2020-08/REINFORCE_D2.1%20Citizen%20Engagement%20Plan.pdf

3.3.4. Process

The process dimension scored the lowest in 2017 and it is still the weakest point with a 2.5 score in 2021. This is the result of a mixed picture. In fact, on the one hand the city IT council can be considered a good practice, because of the interaction that it fosters with the business community. The fact that council members are empowered to set the agenda for the meetings creates a true, two-way conversation about how to address practical challenges. Also, the growing investment coming from national government and private industries in innovation parks, such as Astana Hub, the Park of Creative Technologies and SEZ PIT, demonstrate a strong commitment to leverage digital as the kernel of economic growth for the city.

On the other hand, the lack of orchestration of smart city projects within the city administration results in uncoordinated and slow execution. Also, the coordination with central government, particularly in domains like health and social service, education and public safety is subject to complex policies, for instance for data sharing, that reduce the potential positive impact of projects like the unified datawarehouse and the usage of emerging technologies, such as machine learning and artificial intelligence that would benefit from larger, good quality, consistent datasets. The Figure 6. reflects this varied picture:

FIGURE 6

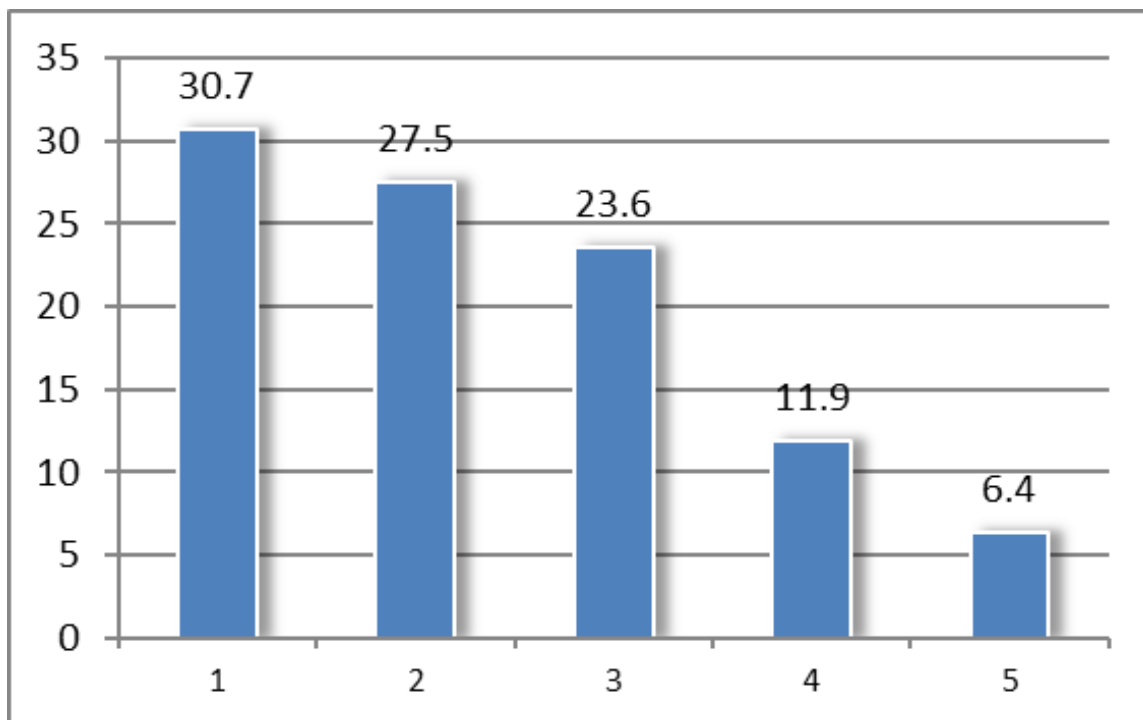**Process scoring (percentage of standardized responses)**
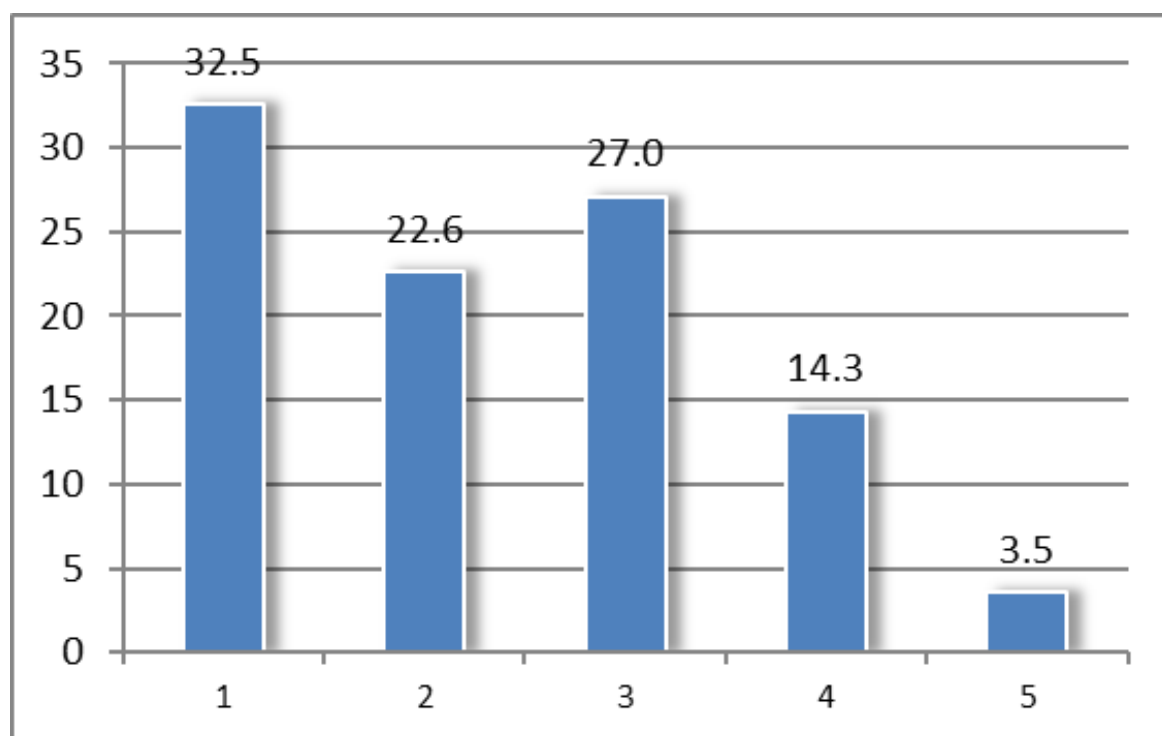
Source: IDC Government Insights, 2021

3.3.5. Technology

The city of Almaty made a significant improvement in terms of technology, from 1.7 in 2017 to 2.6 in 2021.

FIGURE 7

Technology scoring (percentage of standardized responses)

Source: IDC Government Insights, 2021

The increased investment in IoT, data related technologies and the modernization of public safety systems has driven up the maturity of the Technology dimension, but there are still some areas and good practices which seem to be sometimes missing

The biggest challenge is the existence of 15-20 years old legacy systems. These systems delivered the value for money that was necessary at the time of their implementation, but should now be sunset. This will require a clear roadmap on how to migrate the data and services they provide onto new systems that are based on modern cloud-native architectures. This is both a technological transformation and an organizational transformation that impacts the cultural dimension – some risk will have to be undertaken and the city leadership should make reward the executives that are capable of assuming accountability for those risks and learning from them – and the process dimension – sourcing new systems will require an innovative approach to engaging with both global platform providers and local specialists. If undertaken successfully, a legacy modernization program would not only enable the city to deliver better services to citizens, but also allow city employees to adopt new work approaches (for instance hybrid, remote working). And it would nurture the competencies of local IT companies that could then re-sell their solutions to other cities and regions, and export to other countries.

### 3.3.6. Data

The data is the dimension showed the biggest improvement, since 2017, from 1.6 to 2.7. The situation center, the start of the integrated datawarehousing project, the consolidation of geographical information systems are all steps in the right direction, but the transformation is unfinished with data silos still existing, within city domains, for instance in housing and utilities,

across city domains and between city systems and national government systems. This is reflected in the Figure 8.

FIGURE 8

Data scoring (percentage of standardized responses)
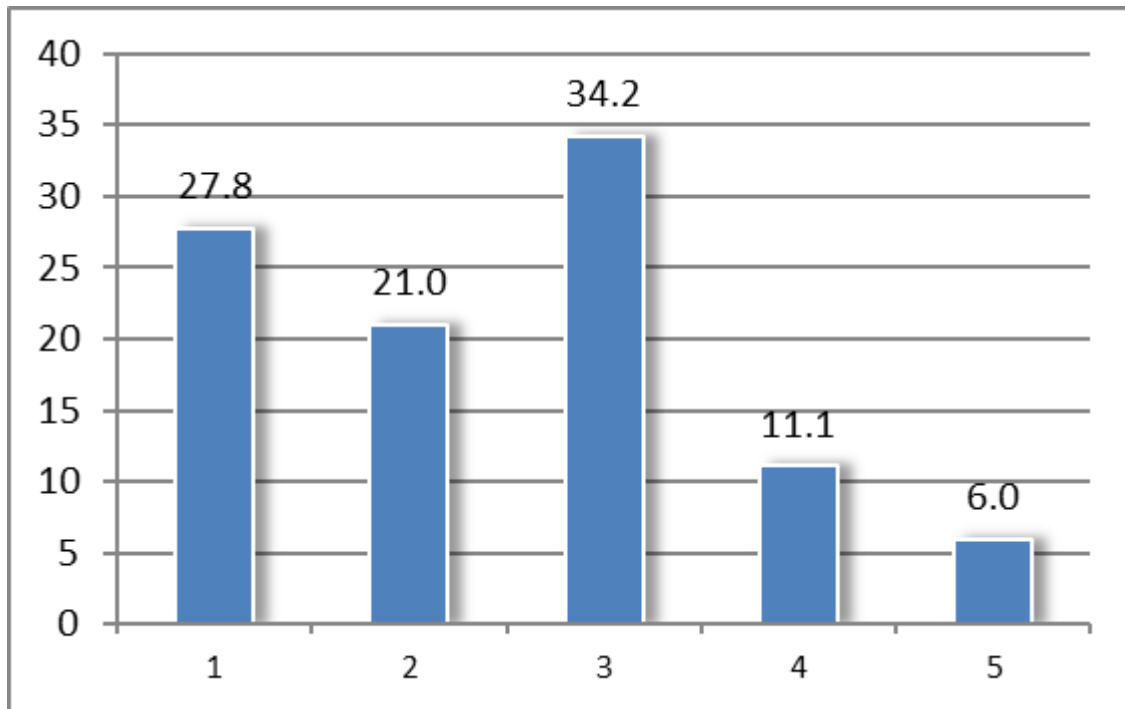
Source: IDC Government Insights, 2021

Key improvements should include:

- automation of data exchange among city departments, between the city and the national government and with the private sector – this is both a technological matter that can be addressed through standardization of APIs and a process matter that will require setting up clear data governance arrangements. Almaty could propose data governance models to enhance interoperability with the national government that can benefit also other cities and regions in Kazakhstan. And it could become a national trailblazer by bringing to Kazakhstan and the Central Asia region best practices in data sharing between public and private sector, which are being developed in Europe to realize the potential of ecosystems, beyond open data5.
- application of machine learning, in areas like IoT and edge data processing and analysis, which would set the foundation for more sophisticated investments like digital twin. This will require not only technology investments, but also investment in skills in partnership with the Almaty digital ecosystem including private companies and academia. The IT council should be the steward of a program in this area.

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5 https://www.euractiv.com/wp-content/uploads/sites/2/2020/02/B2GDataSharingExpertGroupReport-1.pdf - https://oasc.atlassian.net/wiki/spaces/OASCMIM/overview

3.4. Key findings by domain

The domains were not formally evaluated in terms of assigning the MaturityScape score, but some guidance can be drawn from the self-assessment questionnaires and the focus group interviews.

The city has good smart city vision across all domains, but the depth of the vision varies, with the dimensions more influenced by national policies having stronger anchoring in policy documents and plans (e.g. Education, Healthcare, economic development). Or in domains where the city has complete ownership of the strategy and action plan, such as mobility, culture and tourism. Other areas, where there is a more complex coordination between national and city government, such as public safety, or a fragmentation of intent at the city level, for example in the housing and communal services, the strategic vision is much less mature.

With regards to the dimension of culture, critical domains like public safety will benefit from better ability to embrace and reward innovation and citizen engagement. Local akimat have started to modernize through various digital interaction channels, but their level of maturity is not homogeneous. And a stronger culture of innovation must be promoted within the city administration.

The process dimension seems to be an issue across most domains, but in particular in public safety, housing and communal services and local akimat. The fragmentation of governance across city agencies and departments, or the difficult coordination with national government is the biggest bottleneck to prompt further innovation, including extending partnerships with the wider city business ecosystem.

The high technology maturity of the Department of Digitalization is not easy to extend to the entire city, because of limited skills and budget. Nonetheless, some domains, like mobility and education are making significant progress. Also, the high level of digital services made available to citizens and businesses is not yet complemented by intelligent automation of internal processes that would enable the city workforce to embrace new hybrid ways of working.

The dimension of data also varies significantly in its maturity based on the individual domains. While in the Department of Digitalization, in the situation center and domains like education and social services data-centric processes and intelligent tools are becoming more pervasive, in other domains, like housing and communal services, siloed systems and fragmented data governance is hindering the city ability to make better decisions about energy and housing efficiency.

3.5. Recommendations

The city of Almaty has made significant progress in its path to become a smart city that can meet citizen and business expectations and be resilient to future shocks and stresses. To fully realize the benefits of technology, the city of Almaty needs to implement actions that span all dimensions that make a smart city successful, from raising awareness about the benefits and strategic goals of smart city, to orchestrating digital transformation projects more efficiently across city departments, to collaborating with the private sector.

FIGURE 9

Key recommendations

Next 3 months	3 to 6 months	6 to 18 months
Vision — Summarize the Almaty digital strategy into 10 strategic principles and get them signed and communicated by the mayor	Design a strategy and action plan on how to bring housing and utilities up-to-speed with the progress that Almaty has made in other smart city domains	Measure and communicate progress of smart city projects based on international public value and outcome indicators, such as UN SDGs
Culture — Raise awareness about the why and how of digitally-enabled business innovation within the city administration, through training and workshops.	Promote participation of city IT and non-IT employees to agile innovation projects.	Design community engagement projects that go beyond participatory budget and reward citizens for their contributions.
Process — Create a PMO office within the Department of Digitalization to help orchestrate digital transformation projects across city domains and departments. - Staff the PMO office with project management, design thinking, agile development, data science, cybersecurity, enterprise architecture skills.	Promote the IT council as a best practice at the national and international level. Invite international businesses and experts to contribute.	Work with companies and universities that are part of the Park of Creative Technologies, Astana Hub and SEZ PIT to develop and test smart city innovations in the city
Technology — Prioritize 5-10 legacy systems to be retired.	Design a roadmap of how the systems selected for retirement will be replaced by new solutions based on cloud native architecture.	Design and develop machine learning, robotic process automation, chatbot enabled services for a set of priority use cases. Focus on mobility, public safety and housing and utilities.
Data — Define and promote minimum data interoperability requirements (technical, semantic, organizational and legal) for any system that the city has in place or plans to acquire, so that data can be 'ETLed' into the unified datawarehouse	Define and promote minimum data interoperability requirements (technical, semantic, organizational and legal) for data that the city can source from the private sector to help improve public services.	Design a roadmap and action plan to build a digital twin of Almaty. Anchor the investment with specific use cases, such as transport infrastructure planning, smart buildings and building permitting.

Source: IDC Government Insights, 2021

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